THE SIXTH

BALKAN MINING CONGRESS

PETROSANI, ROMANIA

20th – 23th of September 2015

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Energia pamantului romanesc

GEOROM foraje orizontale dirijate

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VRANCEA ZONE- A NATURAL MULTI-USER LABORATORY FOR THE STUDIES

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1. Introduction

The Planet Earth System, is, as any living system (or a supporting life system), extremely difficult to be define and characterize properly and completely. Presently mankind can be described as being in a Modern Era in which the Informational Society is currently unfolding, while at the same time the Knowledge-based Society (not fully matured or functional) may be regarded as emerging. Taking into account this general context, we attempt a definition of the Planet Earth System that extends beyond the natural structures (inorganic, organic or living) that are typically the object of study for Geosciences and/or Biology and Biochemistry. Besides the Natural structures, man-made artifacts have also been produced and, after adding into/combining with the Natural ones, complex symbiot emerged.

Presently, a tentative list of such artificial systems with significant impact (ecologically, economically and socially) may include the following items:

- the entire assembly of systems dedicated to the generation and distribution of electrical energy, as well as the extraction and refinement of oil and the distribution of the final oil-derived products down to industrial and individual customers;

- the entire combination of roadways, rail-roads and airways that make up the infrastructure necessary for commerce and tourism, i.e. the circulation of goods and people;

- the production and distribution of any type of goods.

All these artificial systems, when combined with the Natural ones in which they are situated and/or with which they interact for their normal operation generate an entirely new System, of a different type and quality. Natural and Artificial systems are now intermingled, interacting, interrelated and interdependent, thus permanently defining and influencing each other, giving rise to an entirely new and qualitatively different dynamics.

This new symbiosis and its dynamics are only partly controllable or predictable, and in order to be understood (even if only partially) they have to be examined using an interdisciplinary approach, a re-evaluation of the classical methodology, a fundamental change in theoretical approach and in the techniques used to study, modeling and prediction of the evolution of such complex systems [1]. Investigations have been started and research is being carried out worldwide in order to elucidate which are the best directions of study to be followed for the examination and understanding of this Artificial-Natural hybrid. From the findings that have resulted from such a diversity, the Science of the Complexity can be the right approach, having an integrative view, [2]. In this new vision, the behavior and dynamics of the Planet Earth System is simultaneously determined by two major trends:

a) The complicated interactions between the crust, atmosphere, hydrosphere and ionosphere, whose activity is additionally influenced and modulated by the Solar System's dynamics (electromagnetic storms, the solar 'wind', the ionospheric and telluric currents, the sun spots and their eruptions, the tides, etc.)

b) The essential social components that define in their evolution new needs and opportunities, resulting in a constantly changing world of artifacts, and hence a permanently modifying coupling and interaction between Natural and the Artificial across the entire planet.

From this perspective, the sociological, economical or engineering studies/sciences must be reconfigured and integrated in a larger and broader subject (meta-science) that transcends and combines them in an interdisciplinary approach in order to create this new framework in which each part would depend on (and be supported by) elements from the other ones. In a first stage, the generation and application into practice of the previously mentioned process has already been started, and an increasing number of researchers refer to such novel meta-domains more and more frequently, e.g. bioeconomy, biogeophyisics, geobiophyisics, astrobiophyisics as well as bioelectronics, microelectromechanics and jurisdynamics.

Although not yet fully mature or developed as complete meta-sciences, we can consider them as intermediary stages in the integration of several different sciences in a new vision of Natural Sciences. We can thus presume that this can be identified as the first sign highlighting a significant current trend of integration of various disciplines that ultimately may lead towards a single global concept, probably similar to some extent with the Gaia concept [3]. " It argues that we are far more than just the "Third Rock from the Sun," situated precariously between freezing and burning up. The theory asserts that living organisms and their inorganic surroundings have evolved together as a single living system that greatly affects the chemistry and conditions of Earth's surface. Some scientists believe that this "Gaian system" self-regulates global temperature, atmospheric content, ocean salinity, and other factors in an "automatic" manner. Earth's living system appears to keep conditions on our planet just right for life to persist!" [4].

It should be clear that, once such a meta-science has been generated, disciplines like economics and sociology will no longer be studied separately or independently, but interdependently and always within the context of their interactive co-evolution with the Planet Earth System.

Consequently, in this new context one may expect increased interest and more intense studies in the following possible directions:

- stimulating knowledge transfer between different fields and encouraging inter- and trans-disciplinary approaches;

- evaluating the capability of present day's methodologies of efficiently understanding theoretically and experimentally the transition from part to the whole, from complicated to complex;

- discovering and inventing new experimental concepts, models, theories, methods and techniques of monitoring and evaluating hierarchical dissipative systems that evolve far from thermodynamical equilibrium;

- developing and successfully using an educational infrastructure that can ensure the transfer and filtration of information, specific knowledge and know-how.

The main target is to educate the new generation and re-educate the current one by shifting from the current reductionist paradigm to one related to nonlinearity and complexity. This should result in a better understanding of current phenomena, increased capacity and willingness to assimilate new knowledge and adopt an exploratory frame of mind in order to further generate new knowledge. Therefore, a long-term consequence of such a new educational infrastructure should be the creation and propagation through society of a life-long learning attitude, based on a formal 'standard' education but also including an informal one and a non-formal one as well, while at the same encompassing both localized and delocalized aspects (e.g. e-learning).

2. About a science of Complexity

The Science of Complexity appeared due to the joint merger of various new fields that they have been born from new breakthrough in various areas: fractal geometry, the general theory of dissipative systems, chaos theory, synergetics, cellular automata, genetic algorithms, intelligent agents, artificial life. A turning point also proved to be the foundation of the Institute for the Science of Complexity in Santa Fe by a group of physicists, among which were George Cowan, David Pines, Stirling Colgate, Murray Gell-Mann, Nick Metropolis.

Thereafter, the rather loose collection of previous theories and models have become more coherent and organized in a certain structure that became known as the Science of Complexity, and which soon found numerous practical applications. The Science of Complexity changes drastically the approach of studying the reality and the surrounding environment: instead of using a reductionist and linear approach that provides analytical solutions, it introduced a holistic and nonlinear approach which could be modeled using cellular automata, neural networks or intelligent agents.

In 1976 Ilya Prigogine, Nobel prize laureate for Chemistry in 1977, elaborated "The Theory of Dissipative Systems", with which he became one of the pioneers in the field of self-organization studies [5]. The theory stipulates that order will appear spontaneously in systems that evolve far from thermodynamic equilibrium. This order appears as a result of a self-organization process that is strongly dependent on the energy fluxes present in the domain where this order, or structure, appears. This new 'entity' acquires new and specific physical and 'behavioral' properties. Thus, besides the link between energy and matter established previously by Einstein, Prigogine's theory makes a new and more subtle connection between energy and structure. Tree-like ramified structures, as well as self-similar and fractal objects found in Nature are examples of practical manifestations illustrating the dynamic interaction between energy and matter [6]. Bejan's constructalist theory [7] formalized the relation between structure and the energy flux that keeps the dissipative system far from thermodynamic equilibrium, defining several notable laws regarding alometry [8], with a high degree of universality [9]. The structure of such a system is conserved for as long as the energy flow is maintained within certain operational limits. Exceedingly large variations above or under this operational range trigger specific restructuring mechanisms (phase transitions, bifurcations), which can be carried out in a very fast and abrupt discharge, or slowly, during a time interval. Since 1990, the geodynamic events in general and the seismic ones in particular have been analyzed from this new perspective. This new approach requires the modern researchers to understand the intrinsic interactive dynamics among the various blocks and sub-blocks that form the Earth's crust in a seismically active region. Furthermore, it is also necessary to recognize and comprehend the mechanisms of genesis and the long-term stability of this cellular structure capable to dissipate energy from a concentrated point-like source (focal point) to a much larger volume of matter. In this respect, we intend to explore the manner in which a geodynamical active region that evolve far from thermodynamic equilibrium can be modeled in this nonlinear framework, paying attention to the choice of geophysical/ biophysical sensors used and their location in the area.

In 1987 Per Bak, Chao Tang si Kurt Wiesenfeld (the so-called BTW trio) discovered and formulated the Principle of Self-Organized Criticality, which highlighted another essential property of complex systems: their behavior was extremely sensitive to the initial conditions and the 'history' of the system, i.e. the succession of events to which it has been subjected along its evolution since its appearance. A strictly deterministic and causal approach, as had been used classically in many physical sciences, is no longer efficient or suitable in these circumstances since the transfer function of the system is constantly changing and evolving together with, and as a result of, the interactions between the system and other external surrounding systems, at the same hierarchical level or situated above and under it, respectively. A part of the energy flux received by the system is retained in its substantial-radiative structure, gradually contributing to its cumulative storage until a critical state is reached, when a sudden energy discharge takes places. The alternation of numerous charge-discharge cycles of this type maintains the system in a state that is always relatively close to the critical point (i.e. it can be said that the critical state is very robust). In the immediate vicinity of a critical state, the system's sensitivity even to infinitesimal accidental fluctuations increases exponentially, which makes possible that utterly small variations of collateral factors could easily trigger large-scale energetic discharge processes that irreversibly modify the structure and behavior of the entire system. Such a behavior outlines once again the acute necessity to extend the study based on the Science of Complexity so that it would also examine the triggering factors of such catastrophic events. Moreover, it also clearly suggests once again the essential need of breaking with the classical approaches that are utterly incapable of analyzing such concepts and of grasping even the basic principles of such phenomena. Instead, we suggest the implementation of an entirely novel approach: building an intelligent monitoring system and its corresponding data analysis & interpretation model, that are both capable to evolve in time together with, and in response to, the monitored Reality.

The studies carried out by per Bak [10], and especially the generalization made by Wolfram [11], in the field of cellular automata has led to new applications: genetic algorithms, neural networks, intelligent agents, artificial life. All these disciplines coagulated into a new computational science whose main aim is to re-create the genesis and the evolutionary dynamics of a real system in a virtual environment, in which other methods and tools are defined for investigation, monitoring and visualization than in the case of monitoring a real system. This enabled the scientists to replace the previous "static" modeling of dynamic systems using differential equations and systems of differential equations, i.e. using the so-called "rigid" models, with stable solutions expressed by continuous functions, that may be arbitrarily "elasticized" by adding stochastic terms that could extend the validity of the solutions in cases when the modeled system undergoes various fluctuations in its parameters. The new approach is based on a deep understanding and the application of the Science of Complexity and request an intelligent-evolutionary approach. A "virtual system" (a simulation) is generated starting from a set of local interaction rules between "cells" / agents. Due to the emerging properties we get a structured hierarchy that can be studied as a new kind of model. This approach is a conceptual leap forward, from a mathematic description with a limited valability, to the intrinsic simulation of the system which can evolve in a virtual environment in a manner similar to that of the modeled reality.

In 1975 Feigenbaum has made another major breakthrough that consolidated the creation of the Science of Complexity: the scenario of transition to chaos through successive bifurcations. The Structuring of the Chaos Theory was accelerated by other important contributions, such as: - the discovery of the two fundamental universal constants of chaos, - the development and application of computational sciences for solving nonlinear systems of equations, - the understanding of behavior of a nonlinear system by analyzing its dynamics in the phase space, - the discovery of fractal attractors and the generalization of bifurcation theory. According to the Chaos Theory, a chaotic system inherently exhibits "sensitivity to initial conditions". In other words, two trajectories originating from a given point will grow apart with an exponential divergence if an infinitesimal variation exists between their initial conditions. This fact is a fundamental limit for the predictability of such systems beyond a certain limited time interval (temporal horizon). Chaos Theory has also been applied in electronic circuits, leading to the realization of chaotic oscillators –Chua's circuit- [12] and enabling to formulate the concepts of chaotic resonance [13] and of synchronization using chaotic oscillators [14].

All these models and theories assert that a chaotic system always exhibits a few general common features:

- can be found a rule, or pattern, for the process in which the system loses its stability; (the path of chaos)

-The loss of stability can be studied separately and classified using specific evaluation methods and representation systems (the Lyapunov exponent, logistic maps, the phase space, attractors, strange attractors);

-One can identify certain values for the initial condition(s) that are guaranteed precursors for the bifurcation points [15], thus defining (i.e. enabling to predict) the evolution towards a critical state of a chaotic system (generalizing this statement we may be able to tell whether a precursor is expected or not to appear in a chaotic system's behavior during its dynamic evolution);

- By applying non-periodic perturbations of small magnitude one can, under certain circumstances, permanently maintain a chaotic system in a stable state, although dynamically it is situated in an unstable region of behavior. This control technique radically challenges and changes the entire concept of 'noise', as well as its role in identifying and maintaining the stability of a system;

-The analog, or informational, inter-connection of more chaotic oscillators with each other can, in special conditions, lead to the synchronization of all the oscillations. This is a key effect with crucial implications in understanding the coupling between complex nonlinear systems and the variability in their behavior predictability, with tremendous valuable potential applications for social, financial, economical, and other type of systems, and which is also employed in the so-called chaos communication [16].

We find to be necessary to insert in this paper a short review of the principal moments in the "aggregations" of concepts and theories in what it is known today as Complexity Science just to point out the major difficulty in understanding those new concepts, the correlations between them, the differences between the classical, Newtonian approach and this nonlinear one. We entirely agree with Eve Mittleton-Kelly form London School of Economics: "Complexity is not a methodology or a set of tools (although it does provide both). It certainly is not a management fad. The Science of Complexity provide a conceptual framework, a way of thinking, a way of seeing the World". To prepare the society and of course the new generation of scientists and researchers to be capable to understand this new way of seeing the World and to act creative in this new conceptual frame, we need new educational technologies, more close to: „learning by discovering", "learning by direct implications in real projects (experiments) in interdisciplinary teems, near senior researchers and professors from Universities ", self-education in e-communi-ties, based on e-learning processes.

3. A natural,multi-user laboratory

It is known the fact the Romania has a unique geodynamical active aria: The Vrancea zone. The strong earthquakes having the epicenter in a very narrow aria, close to Focsani, the presence of some mud volcanoes, strong geological accidents easy to be seen at the surface, make this specific place **a natural laboratory,** good for experimental research in so called **the GAIA theory** [17]. In the same time, it is already accepted that all geodynamical phenomena are complex, so it seem to be natural to use this place for a multi-user laboratory in geodynamics dedicated for the understanding of the stability of such an ecosystem using the Complexity Science approach and the e-learning process. As researchers in an academic research institute we try to understand the geophysical phenomena linked to the accumulations of mechanical stress and of the mechanisms that are responsible for an earthquake. Generally speaking, as a pragmatically objective, we try to improve the evaluation **of the seismic risk** of a certain geographical region. Such studies have had a new impetus due to the application of a very new set of theories and models. After Mandelbrot's introduction of the fractal geometry and the subsequent appearance and affirmation of the Chaos Theory and the Catastrophes Theory, seismic events have been reinterpreted as typical examples of manifestations for the dynamics of nonlinear systems. Self-organization has quickly become the most important and often used concept in modeling earthquakes. Other studies, made using large databases that included any seismic events of magnitudes larger than 2 on the Richter scale, highlighted variations between intervals with acceptable or high predictability of the seismic events, and those in which such events seemed to have occurred randomly. This observation led to the conclusion that the degree of predictability itself for seismic events is a variable that changes in time. From this point of view, the earthquake was re-interpreted as an expression of the "**geocomplexity**", and this new point of view reoriented the research in this area towards understanding complex phenomena. Specifically, this marked the beginning of a new stage in geosciences in general, and in seismologic research in particular, especially regarding the practical application of the main concepts, models, theories and methods provided by the new paradigm of Complexity.

If one assimilates a seismically active region with a nonlinear complex and hierarchically structured system [18], then the following features can be deduced or assumed as characterizing this system:

a) Each seismic event modifies irreversibly the system's structure, and for this reason a new re-assessment of the situation and re-adaptation of the analytical model has to be carried out permanently;

b) Each seismic event discharges a specific amount of energy *(recorded in earthquakes as the magnitude, e.g. on the Richter scale),*and this energetic variation modifies the internal state of the system and provides totally new and different initial conditions for the newly started phase of charging. The immediate result of such a behavior is a much reduced predictability, yet not impossible;

c) The energy discharged by each seismic event that 'resets' the local system is radiated/transferred to neighboring systems of equal or inferior hierarchical position. For this reason the accurate understanding of the evolution in time of a seismic region cannot be carried out without an initial thorough and multidimensional monitoring (at the same or from a higher hierarchical level) using a network of various types of sensors;

d) When the system is in the critical state preceding the seismic discharge, the triggering factors can alternate or combine with inhibiting ones, resulting in a reduced classic predictability of the seismic event. At the same time, this also highlights two necessary purposes (or requirements) for which a sensor network intended to monitor a seismically active region must be designed and set up: - capable to evaluate objectively when the monitored system (i.e. the seismic region) evolves in a critical state, and -closely monitor the low intensity processes that are resonant with the epicenter, and that could thus bring valuable information about how the triggering signal appears;

e) The monitored seismic region is just another element of a larger and also hierarchically organized system, being coupled and interdependent on the interaction with other similar systems in this super-system. This means that other important data can be obtained by monitoring the energy exchange, and other types of exchanges, between adjacent and subordinated systems, both living or not;

f) The changes in the structure of the system will always take place as a function of the variations in the fluxes of energy, information and matter. As such, these changes will obey universally valid laws (pattern, alometric constants [19]) which can also be used in our analytical model that controls the system in order to characterize in real-time the evolution and behavior of the observed region.

According to these observations, we can conclude that, monitoring this seismic zone with a complex network of sensors of different kind, we can collect and store real data, from a real complex system that evolves in time. So, designing a complex multi-user laboratory and put it in place in the epicenter of this unique geodynamic aria could be a very good opportunity for improving research and education in natural sciences *(the entire Nexus network became capable to use real and in real time data to verify theoretical models or to bring some new experimental devices in this laboratory, to let it there for a time, to verify the capability of the device to work accordingly to the purpose/ design).*

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MINING DUMPS & WET LANDSLIDES

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ABSTRACT

The manuscript refers to problems connected to environmental engineering for mining operations, presenting theoretical and practical approach in a real situation.

This analyze presents one of the major influences of mining industry to the environment and safety - uncontrolled wet landslides, generated by closed dumps. This phenomenon generally appears because waters, like springs and swamps that had been encountered during mining operation, were not well managed, in the sense of being drained and exported outside the mining perimeter.

The situation is illustrated with few pictures for a better comprehension.

The manuscript is addressed to specialists involved in the production process, researchers and designers from mining field, with a view to introduce an efficient method for intervention in similar situations. The authors propose this method for Best Available Technique (BAT) in similar situations. [1], [8], [15], [19] [22], [23]

KEYWORDS

Wet landslides, Mining Dumps, Mine Closure

1. HEADING 1

Fig.1

The intervention work refers to a closed coal quarry. Waters that had been encountered during mining operation, like springs and swamps, were not well managed, in the sense of being drained and exported outside the perimeter, and an interior dump was carried out in this conditions. Thus, the materials excavated from overburden, consisting in an overwhelming majority of clays, were deposited in a landfill inside the quarry. Once the underground mining operations and water pumping, from inside of a mine located a few hundred meters of the quarry, were stopped, initial hydro geological conditions were recovered.

This led to increased the volume of seepage water from underground, from an under pressure aquifer, because natural shield has been pierced by underground workings. This factor helped to the initiation, the amplification and maintain the phenomenon active, and also to fragmentation of surface, in the quarry (Fig.1). In these conditions, water goes through cracks, giving a permanent accumulation in landfill and a continuous supply of slip phenomenon. While is saturated with water, the slip phenomenon became, gradually, a wet landslide with a speed greater than 1.5 m/day (Fig.2).

Fig.2

Fig.3

Volume of material involved in the wet landslide was over 1,000,000 cubic meters (Fig. 3), resulting a total blockage, at some point, of both riverbed and of access road to the village households, destroying all properties encountered along of its way. Length of the body of slippage was approx. 1,500 m, and reached approx. 200 m of the confluence between Ţiganca Valley and Slănic River. Thickness varied between 2÷3 m at the upper part of the valley and 8÷10 m at the bottom of the valley. Slippage was caused both by the surface water, which stagnated in cracks, and by the underground water, from aquifers coming under pressure.

In the investigation phase, were performed geoelectrical measurements, drillings and laboratory checks. Since the resistivity was less than 50 ohmm shows that the aquifer is made of alternating layers of sand, clay and wet coal (Fig. 9). These geophysical investigations concluded that, geologically, the area consists of clays, sandy clays and sands, and there are no harsh formations (sandstone and limestone) - Table 1. [2], [3]

Simulations, conducted in the laboratory*, have confirmed the correctness of the calculation assumptions:

- slip plane material is saturated and undrained,
- there is the opportunity of consolidation by drainage effect and under the own weight.

Calculation methods were based on the assumption of failure in Fellenius, Bishop and Jambu variants for:

- an imposed sliding surface, and also
- a circular-cylindrical surface,

for a better modeling of the local failure (real situation existing in the site). [2], [3], [4], [27]

Table 1

Geotehnical characteristics	Simbol	M.U.	Clay Variation Range	Powdery sand, Loamy sand Variation Range
Physical characteristics of the soil				
Narural wet	W	%	17.4÷38.4	17.4÷33.3
Plasticity ind.	Ip	-	20.7÷43.0	14÷22.7
Consistency ind.	Ic	-	0.60÷0.86	0.45÷0.60
Tamping degree	Id	-	-	-
Volumetric weight	γ_a	KN/ m^3	18.0÷20.2	12.2÷21.1
Porosity	n	%	18.5÷43.0	18.9÷44.5
Porosity index	e	-	0.55÷0.96	0.61÷0.75
Wet degree	Sr	-	0.84÷1.09	0.72-1.04
Mechanical characteristics of the soil				
Angle of internal friction	Ø	^{0}	7÷14	7÷14
Cohesion	c	daN/ cm^2	0,08÷0,22	0,02÷0,08
Deformation	Ic	M_{2-3}	daN/cm2	-
Compressibility	Id	a_{v2-3}	cm2/daN	-
Specific compaction	γ_a	e p_2	cm/m	-

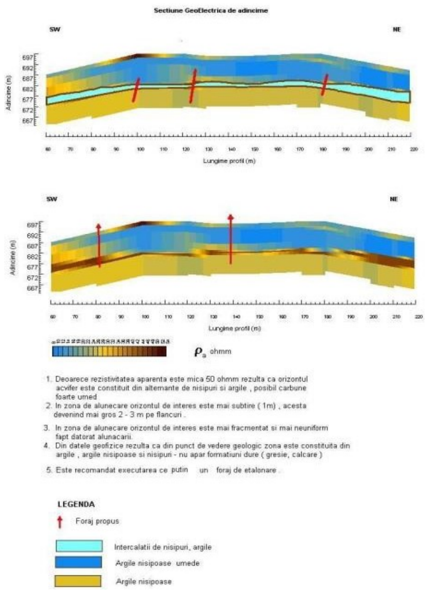


Fig.9

Geotechnical parameters and safety factors (tables) used in calculatios are:

- undrained conditions, the situation in the site (Table 2):

γ=18 KN/mc; φ=10°; c=20KPa

- drained conditions, the proposed solution using parameters determined in the laboratory (Table 3):

γ=18 KN/mc; φ=14°; c=22Kpa

**the laboratory used for analyzes and simulations belong to GEOCONSULTING (authorized Level II nationwide).*

Table 2

Prof. I	Circular-cylindrical surface		Imposed sliding surface I		Imposed sliding surface II	
	static	dynamic	static	dynamic	static	dynamic
Ordinary	0,853	0,622	1,261	0,970	0,753	0,545
Bishop	0,874	0,638	3,429	1,947	0,781	0,561
Janbu	0,838	0,611	2,560	1,458	0,768	0,550
Prof. II			Imposed sliding surface			
	static	dynamic	Static		dynamic	
Ordinary	1,359	0,627	0,818		0,519	
Bishop	1,526	0,705	1,605		0,763	
Janbu	1,382	0,640	1,456		0,695	
Prof. III			Imposed sliding surface			
	static	dynamic	Static		dynamic	
Ordinary	0,712	0,604	0,994		0,558	
Bishop	0,712	0,610	1,530		0,711	
Janbu	0,711	0,589	1,376		0,640	
Prof. IV						
	static		dynamic			
Ordinary	0,667		0,435			
Bishop	0,718		0,469			
Janbu	0,671		0,438			
Prof. V						
	static		dynamic			
Ordinary	2,053		1,035			
Bishop	1,099		1,059			
Janbu	2,030		1,024			

Table 3

Prof. I	Imposed sliding surface	
	static	dynamic
Ordinary	2,467	1,774
Bishop	2,662	1,929
Janbu	2,387	1,707
Prof. II		
Ordinary	5,332	2,699
Bishop	5,769	2,921
Janbu	5,207	2,661
Prof. III		
Ordinary	2,045	1,506
Bishop	2,813	2,122
Janbu	2,750	2,060
Prof. IV		
Ordinary	2,819	1,800
Bishop	3,041	1,913
Janbu	2,776	1,779
Prof. V		
Ordinary	6,158	3,084
Bishop	6,366	3,192
Janbu	6,059	3,035

ENGINEERING & DESIGN [13]

Usually, the landslides are stabilized with walls and/or pillars, followed by a spur of soil compacted, but in this case, because the body of landslide was wet (soil with very high humidity), it was impossible to apply those solutions. Therefore, was chosen a special solution.

The technical solution proposed by engineers was to build a massive wedge prism, made of crushed stone of various sizes, filled in thin compacted layers (with the height growing downstream), placed in front the landslide.

Main idea is to use one of the basic features of the landslides - cyclicity.

Due to gravity, the material within landslide will be continuously deposited on the prism, where, encountering a surface with a good drainage which facilitates the phenomenon of squeezing, the water will be discharged very quickly. The design should ensure that the sliding material is rapidly converted to a stable ground, which may be compacted, and new solid consistency will be opposed to the sliding movement. The wedge prism was designed to work like a dam, with a large development to the base on flow direction, by using a special construction, which covers the following demands:

Fig. 4

a) The designed shape of the wedge prism, in the first phase, must not oppose an important resistance, to enable gravitational movement of material on it; [14], [15]

b) The material, which will be filed continuously on prism, must encounter a surface with a good drainage, to facilitate the phenomenon of squeezing, so the water to be discharged very quickly. The slipping material must turn quickly into a stable ground, which can be compacted, and its new solid consistency must oppose to the motion (in fact, in this way, could be restored the natural balance of the terrain);

c) To ensure the optimal reverse slope (as opposed to the natural ground), for slipping meet a growing resistance and, along with wet material advancement on the ramp, to increase the amount of water discharge. Under these conditions, linear movement (laminar) will turn in a circular motion (rotation with translation) both horizontally and vertically, which will cause a more pronounced water discharge;

d) The shape and the particle size distribution of the material, in the prism, must not block the free flow of water, which is essential in the stabilization process. [16]

e) Electro-mechanical machines and equipment used must be appropriate to conditions in the field. [11], [12]

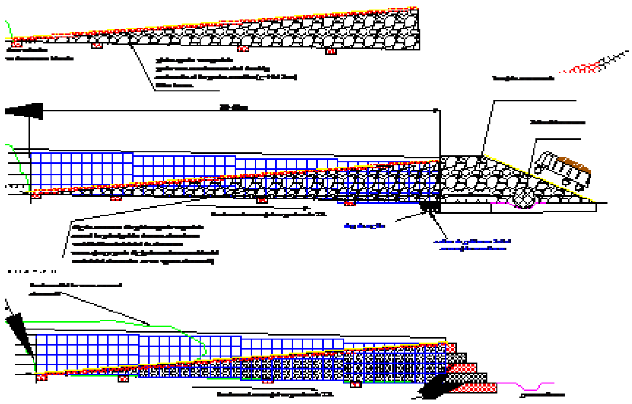
The main idea is to use one of the basic features of the landslides - cyclicity.

Most of landslide's evolution is cyclical: accumulation and flowing. During accumulation, the material, saturated with water, could be drained by gravity, and because pressing it down becomes more consistent. Thereby, over time, becomes it self part of the stable structure, artificially created, by increasing its weight, and overall, contributing to improving the stability factor in the area. [8], [9], [12], [23]

After comprehensive laboratory analyzes, for this particular case, the prism was calculated and built to provide a filter coefficient up to 10 cm/s, safe water evacuation, and no major risk of clogging. [18], [22], [24]

Principle of the system designed:

1. Wedge prism for drainage,
2. The dam and the access ramps,
3. Wall of gabions, for additional support (only if is necessary),
4. Bottom drainage,
5. Regulated riverbed



OPERATING RESULTS

A. Initial conditions

Figure 5 – slip front reached the village

Figure 6 - accumulation and flow, typical movement of a slip,

Figure 7 – in the quarry, the material's continuously saturated with water

Figure 8 – in the middle zone landslide became wet,

B. Operations start

Figure 9 – in the village, the operations are started,

Figure 10 – in the downstream, landslide is in the most critical moment (the excavator is overwhelmed),

Figure 11 – in the downstream of the wedge prism, during construction,

Figure 12 – the squeezing process, at the contact between the drainage wedge prism and slipping material,

Figure 13 – the top of the drainage wedge prism,

Figure 14 – gabions, in the downstream of the drainage wedge prism,

Figure 15 – the access way, built directly on slip,

Figure 16 – minor and major riverbeds, rebuilt at the contact between slip and natural slope,

Figure 17 – surface water drainage channel built with natural materials,

Figure 18 – "Y" shaped drains in the quarry,

C. Situation after work completion (2 years):

Figure 19 - the middle zone of the valley after rehabilitation and stabilization,

Figure 20 - the upper zone of the valley after rehabilitation and stabilization,

Figure 21 - the quarry, shaped natural for good capture and optimal management of the surface

Figure 22 – the new river bed after settlement and households after restoration waters.

COSTS

The estimated value for the works was up to 3 million euro (4 million dollars).

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METHODOLOGY FOR DIMENSIONING OF ROOM AND PILLAR SYSTEM IN UNDERGROUND MINING

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ABSTRACT

The major problems with dimensioning of the room and pillar system in mining are: 1) the unknown acting stresses (natural and induced); 2) the properties and structural characteristics of the rock mass; 3) the influence of the chamber-and-pillar mining unit that constantly changes in time and space; 4) the influence of mining activities on the increasing volume of the massif. The combination of the above indeterminacies impedes dimensioning (geometry, location, supported surface to supporting surface, shaping sequence, etc.) and, therefore, increases the risk of accidents and mishaps. The existing practices in dimensioning of constructional elements (the isolated support pillars) abound in formulae and factors that do not meet the current requirements for stable, safe, and efficient exploitation. Based on a generalised systematisation of those approaches, analyses, and experience amassed, an algorithm (methodology) for dimensioning of constructional elements within the system of mining is offered. This methodology has been applied in dimensioning of isolated inter-room support pillars from the room and pillar mining system of a deposit within the Madan mine field in Bulgaria.

1. INTRODUCTION

Underground mining of minerals is carried out within the rock mass which is an insufficiently examined, constantly changing, and risky geological environment. The efficiency of underground mining, labour safety, and the negative effects of mining activities on the ecosystem are directly dependent on the geo-mechanical stability of the rock mass that imbeds the underground heading. Considering the above, the main role of geo-mechanics is to ensure the optimum use of the rock mass as a constructional element within the mining system. Also, in conformity with the major influencing factors, and under the minimum of geo-mechanical risk, it has to provide opportunities for controlling the processes that go with mining. The strained stress condition (SSC), respectively, the stability of the Imbedding Mass/Extraction Workings (IM/EW) system, is determined by three groups of controllable and non-controllable factors:

- The structure and properties of the rocks forming the rock mass and the disruptions they contain (non-controllable).
- The natural (non-controllable) and the induced (controllable) stress condition of the mass that is caused by technological operations.
- The effects of the technological impact and the growing network of underground

headings whose geometrical and spatial properties disrupt the integrity of the rock mass (controllable).

The stress condition is a major characteristic of each mineral deposit. Under the conditions of its natural bedding, the rock mass is subject to the action of a natural field of stresses which may either be of tectonic or gravitational origin. Mining workings disturb the natural field and induce a new field whose distribution corresponds to the scale and intensity of those workings.

Determining the above groups of factors is the basis for: a reliable assessment of the strained stress condition (SSC) of the Imbedding Mass/Extraction Workings (IM/EW) system; dimensioning of the constructional elements within the systems of mining; ensuring long-term stability; the level of geo-mechanical risk; the conditions for carrying out efficient and safe mining activities.

2. METHODOLOGY

As a rule, engineering estimates while dimensioning of the room and pillar systems of mining are based on formulae from structural mechanics or on experience from analogous situations and expert methods gained from practice [1]. Usually, empirical coefficients lacking reliable justification are employed in dimensioning of constructional elements (the support pillars). In most cases, the above approaches applied to dimensioning do not ensure the stability of the imbedding mass. Deriving from the above examples, the necessity of a geo-mechanical approach in dimensioning is brought forward. Such an approach is illustrated in Figure 1.

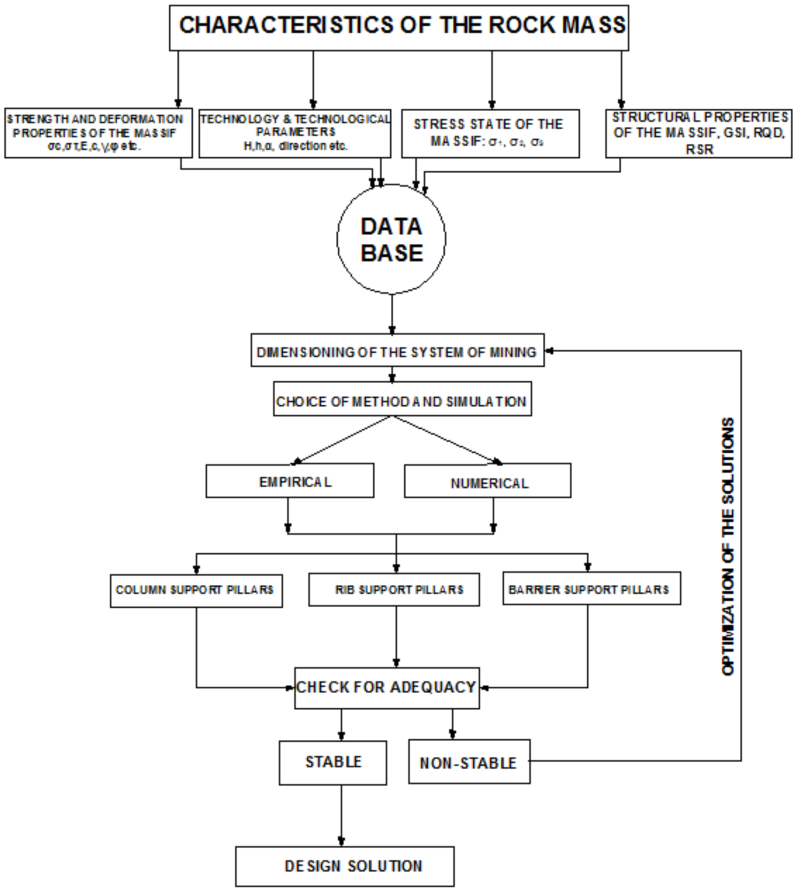


Figure 1. Methodology for geo-mechanical dimensioning of the room fending support pillars with room and pillar systems of mining

3. DESCRIPTION AND PRACTICAL APPLICATION OF THE METHODOLOGY

This methodology has proved its adequacy in dimensioning of the room fenders in one of the underground lead and zinc mines in the Madan mine field in Bulgaria (the Gyudyurska deposit).

3.1 Geological description of the rock mass

From a geological point of view, the imbedding mass in the area where the column-like room fenders are erected is composed of the following lithological types of rock that differ in terms of degrees of secondary changes and disturbances: amphibole-biotite gneisses; marbles; granitised gneisses. The rock mass is disrupted by faults with various orientation that are the result of multiple stages of tectonic impact and that form basically two systems of tectonic disruptions. The first system of tectonic disruptions is oriented parallel to the rock strike and cuts the rocks in a direction which is perpendicular to the bedding. The strike azimuth of those disruptions is 325°-355°. The direction of their inclination varies in strike and dip with the angle of inclination ranging from 55° to 90°. The second system of tectonic disruptions is oriented under stike azimuth of 270° - 310° with the direction of the inclination being N-NW and S-SE. They are structures that steeply incline from 55° to 90°. The tectonic structures of this system are with a strike azimuth of 330°-345° and an inclination angle of 55°-90°. They are also ore-controlling faults. The lead and zinc mineralisation, too, is of primary importance for the structural conditions and, accordingly, the ore localisation of the deposit.

Underground water is classified into two types: non-pressure water with shallow circulation, and pressure water with deep circulation. Shallow underground water has uneven flow which is most often fed by atmospheric water. Fissure water is closely connected with tectonic disruptions that are water permeable. In the design production section where the support pillars are designed, the maximum flow of water measured has been 2.5 l/sek, the minimum has been 0.7 l/sek, and the average flow has been determined as 1.5 l/sek. Deriving from the above properties, the deposit is assumed to be poorly saturated.

3.2 Properties of the rocks and the rock mass

The stages in the geo-mechanical exploration of the rock mass in the area of the design production section were carried out as follows:

- The existing textual and graphical information was collected and compared. For this purpose, the necessary additional laboratory study of the resistance and deformation parameters, as well as of the structural parameters of the imbedded rocks was carried out;
- To study the nature of the mineralisation in the production section, locations from the preliminary geological survey were selected and specimens were taken: core samples with geometrically regular (cylindrical) and irregular shape;
- The systems, ROD were determined based on the nature of the disruptions and the structural and mechanical condition of the rock mass. Also, the RMR and MRMR geo-mechanical classifications were applied, as well as the GSI geological index.

The laboratory and structural examination, along with the application of classification estimates were employed to determine the beyond-the-limit strength and deformation parameters by using the RocLab programme and in accordance with the Hoek-Brown criterion. The above results have given grounds to create a multidimensional database that outlines the characteristic features of the operational section. The results from the above studies are summarised and illustrated in Table 1.

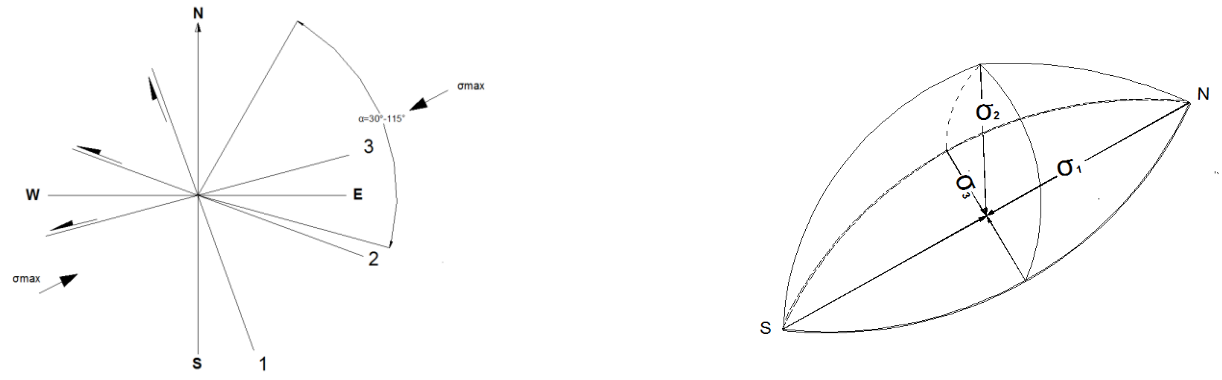
Table 1. Mechanical properties of the rocks and structural characteristics of the rock mass

	PARAMETERS \ LITHOLOGY	Amphibole-biotite gneisses	Hydro-thermally changed gneisses	Gneisses with marble layers
Laboratory testing	Bulk density, [MN/m^3]	0.0265	0.026	0.026
	Specific density, [MN/m^3]	0.0275	0.028	0.027
	Porosity, [%]	3.9	5.6	2.7
	Uni-compressive strength, σ_{ucs} [MPa]	102	83	49
	Tensile strength, σ_t [MPa]	9.6	8.2	5.4
	Cohesion C, [MPa]	34.5	28.0	23
	Angle of internal friction, [°]	43	38	29
Classification characteristics	Fracturing	Two systems of fractures	Three systems of fractures	Four and more systems of fractures
	RMR [10]	69, 2nd class	59-65, 3rd-2nd class	54, 3rd class
	MRMR [10]	60	49	43
	GSI [2]	64	58	53

3.3 Stress state of the rock massif

Stress state in the rock mass was studied in two stages. Analytical and experimental methods [4] were applied as follows:

- During the first stage, the genotype of the natural field of stresses was characterised. The studies were based on processing of the results from the tectonics of rupture and reconstruction of the paleofield of stresses (Figure 2a). These studies have revealed that the range of the maximum tectonic stress σ_{max} varies from 30° to 115° which is connected to changes in the course of the geological history, whereas the minimum principal stress σ_{min} varies within the range of 300° to 350°. The results obtained from the reconstruction of the paleofield of stresses in the area prove the presence of tectonic components stress in the Gyudyurska deposit. The distribution of the paleofield of stresses is shown in Figure 2b). It is in the shape of an ellipsoid with axes σ_1, σ_2, and σ_3. Its configuration and magnitudes vary depending on the depth, the mountain relief, and the properties of the rock mass in the different operational sections



a) *b)*

Figure 2. Reconstruction of distribution: a) in the components of the paleofield of stresses in the section; b) Configuration of the resulting field of stresses.

- During the second stage of field characterisation, the above results were compared to those obtained experimentally in a different operational deposit [5], under similar conditions and types of solid ore that were located in the immediate proximity of the deposit studied. The results obtained are introduced in Table 2.

Table 2. Results of the stress state of the rock mass

Parameters	Calculated stresses	“In situ” calculated stresses			
		ν=0.21; E=5.4 GPa		ν=0.22; E=8.8 GPa	
		3C1	3C2	3C1	3C2
σ_1	8.60÷9.40	11.08	10.54	14.85	14.91
σ_3	3.70÷4.15	5.40	6.6	7.02	4.92

It is obvious that the results obtained through experimental and instrumental methods of investigation are similar; therefore, they can be employed for the purposes of the analyses. Due to the identical characteristics of the structural properties of the rock mass in the two deposits, the experimentally obtained results can be used for the methods of dimensioning.

3.4 Numerical studies

A geological and geo-mechanical model of exploring and dimensioning of the system Production Room/Support Pillar (PR/SP) is constructed as illustrated in Figure 3a). The figure shows the location of the support pillars left in the production section. Figure 3b) models the situation after a pillar has been formed and the room surrounding it.

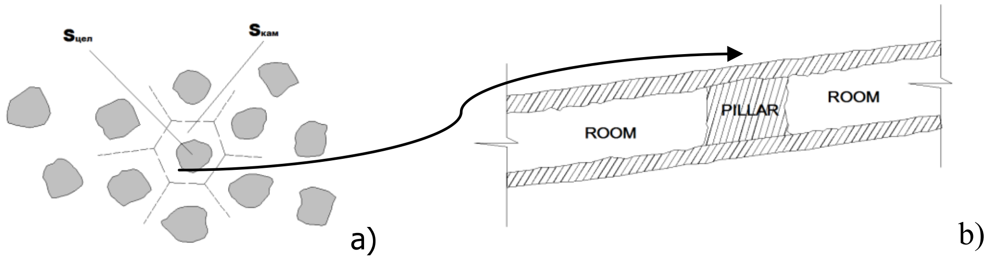


Figure 3 a) Location of the isolated support pillars in the production section;
b) Modelled situation of the room-pillar-room system.

Analysis was performed with a 2D numerical model using the finite element method (FEM) [6]. The numerical model gives opportunities for staging, for inputting environments with various characteristics, for multi-factor analysis of the results obtained, etc. The strained stress condition (SSC) and the deformation behaviour of an isolated support pillar has been studied taking into consideration the development of the production room around it. The results are shown in Figure 4a), b), c), and d). The objective of the survey was to assess the SSC and the strength of the pillar by taking into consideration the stoping, and also by determining the FOS factor whose values are classified in Table 3.

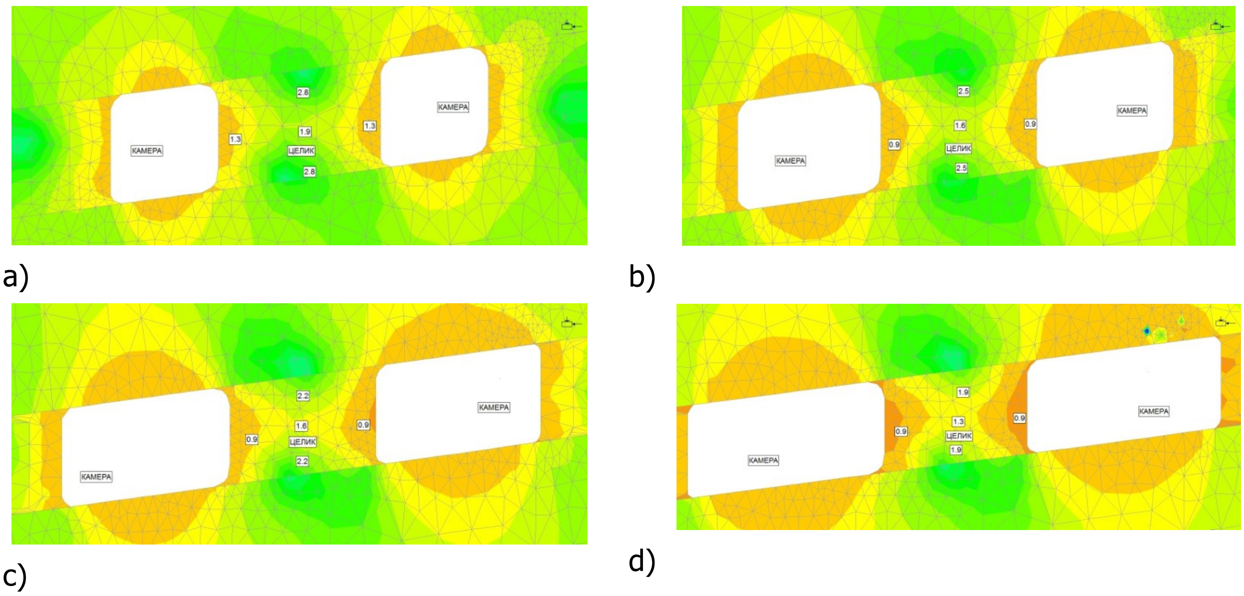


Figure 4. Results from the parameter analysis: a) at S_{room}/S_{pillar}=5; b) at S_{room}/S_{pillar}=7.5); c) at S_{room}/S_{pillar}=10; and d) at S_{room}/S_{pillar}=12.5

The results from the parameter studies are compared to the commonly applied empirical methods employed in dimensioning of isolated inter-room pillars in the deposit.

Table 3. FOS Values determined through a numerical method and through empirical formulae

Room surface / Pillar surface S_{room} / S_{pillar}	FOS	
	Numerical model	Empiprical formula
5.0	1.9	2.5
7.5	1.6	2.0
10.0	1.4	1.7
12.5	1.0	1.2
15.0	0.6	0.8

The comparative analysis has taken into consideration the generally approved values for FOS>1.5 and has estimated that the optimum value for the FOS factor is obtained when the ratio of room suffece to pillar surface is not greater than 10.

The methodology suggested is applied in the mining practices of a number of states (Canada, the USA, South Africa, etc.). It can actually be employed by adhering to the principles of the Stress Path method as illustrated in Figure 5. This method monitors the variations in the geo-mechanical situation prior to, during, and after the shaping of the production room around the pillar. The maximum principal stersses (σ_1,σ_3) for the above two listed states are plotted within the stress space limited by the destruction criteria (Hoek-Brown or Mohr-Coulomb). The difference beween the principal stresses (σ_1 increases, σ_3 decreases) is indicative of the variation of the SSC of the system in conformity with the technological processes. The stress zones of variability trace the direction, i.e. the intersection point and the induced stress

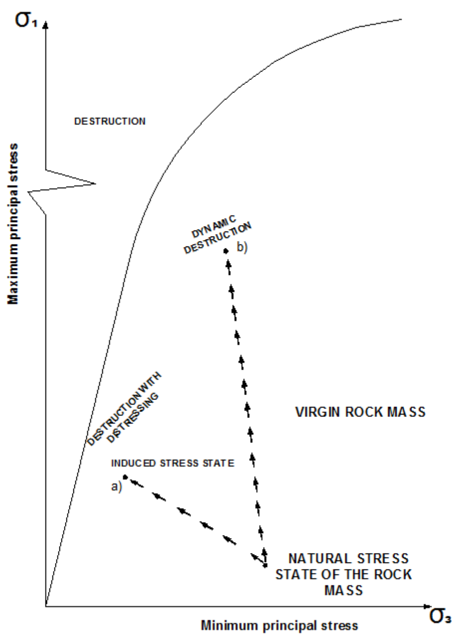


Figure 5. Stress Path

Mining activities can follow one of the following two paths: Trajectory a) is characteristic of the mode of mining work without inducing stresses and without indications of pillar run-off and accumulation of seismic energy in the pillar. The distribution of the stress state shows that in the case of a), the SSC of the pillar varies without the risk of accidents (resulting from exceeding the strength). This determines the most probable mode of loading of the system and the loss of stability "in batches" which allows for relaxation. Trajectory b) shows that with such a mode of development of mining work, the SSC of the system rises sharply and zones of concentration of stresses trace the variation of the stress condition (SC) and will induce seismicity and sudden collapse.

4.CONCLUSION

The methodology applied allows for operational activities to be performed by taking into consideration the effect of the strength and deformation parameters, the stress state, the structural characteristics, and their interaction. All of the above help ensure the stability of the system and the respective efficiency and safety of work. The methodology offered has been tested "in situ" conditions and has yielded positive results in the course of dimensioning which proves its applicability.

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PLANNING THE DEVELOPMENT OF THE SURFACE COAL MINE IN FUNCTION OF THE GEOTECHNICAL STABILITY OF THE WORKING SLOPES

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Abstract

Analyzing the state of geotechnical stability of the slopes of the digging blocks, provides an opportunity to evaluate the safety of the ongoing process of exploitation and planning the further development of the mines. As one of the main factors in the estimation of the stability of the slopes are the physical – mechanical properties of the rock masses. The geological, hydrogeological and climate characteristics of the analyzed area and the wider region, condition a specific hydrogeological characteristics of the investigated area. The development of the surface mine as a techno genic factor also affects the hydrogeological parameters and the overall issue which is the subject of analysis and study. It should be noted that the hydrogeological issue has a huge impact of the stability state, therefore while describing the geo - mechanical parameters it’s important to take in consideration the effects of the level of underground water. Every change in the level of underground water, freezing, defrosting etc. creates new elastic conditions in the rock masses than can lead to occurrence of slope instability. In order to define the conditions of exploitation and geometry of the mine in separate stages, are made an appropriate analysis of the stability. In the analysis are used advanced methods for defining the stability of the slopes (lamellas method, Bishop, Spencer and Janbu).

Key words: Mining, groundwater, piezometers, hydrological, landslides, stability.

1. Introduction

The most typical factor for disruption of slope stability is the change in the geometrical form, partial or local disturbance or sliding i.e. creating of new slope. In the changes of the forms of the slopes comes to a change in the strain condition and in some zones of the rock masses new strain conditions, meaning new deformations. When the new strain condition creates critical deformations, results with huge changes and deformities in the geometrics state of the slopes in general.

The changes of the physically – mechanical properties of the rock masses is very frequent cause for the occurrence of slope instability. The changes in the level of underground water, their freezing, thawing etc. creates new conditions for strain state in the rock mass which creates greater instability of the slopes [1].

The long-term process of changes in the strain state and conditions of deformity while the other conditions remains equal, can also lead to instability of the slopes. The process of releasing of the strain forces in the new nearby created slope, results with additional discontinuity and weakening of the rock mass.

Condition for stability for each slope is to develop balance between external forces and internal resistance of the environment in the slope. The analysis of the geotechnical stability of the slopes on the excavated blocks in the coal mine “Suvodol” creates opportunity for assessment of the safety of the ongoing process of exploitation, as well as planning further development

2. Methodology of investigation

The methodology of the investigations is conducted with terrain investigations, macroscopic evaluation of the geotechnical stability of the mine and excavated blocks and mathematical analysis using modern methods border balance for analysis of the geotechnical stability of the slopes of the surface mine. There are several methods for calculating and determining the factor of slopes stability. The analysis are conducted with the following modern methods for defining the stability [2]:

- Method of Lameli
- Method of Bishop
- Method of Spencer
- Method of Janbu

The geomechanics is relatively “young” discipline. In the first half of the previous century Fellenius develops method under the name Swedish method based on defining the critical circles of the slide surfaces. In the middle of the fifties Janbu (1954) and Bishop (1955) are upgrading this method. The usage of the computers since the year 1960 allows to improve the performance of the iterative procedures in these methods. This lead to developing mathematically more accurate formulations as the method of Morgenstern and Price (1965) and Spencer (1967).

The software solutions increased the reliability of the methods used for defining the slope stability. In the recent years are developed powerful software packages such as: SLOPE/W, GALENA, ROCKPACK, STABLE etc. Each of this methods gives relevant and optimal factor for stability, satisfying the balance conditions.

3. Planning and development of the surface mine process of exploitation in function of the geotechnical stability

The slope instability is common activity at surface mines, even dough are projected with acceptable stability factors. The answer in this phenomena should be found in the analysis of the multiple natural and technical parameters that ultimately influence the stability. While investigating the slope stability issues in the geotechnics firstly is designed the potential surface line (zone) critical for sliding, and after that is calculated the resistance that acts along its length. In the development of the slides of the rock masses the stability factor is lower than 1.

The slope stability is also under huge influence of the underground water. The presence of underground water can significantly lower the stability factor even in the rock masses with high stability factor. In the masses with no cohesion the presence of underground water can lower the stability factor at half of its value.

The coal mine “Suvodol” is in a very complex situation that requires very detailed analysis and plan for dynamics of the exploitation of the mullock and coal. The amount of exploited coal should meet the minimum tons needed for the upcoming heating season, while making conditions for gradual stabilization of the already formed landslide. Because of the complex mining and geological conditions the finalized plan for development of the surface mine “Suvodol” is developed with multiple analysis and on the basis of previous experiences. The development plan is with the following arrangements:

- Development of the mining front through the southwest border between the profile lines 68 – 76 and 57 – 63, as well as the northeast border between the profile lines 43 – 49 and 72 – 82. In the central area between the profile lines 49 – 57, decreasing in the exploitation pace because of the pressures of the blocks that are directed in that area.
- Releasing the mullock pressure of the southwest part of the mine between the profile lines 78 – 84 and 49 – 57, with discontinuous excavation while using mining construction operatively.
- Excavation of the mullock with the existing equipment in the central area between the profile lines 78 – 74 and 49 – 57, from the top down with formation of floors with safety berms just above the coal layer in order to provide enough coal for the heating season.
- Filling of multiple existing cracks for protection from ground water leaning in, as well as development of drainage channels through the floors for collection of the water in the central water collector.
- Dislocation of the transporter from the I ECD (excavator, conveyor, disposer) system and connecting with the floor transporter a the O ECD system

4. Planned coal exploitation

The process of coal exploitation for the analyzed period is conducted in very complicated geomorphological conditions. The process is executed with rotary excavators: CU 300, SRs630/1 and SRs 630/2. The excavator SRs 630/1 is transferred for mullock exploitation after the end of the heating season. The coal exploitation is performed through several floor surfaces. Elevation block above the vertical alignment of the floor transporter ETU1, little elevation of the transporter ETU2 and depth block bellow the transporters ETU1 and ETU2. In the central area the exploitation can be performed with under floor – 4 meters syncline where the coal layer is with higher calorific value. From the southwest border until its ending point, the coal layer is truncated with the vertical alignment of the transporter ZTU1. The rest of the layer is exploited in elevation block above the vertical alignment of the ZTU1 and the ETU1 transporter.

The elevated excavated block for CU 300 should have maximal height of 15 meters, whereas for the excavator SRs630 maximal value of 10 meters. The first depth block should be with depth of 10 meters, whereas the second in the under floor with value of 4 meters. The basic elements of the excavated blocks are defined through the technical characteristics of the equipment, physically mechanical and the geological characteristics of the coal layer.

Because of the complex geomechanical conditions in which the basic equipment is planned to operate, for the whole process of exploitation is allowed deviation from the planned activities if it comes to movement of the excavated blocks. The planned technical activities of the coal system for the analyzed period are given in the following arrangement:

- Radial movement of the ETU1 transporter
- Radial and parallel movement of the ETU2 transporter
- Continuation of the ZTU1 transporter

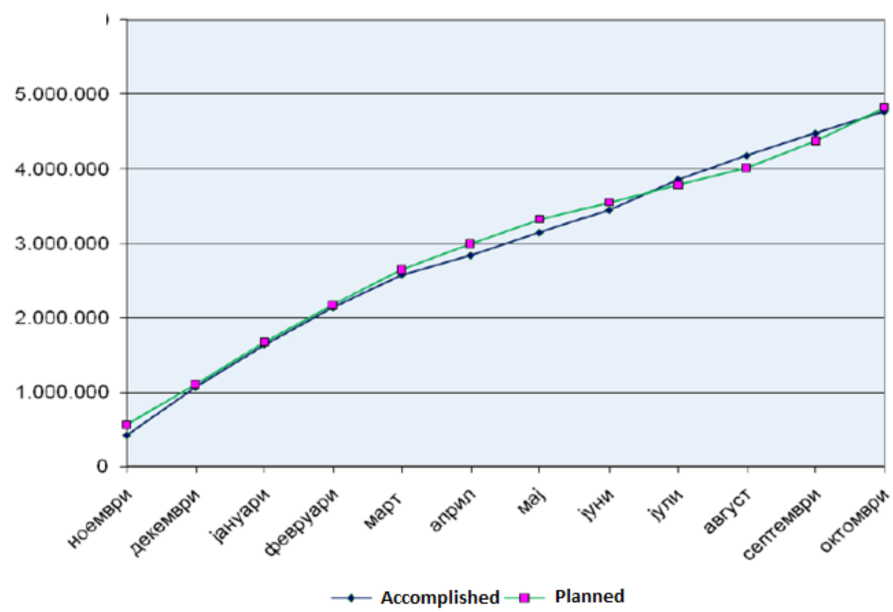
In the table 1 is given the amounts of coal exploitation given in months with a specifically designed dynamics for the analyzed period from November 2009 until November 2010 [3]. In the table are also given the values of the exploited amounts as an illustration to the planned values. This numbers and predicted dynamics is of curtail importance for determining an improving the stability of the slopes without interfering the amounts of coal needed in order to fulfil the requests of the upcoming heating season.

Table 1. Values for planned and exploited amounts of coal given in months

Month and year	Coal (t)	
	Planned	Accomplished
November 2009	560.000	421.133
December 2009	545.000	649.965

January 2010	565.000	566.674
February 2010	500.000	501.036
March 2010	470.000	437.731
April 2010	350.000	260.518
May 2010	330.000	308.915
June 2010	230.000	301.138
July 2010	230.000	412.694
August 2010	230.000	319.654
September 2010	360.000	299.635
October 2010	450.000	289.048
Total	4.820.000	4.768.141

On the graphic 1 is shown the exploitation of coal with the planned and accomplished amounts given through months with the basic equipment presented in tons.



Graphic 1. Exploitation of coal given in months

5. Geotechnical stability of the profile line 51 – 51'

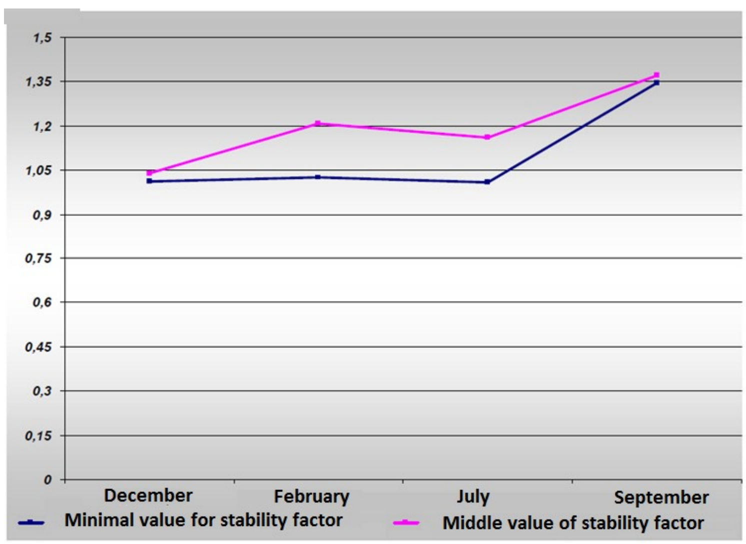
In the table 2 are shown the values for the geotechnical stability of the working slopes obtained through the methods of Lameli, Bishop, Janbu and Spencer. The stability is calculated and presented in months for the analyzed period. In the investigations are taken the current stability parameters of the profile line [4].

Table 2. Calculated values for geotechnical stability of the slopes on profile line 51 – 51'

Assumed sliding surfaces with	Minimal value for the stability factor

assumed piezometrics line in the analyzed period	November	January 2010	May	June	August
Lameli	0.918	0.989	1.001	1.001	1.050
Bishop	1.047	1.256	1.210	1.374	1.257
Janbu	1.024	1.056	1.116	1.292	1.216
Spencer	1.102	1.281	1.264	1.364	1.383
Minimal value for the stability factor	0.918	0.989	1.001	1.001	1.050
Middle value for the stability factor	1.023	1.145	1.148	1.258	1.227
Condition for stability (Fs > 1.3)	N	N	N	N	N
Conditional stability (1.1 < 1.3)	N	Y	Y	Y	Y
Instability (Fs < 1.1)	Y	N	N	N	N

On the basis of the data in the previous table through the middle values obtained from each method is concluded the improvement of the stability i.e. the profile line from unstable with an assumed piezometrics line goes into conditional stability.



Graph 2. Minimal and middle stability of the investigated profile line

From the data of the table is made graphic from which is concluded that the stability of the profile line on the basis of the planned dynamics for development of the surface mine is improved and with a tendency to translate into stable

Conclusion

Because of the complex situation of the surface mine "Suvodol" and the emerged cracks with already formed blocks that are in constant movement, in the process of planning the dynamics are necessary several analysis and continuously monitoring of the terrain. In the process where investigated the basic geological and structural – tectonic characteristics of the wider area, as well as the physically – mechanical and technical – technological parameters of the working environment. The basic geometrical elements of the surface mine as well as the hydrogeological and the data for underground water are also taken in consideration. On the basis of this data is developed an preliminary analysis for the geotechnical stability of the working slopes through different methods for analysis of the stability of the slopes.

In the period that is analyzed in this paper (from November 2009 until October 2010) were analyzed several profile (51- 51', 53-53', 12-12', 14-14', 16 -16' and 76-76') lines from which in the paper is elaborated only the 51 – 51' profile line.

The elaborated profile line according to the calculated values with each method, the stability of the slopes have improvements i.e. from unstable translates in to conditionally stable.

In the analysis of the profile lines the smallest factor values are taken in consideration which means that the profile lines are investigated with the worst case scenario for the investigated stability. From the middle values of the profile lines in the analyzed period is concluded that factor of instability is only presented in the month of November 2009 (at the start of the investigations) that in December the same year is translating in to conditional stability so continuous grow of the coefficient of stability, for ultimately the surface mine reaching stability in October 2010. In the whole exploitation period of coal and mullock the excavated blocks were continuously monitored, with additional analysis especially for the slopes with increased risk and lowered stability, constantly taking all actions for correction and improved stability. The parts that were impossible to predict the sliding slopes were disconnected from exploitation until their stabilization with additional mechanization.

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CERCETĂRI PRIVIND CALITATEA PROFILELOR LAMINATE UTILIZATE PENTRU EXECUŢIA SUSŢINERII METALICE A GALERIILOR DE MINĂ

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ABSTRACT

Abordarea problemelor de calitate a profilelor laminate utilizate pentru execuția armăturilor metalice culisante de susțineri, a fost și ramâne o problemă de real interes, având în vedere că tipul oțelurilor de uzinare și procesele de laminare la care acestea sunt supuse, reprezintă cauzele obținerii, sau nu a condițiilor tehnice optime de calitate, atât pe parcursul prelucrării ulterioare a elementelor metalice de susțineri (debitare și curbare), cât, mai ales, pe durata montării și funcționării susținerilor în subteran. În spiritul promovării și adoptării oțelurilor adecvate pentru execuție, în lucrare se prezintă condițiile de calitate pe care acestea trebuie să le îndeplinească, tipul factorilor și modul lor de influență asupra calității oțelurilor, respectiv situația calității profilelor laminate SG fabricate în țara noastră din punct de vedere a analizelor chimice, metalografice și a caracteristicilor mecanice.

KEYWORDS

Profile laminate, susțineri metalice, oțel aliat/nealiat, structură ferito – perlitică, grăunți cristalini, atac nital, punctaj grăunte, tratament termic, incluziuni nemetalice.

1. INTRODUCERE

Deficienţele semnalate asupra susţinerilor metalice utilizate la execuţia lucrărilor subterane, reclamă îmbunătăţirea parametrilor constructivi şi funcţionali ai acestor tipuri de construcţii. Ca urmare, într-un asemenea context, de-a lungul timpului s-a considerat oportună abordarea problemelor de calitate a laminatelor pentru execuţia elementelor metalice, interesând, în mod expres, calitatea oţelurilor pentru uzinarea profilelor laminate.

Profilele laminate utilizate pentru execuția susținerii metalice de tip culisant, respectiv laminatele tip SG fabricate în țară, au fost obținute prin laminare la cald, din oțeluri tip carbon-mangan (C-Mn), sau oţeluri slab aliate, care prevăd în compoziţia chimică adaosuri reduse în elemente de aliere, respectiv sub 0,19 % vanadiu, niobiu, aluminiu sau titan și care, în ţara noastră, s-au utilizat până în anul 1980 pentru uzinarea laminatelor tip SG-18 şi SG-23, iar până în anul 1988 pentru uzinarea laminatului SG-29 (oțelul marca OPM). De la acea dată, din considerente economice, laminarea profilelor s-a făcut din oțeluri de marcă OPM 1 pentru SG (18 și 23), respectiv 31Mn4 pentru profilul SG.29, ambele mărci fiind caracterizate fără conținut în elemente de aliere, acestea fiind substituite prin creșteri ale conținutului de carbon cu pâna la 70%, favorizând menţinerea caracteristicilor mecanice de rezistenţă la valori limită superioare, pe seama însă a reducerii proprietăţilor de deformare şi exploatare, sub limitele minime admisibile de eficiență, respectiv a alungirii, gâtuirii şi rezilienţei.

Folosirea pentru uzinare a otelului marca 31Mn 4 s-a realizat și în cazul laminatului SG.23, ca singurul tip de profil laminat fabricat în țară și utilizat la execuția galeriilor de la minele din valea Jiului până la o dată recentă, acesta fiind înlocuit ulterior de alte tipuri de laminate achiziționate din import, având caracteristici constructive și de rezistență similare (THN21, K21, K24).

Acest tip de oțel, respectiv cel de marcă 31Mn 4, stă și la baza uzinării profilelor din seria TH(N) întâlnite în străinatate, dar, care spre deosebire de țara noastră, se livrează conform prescripțiilor prevăzute de norma germană DIN 21544-85, care prevede execuția la furnizorii de laminate a tratamentelor termice de îmbunătățire, cu scopul recristalizării și reomogenizării structurii cristaline, întocmai pentru obținerea proprietăților superioare de deformare și tenacitate a oțelului.

2. CONDIŢII DE CALITATE A OŢELULRILOR UTILIZATE PENTRU EXECUŢIA LAMINATELOR

Cerinţele de ordin general la care trebuie să răspundă oţelurile utilizate pentru execuţia profilelor laminate sunt [1], [2], [3], [5] :

- să asigure valori ridicate ale rezistenţei mecanice, pentru ca ruperea materialului să se producă la sarcini cât mai mari;
- să asigure valori superioare ale limitei de curgere, pentru a se imprima profilelor o capacitate portantă cât mai mare în domeniul elastic;
- să asigure valori ridicate ale tenacităţii, alungirii şi gâtuirii, deci o bună capacitate de deformare, astfel încât profilele laminate să poată suporta deformări mari după depăşirea limitei de elasticitate, fără a se produce ruperea fragilă în timpul curbării prin deformare plastică la rece, sau pe durata exploatării susţinerii în subteran;
- să permită reutilizarea elementelor de susţinere prin îndreptare la rece, fără aplicarea însă a eventualelor tratamente de îmbunătăţire anterior operației de curbare.

În principiu, calitatea oțelurilor e influențată de o serie de factori, dintre care:

- o compoziţia chimică, adică natura și conţinutul elementelor chimice;
- o mărimea şi modul de distribuţie a granulaţiei la formarea structurii cristaline a oţelului;
- o cantitatea şi modul distribuţiei incluziunilor nemetalice în structura oţelului;
- o natura şi frecvenţa aplicării tratamentelor termice asupra profilelor după operaţiile de uzinare şi, ca produse finite, după curbare.

Din punct de vedere a compoziției chimice, comparativ cu oţelurile utilizate în străinătate pentru uzinarea profilelor, situația indică pentru oțelurile utilizate în țară, inclusiv din punct de vedere a mărimii caracteristicilor mecanice ale profilelor, valori sensibil apropiate, ceea ce conferă acestora situarea lor la nivelul celor mai bune oţeluri de pe plan mondial [3], [4].

Corespunzător prescripţiilor tehnice de uzinare prevăzute în cadrul normativelor recente existente în țară pentru laminarea profilelor (OPM 1/31Mn 4/STAS 9531-91 pentru SG-18, 23 și 29, respectv 31Mn 4/SF 3-93 pentru uzinarea SG-18 și SG-23) se constată, că în lipsa elementelor de aliere, pentru ameliorarea compoziţiei chimice şi îmbunătăţirea calităţii oţelurilor, noile normative prevăd aplicarea la furnizor a procedeelor termice de îmbunătăţire, anume de normalizare, lucru neconform însă cu situația practică reală întâlnită la acea dată în țara noastră. În acest caz, pentru oțelul nealiat de marcă OPM 1 și, respectiv 31Mn 4, netratat termic, reducerea proprietăţilor de deformare, respectiv a tenacităţii, se datorează prezenţei într-o pondere ridicată a concentraţiei de cementită – Fe_3C în structura ferito-perlitică a oţelului, cu tendinţă de creştere odată cu mărirea conţinutului de C, conferind acestuia o duritate şi fragilitate ridicată, cu consecinţe negative privind amorsele de prelucrare care apar ulterior pe durata curbării prin deformare plastică la rece a profilelor (fisuri, crăpături şi spargeri de material), inclusiv a deficienţelor de montare a susţinerilor în subteran (obţinerea deschiderilor la îmbinarea grinzii cu stâlpii de susţinere, ca urmare a utilizării elementelor cu raze şi lungimi diferite)

Pe de altă parte, caracteristicile de rezistenţă, dar mai ales capacitatea de deformare şi tenacitatea oţelului sunt hotărâtor influenţate de mărimea granulaţiei, respectiv de gradul de finisare a structurii sale cristaline. La rându-i, mărimea granulaţiei este influenţată, printre altele, de: compoziţia chimică, gradul de dezoxidare, calitatea procesului de uzinare (temperatura, durata de încălzire şi viteza de răcire a blumurilor).

Privind participarea elementelor chimice asupra gradului de finisare a structurii, se apreciază că aluminiul, carbonul şi vanadiul imprimă o tendinţă de finisare a structurii oţelului, pe când siliciul, manganul şi fosforul contribuie la obţinerea unor structuri grosolane, care conduc la creşterea fragilităţii, pe seama reducerii tenacităţii şi a capacităţii de deformare.

Astfel, datorită lipsei vanadiului şi prezenţei aluminiului într-o proporţie redusă în compoziţia chimică, oţelurile nealiate, comparativ cu cele aliate, dispun de structuri cu grăunţi mari (grosolani) a căror repartizare nu este uniformă, ci în şiruri.

În ceea ce priveşte influenţa gradului de dezoxidare asupra calităţii oţelurilor, rezultatele obţinute în urma analizelor efectuate pun în evidenţă că oţelurile aliate prezintă un grad de dezoxidare ridicat, funcţie de care, prin formarea la limita grăunţilor cristalini a incluziunilor nemetalice de tip oxidic (Al2O3, V2O2, TiO2), rezultă o granulaţie fină a structurii, care împiedică creşterea şi dispunerea în şiruri a grăunţilor. Spre deosebire de situaţia menţionată, în cazul oţelurilor nealiate nu are loc formarea incluziunilor oxidice, lipsa elementelor de aliere generând reducerea gradului de dezoxidare şi creşterea grăunţilor cristalini.

Din punct de vedere al influenței temperaturii de laminare și a vitezei de răcire, observaţiile şi analizele de calitate efectuate, au arătat că nerespectarea condiţiilor adecvate de laminare, cu precădere în cazul oţelurilor nealiate, cu conţinuturi mai mari de 0,25 % C, determină apariţia aşa numitelor „structuri de călire”, în special pe timp friguros, când se produce răcirea bruscă a blumurilor, rezultând autocălirea oţelului şi creşterea durităţii şi fragilităţii la rupere, pe seama reducerii pronunţate a plasticităţii şi rezilienţei.

Aprecierea calităţii oţelurilor din punct de vedere al granulaţiei se face în funcţie de numărul şi mărimea grăunţilor cristalini prezenţi în structura ferito-perlitică a materialului. În acest context, corespunzător clasificărilor existente pentru încadrarea marimii grăunților cristalini din structura oțelului, rezultatele obţinute în urma analizelor metalografice de laborator şi a comportării laminatelor în exploatare, au confirmat posibilitatea obţinerii unei plasticităţi şi tenacităţi corespunzătoare, în condiţiile unui număr al grăunţilor cristalini de 9 până la 15, caracterizați ca având mărimea mijlocie, spre fină (tabelul 1)

Tabel 1: Clasificarea mărimii grăunţilor cristalini din structura ferito-perlitică a oţelului pentru uzinarea profilelor laminate de susţineri

Nr. crt.	Numărul grăunţilor intersectaţi	Mărimea grăunţilor
1.	peste 15	grăunţi foarte fini
2.	12 ÷ 15	grăunţi fini
3.	9 ÷ 11	grăunţi mijlocii
4.	până la 8	grăunţi grosolani

Din punct de vedere a influenței incluziunilor nemetalice asupra calităţii oţelului (oxizi, sulfuri, silicaţi, nitrați şi fosfați), aceasta este determinată de cantitatea, forma geometrică şi dispersia incluziunilor în structura cristalină, reprezentând puncte de amorsă a tensiunilor interne, cu efecte negative în cazul cantităţilor mari şi distribuţiilor neuniforme, producând apariţia microfisurilor în structura materialului. Dispersia incluziunilor nemetalice poate fi uniformă sau neuniformă, individuală sau grupată, în interiorul sau la extremităţile structurii ferito-perlitice a oţelului de execuţie, cu precizarea că deformarea plastică la cald a materialului, pe durata procesului de laminare a profilelor, favorizează repartizarea acestora în şiruri, de-a lungul planelor de alunecare (figura 1, a şi b).

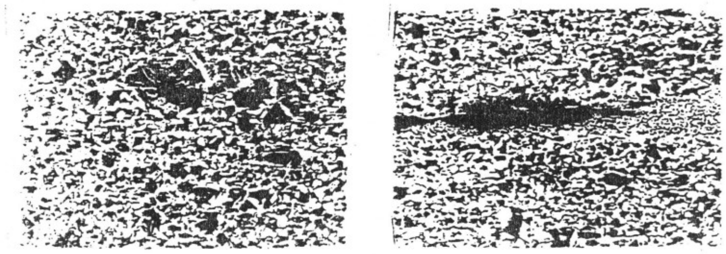


*Figura 1: Structuri ferito-perlitice neomogene (nerecristalizate) cu grăunţi crescuţi de perlită, punctaj grăunte 5÷7 (atac nital, X100): **a**-probă de laminat SG-23; **b**-probă din laminat SG-29*

Dispunerea în şiruri a structurii oţelurilor, ca urmare a distribuţiei neuniforme şi a concentrării cantităţilor mari de incluziuni nemetalice, favorizează creşterea durităţii şi fragilităţii la rupere a materialului, pe seama reducerii plasticităţii, respectiv capacităţii de deformare ulterioară la rece a laminatelor, inclusiv a tenacităţii.

Influenţa tratamentelor termice asupra calităţii oţelurilor rezultă din efectul acestora de ameliorare ce-l imprimă structurii interne a materialului, în sensul recristalizării şi reomogenizării structurii obţinute din laminarea profilelor.

În scopul asigurării capacităţilor de deformare ulterioară la rece a profilelor (necesare curbării elementelor de susţineri), respectiv a alungirii şi gâtuirii, precum şi a tenacităţii în exploatare a susţinerilor, pe plan mondial, se aplică, după uzinarea profilelor, **tratamentul termic de normalizare,** care reprezintă recoacerea cu transformări de fază, adică încălzirea materialului la temperaturi de până la 900°C, urmată de răcirea la temperatura atmosferei. În acest mod, în cazul oţelurilor nealiate se reuşeşte înlăturarea dispunerii în şiruri şi reomogenizarea structurii ferito-perlitice a oţelului.

De asemenea, în scopul obţinerii proprietăţilor adecvate de exploatare a laminatelor, respectiv a rezistenţei şi tenacităţii, după fasonare (debitare şi curbare) se aplică **tratamentul termic de călire** a materialului, adică încălzirea şi răcirea în apă sau ulei, urmată de **o revenire înaltă**. În acest mod, perlita, ceare reprezintă constituentul de bază al oţelurilor în stare recoaptă (stare normalizată), se transformă în sorbită sau sorbită perlitică, conferind oţelului tratat o corespondenţă optimă între proprietăţile de plasticitate, tenacitate şi cele mecanice de rezistenţă.

În cazul oţelurilor aliate, cu conţinuturi sub 0,25 % C, diminuarea stării de tensiune remanentă care se formează după curbarea la rece a elementelor de susţinere, cu recristalizarea şi reomogenizarea structurii materialului, se realizează prin aplicarea **tratamentului termic de detensionare.**

3. SITUAŢIA CALITĂŢII OŢELURILOR FOLOSITE ÎN ŢARA NOASTRĂ PENTRU UZINAREA PROFILELOR LAMINATE

Deşi, prin normativele existente în vigoare, compoziţiile chimice şi caracteristicile mecanice ale oţelurilor utilizate în ţara noastră indică mărimi apropiate faţă de cele prevăzute pe plan mondial, totuşi, prin lipsa elementelor de aliere şi neaplicarea tratamentelor termice de îmbunătăţire a calităţii, profilele laminate înregistrează imperfecţiuni tot mai accentuate, generând producerea ulterioară a amorselor la nivelul operaţiei de curbare a elementelor şi la exploatarea susţinerilor în subteran. Edificatoare în acest sens sunt rezultatele analizelor efectuate de-a lungul timpului pe probe de laminate uzinate din mărci de oţel diferite, prelevate direct din uzinare, sau după curbarea şi exploatarea în subteran a profilelor [1], [3], [4].

Astfel, analizele chimice comparative de şpan, efectuate pe probe din oţeluri nealiate cu vanadiu (mărcile OPM 1 şi 31 Mn 4), au pus în evidenţă următoarele aspecte:

- conţinuturile de carbon au fost în general mai mari faţă de cele prevăzute prin normative, plasându-se în intervalul 0,32 ÷ 0,39 %, faţă de 0,24 ÷ 0,30 %, cât este prevăzut în cazul mărcii de oţel OPM 1 și, respectiv 0,36 ÷ 0,48 % în cazul mărcii 31 Mn 4, faţă de cel admisibil de 0,28 ÷ 0,36 %;
- ca şi carbonul, conţinutul de mangan s-a încadrat de regulă în intervalele de 0,84 ÷ 1,1 % pentru marca OPM 1 şi 0,81 ÷ 1,31 % în cazul mărcii 31 Mn 4, în ambele situaţii plasându-se peste conținutul prevăzut de normative, anume de până la 0,8 % Mn în cazul mărcii OPM 1 şi până 1,1 % Mn pentru marca 31 Mn 4;
- conţinuturile de siliciu s-au încadrat în intervale, de asemenea, mai mari decât cele prevăzute, de regulă înregistrând până la 0,35 %, faţă de maximum 0,25 % cât este prevăzut. Ca şi carbonul şi manganul, siliciul a înregistrat depăşirea conţinuturilor maxime admise, ceea ce a conferit primele indicii de creştere a grăunţilor cristalini din structura ferito-perlitică a materialului, cu obţinerea de structuri neomogene;
- conţinuturile de aluminiu, ca element de aliere cu cea mai mare importanţă după vanadiu, au fost prezente într-o proporţie redusă faţă de cel prevăzut de normative, anume 0,006 ÷ 0,015 % Al, comparativ cu minimul de 0,02 % Al (figura 2).

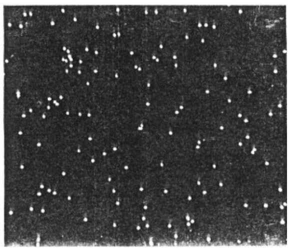
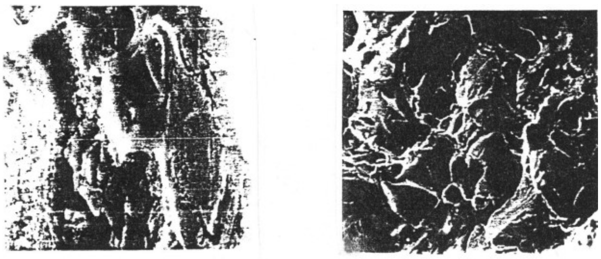


Figura 2: Modul de repartiţie a conţinutului de aluminiu din structura oţelului de execuție, marca OPM 1

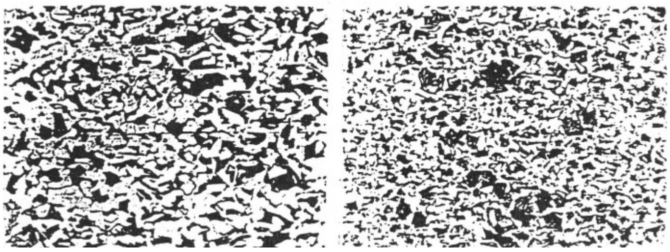
Pe lângă favorizarea diminuării rezilienţei oţelului, analizele macrofractografice efectuate au evidenţiat că prezenţa aluminiului în proporţie redusă a influenţat aglomerarea incluziunilor nemetalice în structura oţelului, care au amplificat în lipsa tratamentului termic de reomogenizare a structurii, producerea ruperii materialului, cu trecerea acestuia de la faza de rupere la oboseală, la faza de rupere fragilă (figura 3, a şi b)



a b

*Figura 3: Procesul ruperii materialului în cazul probei de profil laminat SG-23 prelevat din subteran (X 600): **a**-aspectul ruperii la oboseală în zona de început a amorsării fisurării; **b**-aspectul ruperii fragile înregistrată în momentul atingerii secţiunii*

La efectuarea analizelor metalografice, micrografiile obţinute au indicat, în cazul oţelurilor nealiate (necalmate şi netratate termic), prezenţa structurilor ferito-perlitice neomogene şi neuniforme, cu conţinuturi în elemente nemetalice peste limita maximă admisă, având grăunţii cristalini de tip grosolan, dispuşi în şiruri paralele cu planele de stratificaţie (figura 4, a şi b).



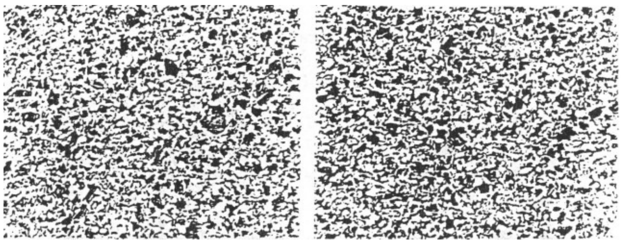
a b

Figura 4: Probe prelevate din laminate SG-18 (a) şi SG-23 (b) uzinate din oţel nealiat marca OPM. Structuri ferito-perlitice neomogene cu grăunţi grosolani de perlită, punctaj mărime grăunte 4 şi 6 (atac nital X 100)

În mod contrar, dar pozitiv, rezultatele obţinute pe probe din oţeluri aliate şi oţeluri nealiate, dar tratate termic (normalizate), au pus în evidenţă structuri ferito-perlitice mult mai omogene, cu repartizarea uniformă şi mai numeroasă a grăunţilor cristalini (figura 5, a şi b), ocazie, când, pentru obţinerea rezilienţei maxime în stare îmbătrânită a materialului (kCU), s-a stabilit temperatura optimă pentru reomogenizarea şi recristalizarea structurii oţelului ca fiind de 850 ÷ 10°C (tabelul 2).

Tabel 2: Rezultatul aplicării tratamentului termic de normalizare pentru îmbunătăţirea calităţii oţelurilor nealiate

Temperatura de normalizare, °C	830	840	850	860	870	880
Rezilienţa în stare îmbunătăţită, J/cm²	61,7	76,4	74	74	64,7	64



a **b**

Figura 5: Structuri ferito-perlitice omogene, punctaj mărime grăunte 8 ÷ 9 (atac nital, X 100): a-probă normalizată la 850°C; b-probă normalizată la 860°C

La verificarea caracteristicilor mecanice, încercările efectuate pe probe de material din oţeluri nealiate şi netratate termic, au pus în evidenţă neîncadrarea rezistenţelor la rupere (Rm) şi curgere (Rp 0,2) în limitele admisibile, acestea situându-se, de regulă, în intervale mult mai mari, respectiv de până la 850 N/mm2 (cazul Rm) şi 590 N/mm2 (cazul Rp 0,2). Obţinerea rezistenţelor mecanice la valori ridicate, cu mult peste mărimile prevăzute, chiar şi faţă de oţelurile îmbunătăţite a fost consecinţa existenţei în compoziţia oțelului a surplusurilor de carbon şi mangan, care au generat autocălirea profilelor în procesul de laminare, în speţă pe timp friguros, când temperaturile de încălzire şi răcire a blumurilor s-au aplicat cu reticenţe [1], [3], [5].

Prin avantajul de reomogenizare şi finisare a structurii de care beneficiază oţelurile aliate (marca OPM) şi cele nealiate, dar tratate termic (mărcile OPM 1 şi 31Mn 4), rezultatul încercărilor mecanice efectuate asupra acestora au indicat mărimi ale rezistenţelor mecanice mult mai accesibile, respectiv Rm = 635 ÷ 640 N/mm^2 şi Rp (0,2) = 415 ÷ 422 N/mm^2.

Ca o consecinţă a conţinuturilor mai mari de C şi Mn prezente în structura cristalină a oţelurilor nealiate şi nenormalizate, valorile alungirii la rupere (A5) s-au situat în limite extrem de largi, plasându-se, de regulă, sub limita minimă admisă de normative (sub 19 %), exceptând o parte a epruvetelor din oţel OPM 1 cu conţinuturi relativ reduse de carbon, la care alungirile s-au încadrat în intervalul 10,5 ÷ 21,6 % în cazul laminatului SG-29, pe seama însă a reducerii considerabile a rezistenţei la rupere. Ca şi alungirea, valorile rezilienţei obţinute din încercări, pe probe supuse la îmbătrânire artificială, au indicat valori sub limita minimă impusă de normative, respectiv min. 70 J/cm^2, atât pentru marca de oţel OPM 1, cât şi pentru marca 31 Mn 4.

Comparativ cu situaţia descrisă, în cazul oţelurilor aliate şi a celor nealiate, dar tratate termic, rezilienţele au înregistrat valori superioare, încadrându-se la prescripţiile prevăzute de normative, atât pentru starea neîmbătrânită cât şi pentru cea îmbătrânită artificial.

CONCLUZII

Actual, pentru execuția susținerii metalice de tip culisant aplicată la execuția galeriilor de mină, continuă să se utilizeze, într-o pondere tot mai redusă însă, laminatul SG. 23 de producție indigenă, precum și profile laminate cu caracteristici constructive și de rezistență similare achiziționate din import, a căror uzinare nu presupune în totalitatea cazurilor folosirea elementelelor de aliere în compoziția chimică a oțelurilor de execuție, dar care, pentru asigurarea calității de prelucrare și exploatare în subteran a susținerilor prevăd, conform normativelor existente în vigoare, aplicarea la furnizor a tratamentelor termice de îmbunătățire, respectiv a tratamentului de normalizare.

În condițiile lipsei la furnizor a tratamentului termic de normalizare, rezultatul analizelor efectuate asupra calității și performanțelor în exploatare a susținerilor, pune în evidență compromiterea cerințelor de ordin general la care oțelurile de uzinare ar trebui să se încadreze, rezultând modificarea structurii interne de material, cu apariția amorselor la operațiile ulterioare de debitare și curbare la rece a profilelor, ca și repercursiuni nefavorabile la montarea și exploatarea susținerilor în subteran.

Față de inconvenientele înregistrate la nivelul profilelor laminate pentru susțșinere, se impune aplicarea la furnizor a tratamentului termic de normalizare, în condițiile desfășurării fluxului/tehnologiei de laminare conform cerințelor tehnologice optime de realizare a acestui proces. Ca alternativă la neaplicarea acestei măsuri, se propune achiziționarea din import a profilelor laminate similare cu cele din țara noastră, respectiv laminatul SG 23 privind forma, dimensiunile și marimile caracteristicilor statice și de rezistență, care sa fie executate din oțeluri aliate sau manganoase, conform normei DIN 21544/85, dar care să fie livrate în stare îmbunătățită, corespunzător condițiilor interne de debitare și curbare la rece a elementelor de susținere prevăzute de respectiva normă.

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THE FUTURE OF THE CONVENTIONAL MINING SYSTEMS AND TECHNOLOGIES

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ABSTRACT

Mining science and practice is actively working to create and implement new advanced, including futuristic mining systems and technologies. In the foreseeable future, however, mining in underground mining, will still rely on the familiar - conventional systems and extraction technologies. In this regard, the report addresses several problematic tasks with the decision of which conventional mining systems and technologies can gain more efficiency, adaptability and applicability.

KEYWORDS

Mining systems, future, technology

The future of the mining industry has been the subject of many studies, analyzes and forecasts [1, 2, 3]. All studies show that it has a future and it is associated with progressive development of technique and technology.

Research and forecasts for the mining industry are considered multilaterally, through modern mining practices in underground mining and mining construction [1] through the present and future of mining technology [2] and forecasts for the future. [3]

An interesting attempt to predict the future of the mining industry makes Jeff Loher and G.Hemingwai [4-9]. Under the collective title in six consecutive different articles titled authors offer their vision for the future of mining technology and mining. Their predictions are based not on predictions but on occurring changes and achievements in all spheres of life, including mining.

Based on comprehensive analysis of the latest achievements in the social sphere, engineering and technology, computer and communication equipment, they consistently provide future mining sites such as rock factory [5]; as living mine [6]; symbiotic structure [7]; fluid firm [8]. In the last part [9], the authors reflect on the power of prediction to help companies discover, place and develop new ways to increase efficiency and return of investment.

In its conclusions, the authors believe that future mines would be smaller and safer. In addition, they will be better equipped and will operate with reduced costs. For the development and improvement of future mines and mining technological schemes will help issued in [10] top 10 technologies: Rapid development; Hard-rock cutting for production; Directional drilling; Tunnel boring machines; Laser cutting; UAVs and drones; 3-D printing; Mineral indicators; Acid digestion for assaying; Microwave & thermal fragmentation and others.

New understanding of future mines and mining technologies in the efficient use of technology described above will cause inevitable change of conditionals indicators to reassess the many fields of mineral resources and their conversion into deposits with reserves.

In recent years, however, it could hardly be expected that all of the above, innovations and achievements will be applied uniformly in the mines. Expectations are that new developments will be imposed and implemented in stages.

At this stage of development there are enough mines with conventional technological schemes, systems and mining technologies working in medium and very complex mining and technical conditions. Many of these technological schemes need improvement. This need is caused by the fact that there are still significant differences in technical-economic and technological level in different countries and regions where mining takes place. For example, within the country such differences exist between mine "Chelopech" and mines "Goroubso" and "Lucky." Differences in technical and technological level exist between mines Lakinska area and those in Goroubso. These differences are related to the type of mineralization, types of minerals, differences in values and mining technical and geological conditions. We therefore believe that in future technological schemes in such mines will undergo improvements in terms of transient mining technology solutions.

Transience of these solutions will be expressed in expanding the use of various innovations and greatly improved extraction technology schemes.

There are still mines in which the uses of recent advances in mining techniques and technologies have not found their place. They at present days are close to the effective operations but are in need of new and more productive machinery. Unfortunately, many of the leading mining and engineering companies in the race to keep pace with future focus their efforts on creating new technical means which are fundamental to mining technologies of the future. For this reason, they abandon most of its projects to create the necessary machinery for conventional systems and technologies in conducting mining operations in specific conditions: low power reserves; undersized sections; weak rocks and minerals; complex geometry of the deposits and others.

In these situations for further work and to ensure its effectiveness is necessary to reassess the possibilities of mining, design of new solutions based on logistic approach of designing and making an application for creation of advanced new - hybrid between conventional and fundamentally new technical means and technology, machinery and equipment.

What are the problems in existing small and medium-sized mines?

Although the conduct of research and development in exchange for drilling and blasting in mining practice [10], we believe that this technology has not yet exhausted the possibilities. For small mining enterprises it can be developed mainly in terms of the use of suitable drilling equipment.

The armory traditional technologies based on drilling and blasting (drill-and-blast technology) mines require technical resources to effectively drill blast holes. In the process of development of this industry are created many technical solutions – production drills, which are done drilling, and drilling for mining purposes, partial study and drill rigs for rock support. Those solutions, however, can hardly be used in confined working conditions, which is why they are used primarily in "mass production", "shaft extraction", but not to produce in confined conditions and selective mining. For the latter are still used hand drills pneumatic and rarely hydraulic and power. The achievements of automation, new materials, services and facilities in the composition of the system machine - they are not yet applied in practice. Transportation, placement, maintenance of the machines and their service in the drilling process still requires manual labor, the use of which results in the reduction of productivity and rise in production costs.

The analysis of the study of the processes related to drill-and-blast technology and rock support operations with anchors shows that production and drilling machines used to serve hard and work with them is ineffective. Drilling time is immense, manual service is heavy and laborious, and time, for example pile anchors, friction type, is significant. In a number of conditions ramming it is prolonged, and in some cases impossible. Drilling different holes oriented in the array using a different type drills.

As stated above, these problems are solved by manipulators mounted and integrated with rail and wheel transport machines move as drill rigs, specialized blasting (production drill rigs, mining and tunneling jumbos) and anchoring (drill rigs for rock support, roof bolters).

The analysis of the parameters and practices in the use of these machines has shown that to ensure the normal operation of these are necessary working spaces with relatively large dimensions in height, width, and particularly in length. This compared to the relatively narrow workspaces of drawing different types of mines and mining operations, hand drills are preferred.

In mining practices for working in confined workspaces and systems development, such as "shrinkage stoping, cut-and-fill, sublevel stoping and variants" are used drill rigs. They have great potential, but still have relatively large dimensions and high value. In their design is used a modular approach, where the dimensions are scaled to large machines without changing their overall design and configuration. We believe that it is not yet sought and used the opportunity to change the configuration of the machines and their entry into the work environment, as was done in the era of implementation of the mining mechanization. At the present stage of development and opportunities of mining and machine building companies, creating a flexible, compact and with sufficient energy, "smart" drilling machines should not be a problem.

To use the advantages of manipulators, carriages and hand drills for working in tight spaces can be created a hybrid machine, based on the combination between mobile cargo transport machine type "Bobcatt" or small excavators and measured column drilling machines with integrated management and relief manual operation. In such combinations it is possible for the drilling module to be relatively independent in operation, maintenance and stabilization of the supporting elements. Transportation and supply of drilling module can be carried out by the transport machine.

Similar machines for breaking and also for rotary drilling and load and haul are widely used in various practices, including mining.

An interesting fact is that while in most areas of the industry, households and communications are constantly monitored developments on the road to miniaturization of technology and various commodities, the mining industry observes a constant maximization of technical devices and their capabilities. However, not always the "bigger" is better solution. We therefore believe that in this respect should be working to create”smart” technologies using flexible and adaptable technical means with which to achieve higher results. This will enable the efficient development of that part of their natural resources, which at this stage have been announced as unconventional or their development is ineffective.

For the development of minerals in complex natural conditions, are most commonly used semi technologies. Their foundation is laid on the basis of drilling and blasting, and the system-geometric solutions in the mining area are based on the possibilities of supply and transport of ore within the area.

Under favorable conditions in small mines, is always used the possibility of gravity delivery of the mining area to a regional or freight loader point. When there is such a possibility, another solution is usually not seek, though there may be another way of shipping and transport with appropriate and productive means.

Where it is not possible to provide such a scheme, there are other solutions in accordance with which the mining and processing conditions can be supplied, delivered and transported to the loader mined point in the workspace.! In complicated situations the preferred delivery scraper in combination with load and haul machines without haulage of the stopes.

Use of haulage equipment in the mining space allows for effective transfer and deployment of mining materials from ore or rock fill. Moreover, these machines increases labor productivity and reduce the time to implement supply-transport operations and volumes. It can be assumed that supply-transport operations in underground mining are determined directly by the natural conditions and indirectly by mining and geometrical parameters of the system. In accordance with them it is assessed how to organize these operations and adopt appropriate means of mechanization. It is believed that the mining and machine-building companies have created acceptable deliver Gear for working in confined conditions to satisfy the requirements of the majority of mines, including the small.

Another important element of extractive technologies is the management of rock pressure. It is connected with the state of the mining massif in mining and seized spaces. The state of stopes can be: caving; secured; filled; empty - supported with pillars. In the big coal mines are most often used by management jacket full caving. It can be seen that in modern coal mines, problems related to the management of rock pressure are determined based on mechanized complexes and anchor fasteners.

In mines with complicated natural conditions and conventional technologies, the problem of managing rock pressure is a serious and with a lack of proper technique their closure is almost predetermined. Information on this process can be derived from the practices in our country, the Balkan region and the world.

For small ore mines, in most cases, healthy - persistent arrays preferred rock pressure control is carried out with natural and artificial pillars and support columns. To ensure sustainable system status cameras - pillars used fasteners. Most preferred fasteners' anchoring is a combination of anchors - plates and wire mesh.

In mining practice are used large quantities of anchors. They vary in type, size, principle of operation and conditions of application. In mining areas the most frequently used are the so-called Friction anchors. They are characterized by simplicity of operation and technology insertion. When fastening with large amounts anchors what is typical of modern mining technologies with mass production, the anchor is combined with tools for drilling anchor holes and placing anchors (rock support drill rigs).

In narrow terms, small-scale mine workings and stopes, most drilling and placement - ramming anchors it with hand drills (hand support drills). In these tight spaces regardless of the use of hand drills problems arise when drilling of longer holes for anchors and ramming themselves anchors. Therefore, in fixing schemes such spaces Avoid betting anchors with a length greater than the largest size of the workspace in the direction of the anchor. To overcome this problem, the use of flexible anchors, which unlike friction have other characteristics, principles of operation and technology insertion.

In the development of reserves in metadepozit in section "Marzyan" mine "Erma River" appears the problem by placing anchors with increased length in limited workspaces - rifled workings and cameras. To overcome this problem has been developed special friction anchor with two diameters for roof support in workings and cameras. Applying this type anchor enable in workings height 2,4 - 2,5 m to be realized anchor grid of 1x1 and 1,25h1,25 m, in length of anchors 1.2 and 2,4 m. Drilling holes and hammering anchors were simple and implemented on the basis of hand drills - mainly telescopic hammer.

Limited capacity of the mines to the funds for the acquisition of modern machinery and equipment almost always requires decision making systems for mining and extraction technologies other than optimal. This fact is too often seen in the small mining companies operating on the edge of efficiency. They have discussed above problems and solve them to always comply with the technical possibilities. The rarely positive examples in this regard, are mostly linked with gold mining mines.

One of the cases making suboptimal decisions was connected with the choice of preferred systems and extraction technology to develop of metadepozit. The preferred option required the acquisition and use of suitable equipment such as drilling machines, drilling equipment, cargo handling equipment for anchoring. Due to limited resources and opportunities, this option was not adopted for implementation.

Mining engineering companies for the sake of their development and survival must respond adequately to the needs of the mines. Altogether they should use modern achievements in the field of engineering and information technology, to produce all the technical means necessary for the logistics of modern mining systems and technologies.

Conventional systems and extraction technologies have many reserves for rational and efficient development, complemented by logistic developed "smart" design solutions and using modern technical means, they will gradually transform itself as an integral part of mining theory and practice of the present and future

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ASPECTS OF EXTRACTION OF BORDER LOCATED RESERVES IN THE BULGARIAN OPEN PIT MINE ASAREL MEDET

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ABSTRACT

In the article are examined variants for combined extraction of mineral resources located along the border of open pit mine.

In the first variant is examined the possibility for a shaft and a crosscut which will be used for underground mining. In the second variant is examined the use of incline shaft with mobile mechanization. The third variant includes using of incline shafts and conveyor transport for extracted ore.

It is presented an expert assessment of the variants for different amounts of extracted ore.

KEYWORDS

Combined extraction, Incline shaft, Conveyor transport

1. INTRODUCTION

There is a tendency for transition from open-pit to underground mining worldwide. More than 100 pits are being developed in open-pit and underground way simultaneously and six of them have annual production output of 10 mln.t (Palabora, Kiruna, etc.) [1].

The combination of these two ways of mining requires smooth transition taking into consideration the presence of border located reserves and the value of the ore in them. [2], [3]

2. METHODOLOGY OF THE STUDY

The methodology offers expert models for opening up and preparation of the main and border located reserves which require the following characteristics for the pit's construction for opencast and underground mining:

1. Driving of vertical shafts;
2. Driving of spiral shafts;
3. Driving of inclined shaft with belt conveyor;
4. Forming a barrier pillar;
5. Selection of mechanization for mining and transportation;

6. Systems for development of main and border located reserves;
7. Categorization of the reserves according to their value.

3. VARIANTS FOR COMBINED MINING. APPLICATION.

3.1. First variant

The main reserves are with average value and the border located ones are with high value (more than 3 g/t Au).

The opening up of the border located reserves is with vertical skip shaft1, equipped with a skip 30 t, auxiliary ventilation shaft with cage winding 9. Crosscut tunnels 2 and 10 are driven from the two shafts to the ore body and levels 3 are driven from them. Ore chutes 4 are driven between the crosscut tunnels and crusher transfer stations 5 are built under them.

The opening up of the main 9 (under-quarry) reserves is done by driving a spiral shaft 11 with cross-section 25-30 m^2 for the operation of underground dumpers with a load of 80 t. (Sandvik – TH 680)

The other opening is a vertical shaft 13 with two-floor cage for wagons 2,7 m^3, as well as crosscut tunnels 2.

The two types of reserves are developed by horizon mining and is secured by driving of levels and rises.

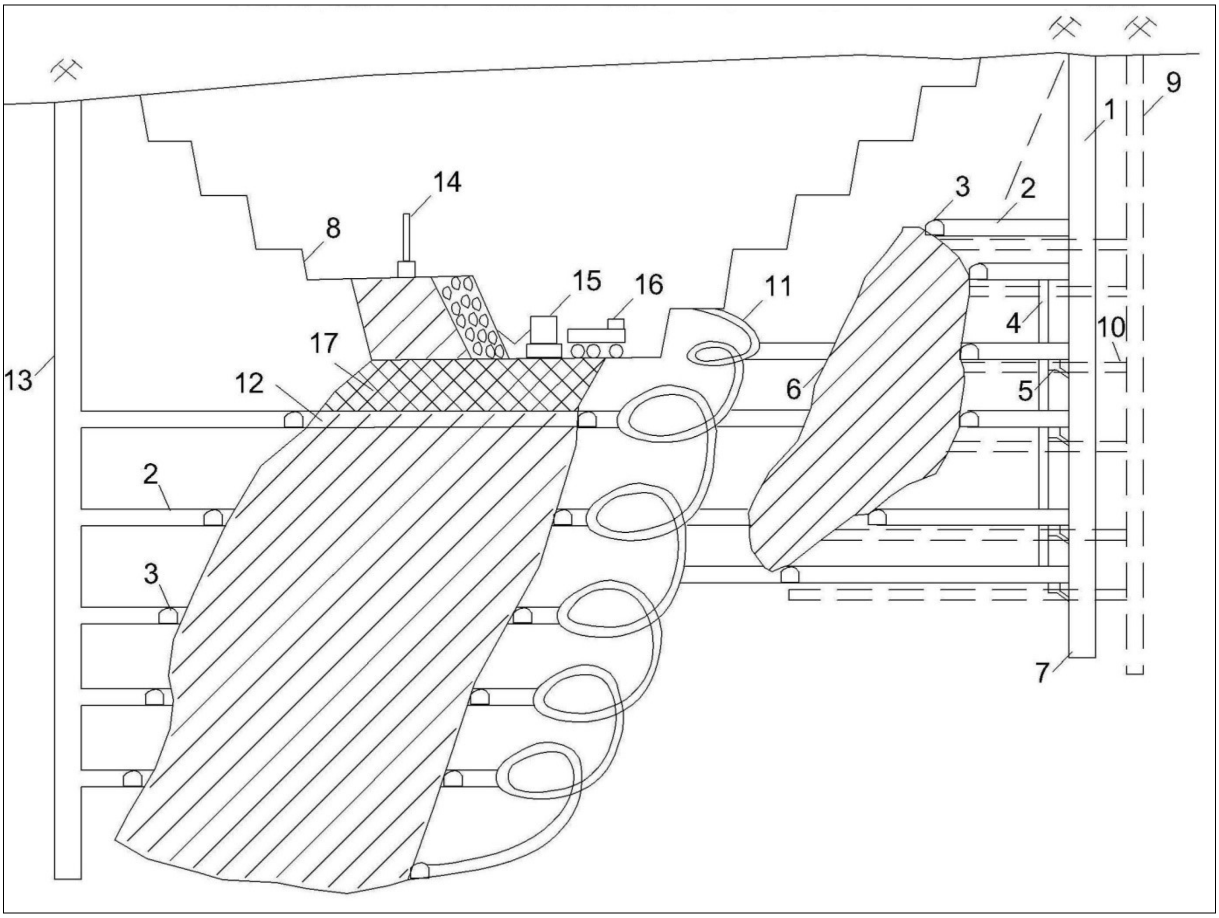

Figure 1: Variant I – Vertical shaft, spiral shaft and crosscut tunnels.

The production output of the winding and the transportation of the ore is as follows:

- Skip winding (shaft 1) – 650 000 t/year;
- Cage winding (shaft 13) – 500 000 t/year;
- Spiral shaft 11 – 1 448 000 t/year.

If this way of opening up and development is applied, the mine-pit output is 2 598 000 t/year. The opencast mining is 7 500 000 t/year and the overall is 10 098 000 t/year.

The systems of development offered for the different types of reserves are as follows:

- For the border located reserves with high value – sublevel caving back stoping with area frontal drawing; chamber and pillar with filling;
- For under-quarry reserves – block caving.

The height of the horizons is from 50 to 80 m. The diameters of the blast hole are respectively from 64 to 89 mm for the first two systems and from 105 to 110 mm for the block caving.

3.2. Second variant

In this variant the reserves are with average value (border located and under-quarry reserves).

The opening up is made by driving a spiral shaft 1 for the operation of 80-tonnes underground dumpers.

On the other side of the deposit, a vertical skip shaft 13 is driven equipped with a skip 60 t.

Crosscut tunnels 3 and levels 4 are driven from the vertical and spiral shafts. Ore chutes are driven between the crosscuts and they are equipped with shaker chutes for loading the ore onto the dumpers.

Block caving for the main and border located reserves is proposed for this variant.

The diameter of the blast holes is from 105 to 130mm.

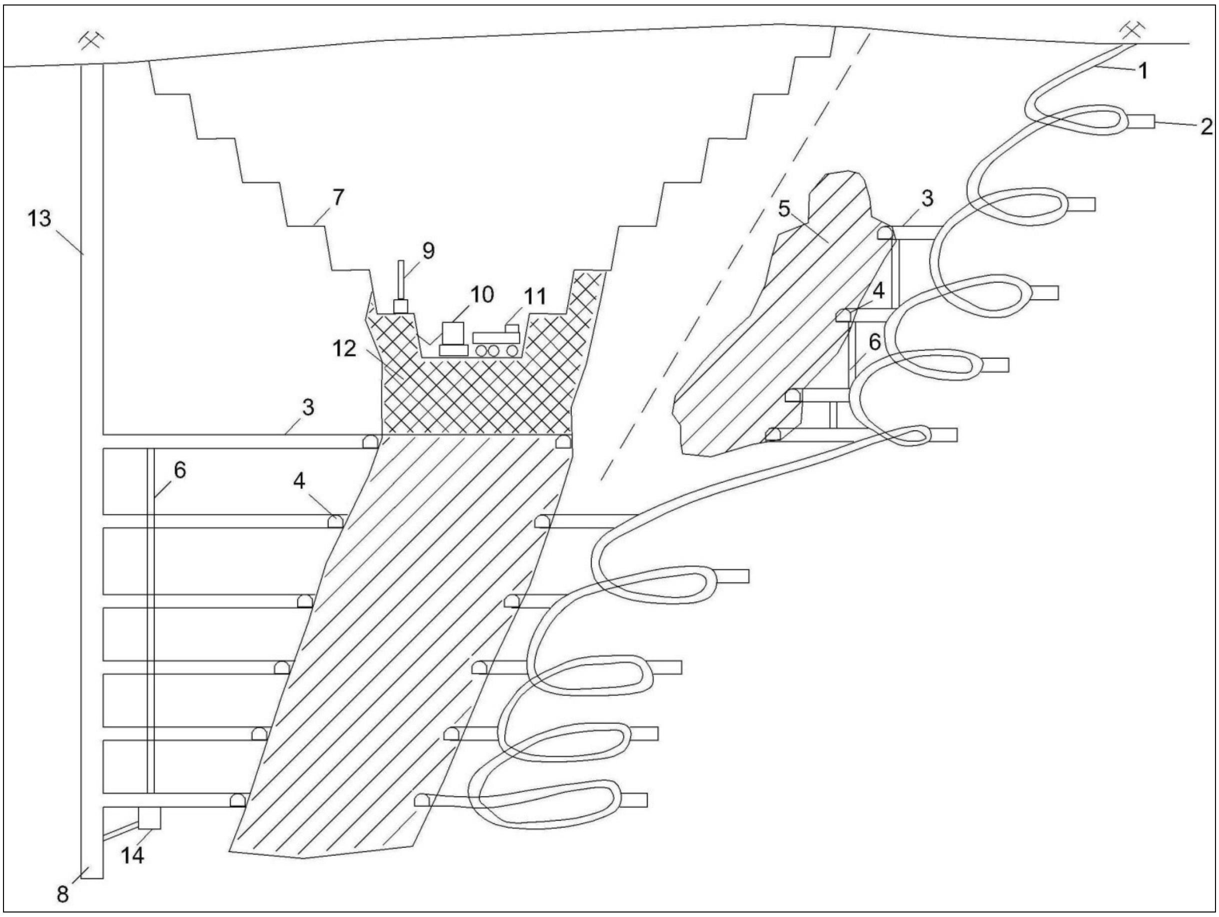

Figure 2: Variant II – Spiral shaft for self-propelled mining equipment and vertical shaft

The annual mine-pit output of the winding with 60 t skip is 1 303 000 t/year, for the dumpers' transport it is 4 633 000 t/year and overall for the underground pit it is 5 936 000 t/year.

The opencast mining is 5 000 000 t/year or the total for the two ways of mining is 10 936 000 t/year.

3.3. Third variant

In this variant the under-quarry reserves are with average value and the border located ones are with high value.

The opening up of the border located reserves is with inclined shaft with 8 arms equipped with belt conveyor.

In depth the under-quarry reserves are opened up with a spiral shaft 20 for the operation of 80-tonnes dumpers.

Vertical skip shaft 21 equipped with skip 60 t is driven in the rocks' roof.

Crosscut tunnels 9 connected to ore chute 10 and crusher transfer stations 22 are driven from the spiral and vertical shafts.

Such a section is also organized above the belt conveyor for the feeding of ore which has undergone coarse crushing. This stabilizes the ore flow in terms of size and decreases the fluctuations in the contents of the useful components Cu and Au.

The output of the skip shaft is 1 728 000 t/year, of the dumpers - 2 896 000 t/year, of the belt conveyor – 4 500 000 t/year.

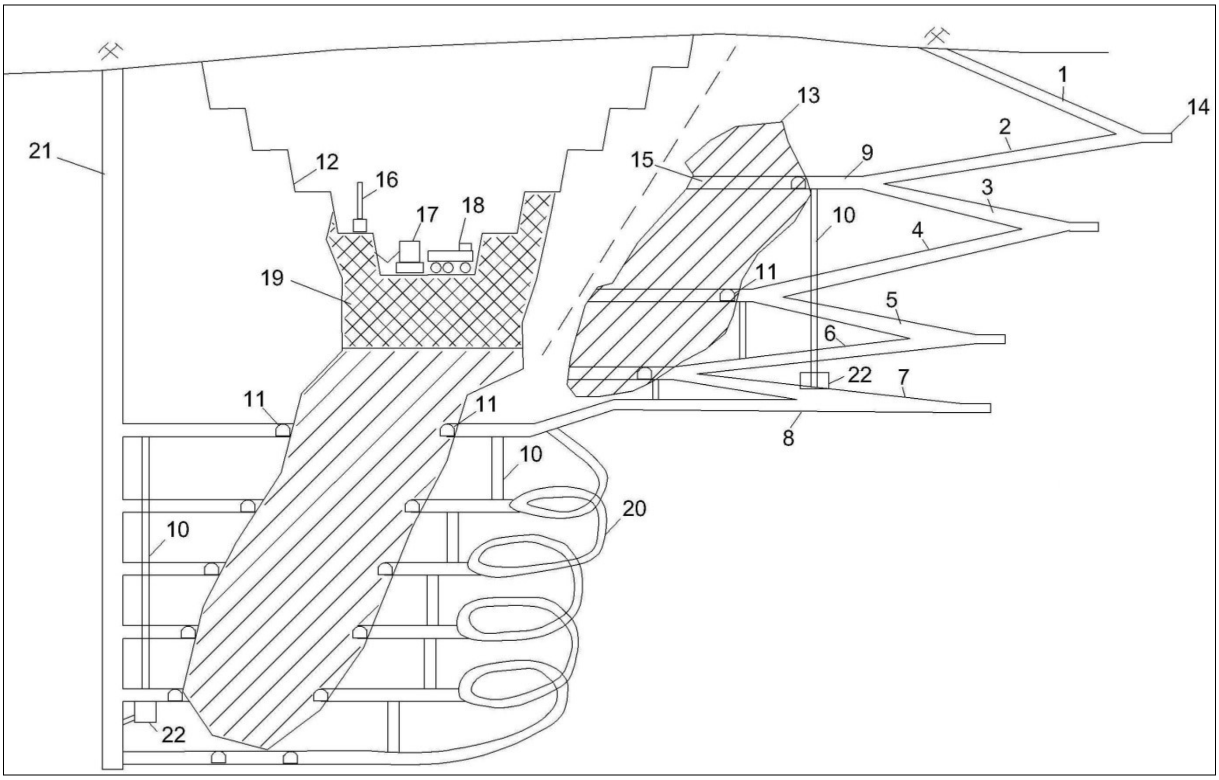

Figure 3: Variant III – Belt conveyor

The underground mine-pit output is 6 228 000 t/year, the opencast output is 5 000 000 t/year or 11 228 000 t/year in total.

Sublevel caving back stoping with area frontal drawing is proposed for the mining of the border located reserves.

The mining of the main (under-quarry) reserves is done via block caving.

4. CONCLUSION

The development of ore mining worldwide is invariably related to the transition from opencast to underground mining.

The equipment for drilling and loading of the boreholes with diameters of more 100 mm, front-end loaders with a volume of the bucket from 5 to 7 m^3, underground dumpers with load of 80 t., etc. are developed on this basis.

Taking into account these achievements and on the basis of the above-mentioned three variants, the authors propose for the particular mine the detailed design and implementation of the third variant. It is a combination of a cyclic, cyclic-flow and flow mining.

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THE NEW ASPECTS DRILLING AND BOLTING IN MINING INDUSTRY

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ABSTRACT

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KEYWORDS

Drilling, Bolting, Copper

1. INTRODUCTION

Currently the exploitation of copper ores is carried out in three Mining Plants: O/ZG "Lubin", O/ZG "Rudna" and O/ZG "Polkowice-Sieroszowice". In each of the selected mining areas, the quantity of output of ores is and will be different for each of these mines in the future years. An analysis of the state of deposits leads to a necessity to modify current types, models and structures of workings within allocated mining areas of active mines. A modification of structures for deposit availability should be aimed at creating additional underground transport arteries, linking existing transport ways, which would lead to flexibility and easiness in transferring ores to the main drawing shafts in the current mining plants.

The exploitation of deposits of copper ores in the Legnicko-Glogowski Copper Region is getting close to the boundaries of "Rudna" and "Sieroszowice" mining regions. After the year 2000 all three mines of KGHM faced new challenges and they now practically respond to it. A currently available and tentatively studied deposit lies in thin deposits of 1.0-2.0 m or even thinner at greater and greater depths. Current exploitation levels are already placed over 1000 m below the surface. Concept and technical preparations have been started, aimed at entering a deposit at a depth of 1500 m. It is a perspective of just a few years and it is supposed to enable exploitation of copper ores and accompanying minerals for the future 40-60 years.

So, a natural direction of development of exploitation carried out by KGHM Polska Miedz S.A. is to exploit deposits of copper ores lying below 1200 m in the mining area of "Glogow Gleboki-Przemyslowy". The deposit in this area is a continuation of the deposit lying in the existing mining regions; it lies up to 1400 m and is characterized by mining-geological conditions which are similar to those in the KGHM Polska Miedz S.A.'s mines. Study and design works show that the most efficient investment solution as for availability and management of Glogow Gleboki-Przemyslowy deposit is a model of a combined mine, basing on the infrastructure of the existing mines of Polkowice-Sieroszowice and Rudna. This model ensures a reasonable management of the deposit and an optimal use of the production potential, as well as a use of basic shaft objects, arterial routes and ventilation roads. Figure 1 presents size and shape of mining regions allocated to Mining Plants and regions that perspective in LGOM (Legnicko-Glogowski Copper Region). The mining region of Glogow Gleboki-Przemyslowy is marked with a red line, whereas the perspective areas of "Bytom Odrzanski", "Glogow" and "Retkow" with a green line (red line: mining region of Glogow Gleboki-Przemyslowy; green line: perspective areas of "Bytom Odrzanski", "Glogow" and "Retkow)

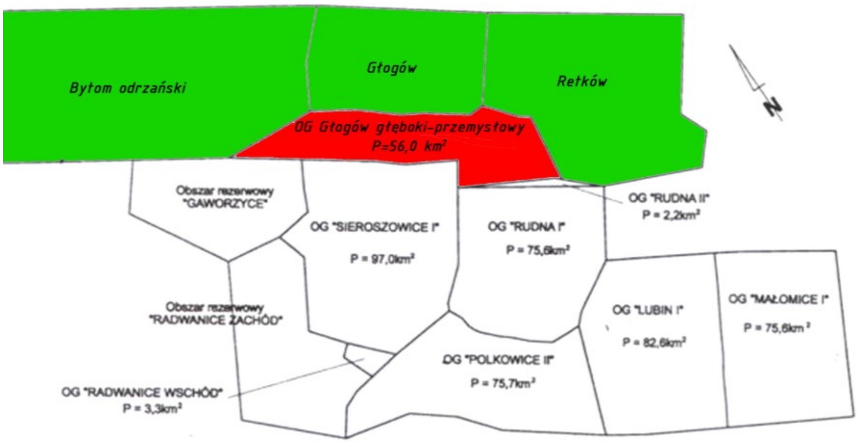


Figure 1: Current and perspective mining regions in the area of LGOM (as of 2006)

According to a current geological recognition, in the considered area there are deposits of resources of over 300 million tons of ores including almost 7 million tons of pure copper and over 24000 tons of pure silver. Present market prices of these metals and the forecast of their development let us make investment decisions which guarantee that the exploitation in the conditions of deep deposits will be profitable. Experience shows that the technological processes of deposit mining will be similar to the current ones, yet they will be carried out in more difficult mining-geological conditions. It concerns processes connected with the exploitation of these deposits and the protection of roofs in the workings, in particular. We are presenting below a solution of a modern roof bolter which has been designed by AGH Cracow and Mine Master, Wilkow, and which should ensure safe and efficient work in this region during the exploitation of copper ores.

1.1 Systems of exploitation of deposits of thickness up to 3.5 m and a suggested technology of roof protection

A choice of a system of deposit exploitation in ore mines depends on many factors. One of the most important factors is to adapt the exploitation port to the changeable parameters of deposits, especially thickness, which is closely connected with an application of appropriate mining machinery. An appropriately selected system should also ensure maximum work safety (crump hazard) and an achievement of the highest efficiency of production with the slightest exploitation losses. Experience has helped to work out and introduce room and pillar systems with a continuous liquidation of workings. In these systems a deposit is exploited in an area simultaneously, using a system of many chambers having a width of 5-7 m. The chambers are driven parallely (the so called stripes) and perpendicularly to the front line. Between pillars, other pillars are erected and their dimensions are adapted to the local mining-geological conditions. Behind the front line, there are a few rows of pillars and stripes.

On the basis of an analysis of mining-geological conditions of Glogow Gleboki deposit and the exploitation systems used in the Legnicko-Glogowski Copper Region, two pillar systems have been accepted for region of Glogow Gleboki-Przemyslowy: one with susceptibility of the deposit and additional protection of the roof, whereas the other with a deflection of the roof and an operating closing pillar. The first system, shown in fig. 2, is aimed at exploiting deposits of a bed type with the following characteristics:

- deposit thickness to 7 m,
- dip to 8°,
- roof rocks enabling application of bolt support,

It requires contouring the area of exploitation with workings driven in at least a bifilar system, which need to be connected with active workings in the mine. If the thickness of the deposit exceeds 5 meters, workings are driven in the deposit bed below the roof.

In the other system which is aimed at deposits of similar conditions, it is not necessary to contour the deposit fully by means of preparatory workings. A launch of exploitation is conditioned by a small range of preparatory works only, i.e., bundles of workings from which an exploitation front will be launched. If the thickness of deposit exceeds 4.5 m, workings are driven in the deposit bed below the roof. Contour workings must be connected with active workings in a mine.

For preparatory, first driving and exploitation workings, on the basis of an analysis of applied roof protection methods in the mines of the Legnicko-Glogowski Copper Region, a bolting technology was suggested for the exploitation of copper ores in the Glogow Gleboki deposit. Roof conditions that were accepted were similar to those occurring at the depth of over 1000 m in Polkowice-Sieroszowice mine. Thickness of the extracted deposit ranged from 2.5-5 m. The dimensions of the chamber for the accepted room and pillar system were as follows: width 6-7 m, height 2-3 m, length 8-12 m. Whereas, because of the climatic conditions existing at those depths, it was assumed that the height of dog headings cutting the deposit would be 4 m. The basic bolting net was 1x1 and the alternative one was 1.5x1.5. Bolts were installed in rows, 6 pieces in each. The minimal depth of bolt holes was 1.6 m and their diameter, depending on the kind of installed bolt, 25.4 or 38 mm. Figure 3 shows a diagram of a network of workings for the assumed conditions along with the suggested bolting net and longitudinal and cross sections of a dog heading. Below, we are presenting the order of installing particular bolts for the presented bolting net and a 4-meter-high working

For installing the first bolt, a roof bolter is placed and stabilized in the axis of working. This placement of the machine is sufficient for bolting the whole row of bolts (6 pieces). If we want to mount bolts in one line, in accordance with the 1x1 bolting net, we need to lift the jib by 45 degrees. The first bolt should be installed near the axis of a working with the jib being pulled out, as it is shown in fig. 4. Then, we determine the position of neighboring and outermost side wall bolts, which are installed no further than 1 m from the side wall and at the angle of 10 degrees. Because all of the bolts must be installed in a line, creating the so called 'bolting net', we must pull out the jib maximally and regulate the position of a bolt by the angle at which the jib is lifted and turned.

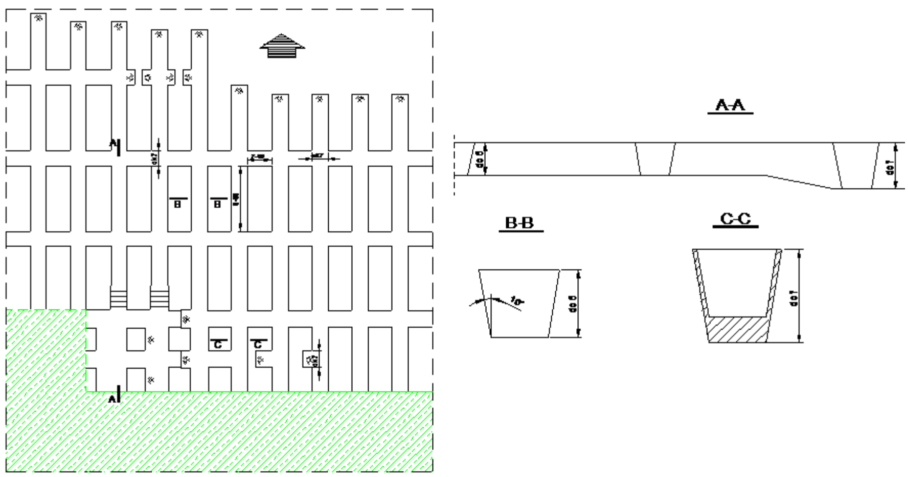


Figure 2: Diagram of exploitation by the room and pillar system with susceptibility of deposit and additional roof protection

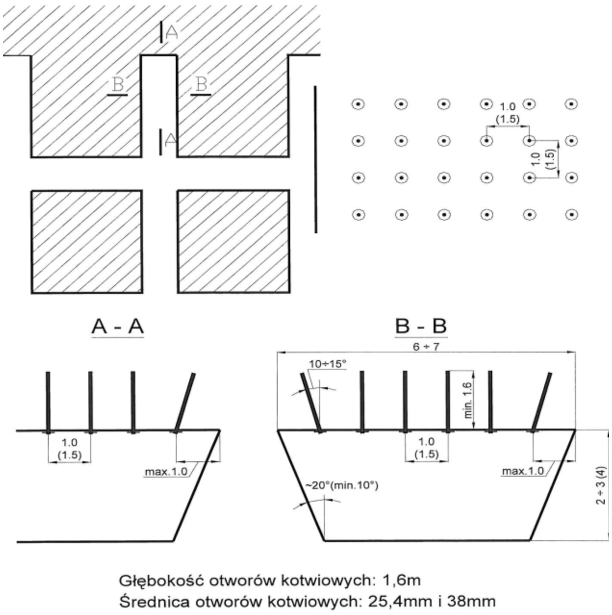
With the presently used solutions of roof bolters in the Legnicko-Glogowski Copper Region, applying the above presented technology is difficult or even impossible. Thus, it was necessary to work out a structure of a roof bolter with an automatic drilling-bolting turret, which enables to carry out such works safely and efficiently.

1.2 Assumptions and guidelines for the new solution of a roof bolter

An analysis of work and parameters of roof bolters operating in the KGHM Mining Plants and the suggested technology of bolting for exploitation conditions in the region of Glogow Gleboki were the basis for a technical development of a new solution of a roof bolter with an automatic bolting turret. These assumptions are the basis for a preliminary design of a self-propelled roof bolter with an automatic turret for medium and high deposits.

For a self-propelled roof bolter with an automatic bolting turret, the following assumptions (connected with geometric, structural, kinematic, organizational and technical parameters) were made:

- Transport height of the whole machine cannot exceed 1.8 m
- Maximum width of the whole machine cannot exceed 2.4 m,
- Length of the machine shouldn't exceed 11500 mm,
- Weight of the machine shouldn't exceed 18000 kg,
- Speed of the machine: gear I - 4 km/ h , gear II - 10 km/h,
- Ability to go up a hill – longitudinal slope 12°, cross slope 4°,
- Ability to go along mining workings of minimal width 4.5m, intersecting at an angle of 90°,
- Machine must be operated by one operator,
- Protective construction of the driver's cabin must meet strength requirements against hits from the roof (energy 60 kJ) in accordance with requirements for constructions protecting the driver, standard: PN/G- 59001,
- the driver's cabin must be air-conditioned and equipped with a system that cools down the air while that machine is moving and during the operation of the electric engine,



Depth of bolt holes: 1.6 m

Diameter of bolt holes: 25.4 and 38 mm

Figure 3: Diagram of a working network along with a suggested bolting net and longitudinal and cross sections of a dog heading

- Application of a hydrodynamic power transmission system with a combustion system in accordance with the COM III standard, and the driving axles must be equipped with internal dynamic brakes, an emergency brake and a parking brake,
- Construction of the whole machine and all the elements and subassemblies used while constructing the machine should meet all the standards so that the producer would obtain a certificate of conformity, WE type, issued by the independent Certification Institution,
- There should be an ergonomic post with an isolated desk for bolting during the operation of the electric engine and a different post for driving it when the combustion engine is in operation

Taking into account the bolting technology and the requirements for the operation mode of the automatic bolting turret, the following technical assumptions (which the working system, i.e., jib and drilling –bolting turret should meet) were made:

- Possibility of installing expansion and glue-in bolts in workings whose height ranges from 2.5 do 4.0 m,
- Diameter of the drilled holes Ø38mm,
- Length of bolts being installed in a working 1.6 m and 1.8 m,
- Application of a hydraulic rotary driller (with a system of suction removal of drill cuttings through the drilling rod and the driller) for drilling holes in rocks whose thickness ranges from 80-120 MPa,
- Height of the bolting turret during transport shouldn't exceed 2100 mm,
- The bolt magazine in the turret must be capable of holding up to 6 bolts
- Working system should be capable of installing one row of bolts according to the bolting diagram in fig. 3,
- Operation of the bolting turret is automatic, but there must be a possibility of manual operation from the driver's cabin,
- Assumed duration of a complete cycle of installment of an expansion bolt (1.6 m) can't exceed 3 minutes and a glue-in bolt 3.5 minutes.

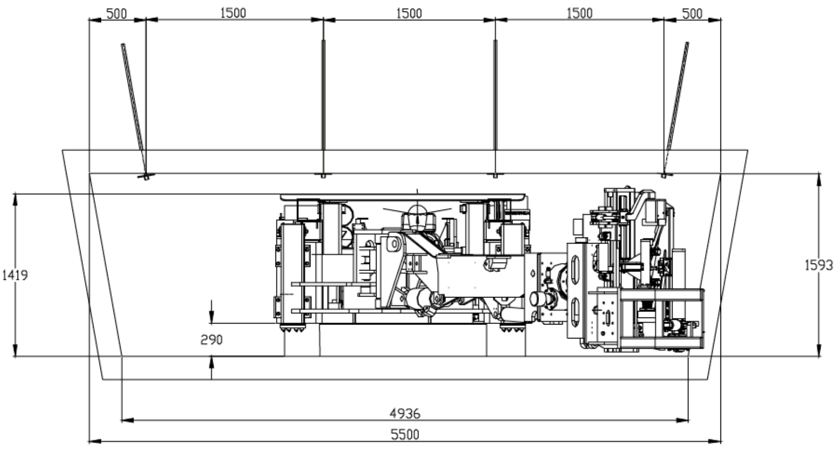


Figure 4: Diagram of installing an exemplary bolt

Taking into account the above presented requirements that should be met during the preliminary design of a new solution of a roof bolter on a wheel chassis, the following assumptions were suggested. Three basic subassemblies were distinguished:

- Chassis with power transmission system, turning system and brake system,
- Bodywork with an air-conditioned driver's cabin and with a hydraulic working system and electric system,
- Complete working system consisting of a telescopic extension arm, a drilling-bolting automatic turret and a system of suction removal of drill cuttings.

1.3 Preliminary design of a new structural solution of a roof bolter

On the basis of the accepted assumptions and guidelines, a preliminary design of a self-propelled roof bolter was made. It had an automatic bolting turret and an air-conditioned driver's cabin. While creating the design, design engineers used experience that had been acquired while designing similar constructions of self-propelled vehicles and they tried to adapt as many ready and reliable elements and subassemblies as possible.

The preliminary design of the self-propelled roof bolter on a wheel chassis with an automatic bolting turret was worked out as a module construction. It consists of a chassis, bodywork, and a working system.

In accordance with the accepted assumptions and guidelines, the designers planned an application of dry rotary drilling with the system of suction removal of drill cuttings through the drilling rod and the driller. The inner suction removal of drill cuttings keeps the area around the operator clean. This system draws contaminations through the rod and the driller for preliminary cleaning. The final filter stops the smallest elements of contamination. It requires applying a reliable solution of a rotary boring head, Fletcher, with the system of suction removal of drill cuttings. It consists of a hydraulic rotary driller, Fletcher, and a vacuum pump, Roots, which is driven hydraulically so as to remove drill cuttings. This solution of the head is supposed to drill holes ø 25 – 38 mm in diameter and to enable installing glue-in 1.8-meter-long bolts. Thus, the bolting turret should be characterized by a feed stroke of at least 1900 mm.

The turret along with the jib is supposed to be able to install 6 bolts in one row (every 1.5 m, at a distance of 0.5 m from the sidewall) from one position, without moving it. The bolt magazine in the turret must be capable of holding at least 8 bolts. Whereas the jib should be able to lift the turret by - 5° / + 21° in relation to the level of the floor and to turn it by 35° to the left and 35° to the right. In addition, the jib should have a capability to extend forwards up to 1000 mm. So as to ensure hole drilling and bolt installing in accordance with the approved technology, the bolting turret should also be capable of inclination to the left and right by 90° so as to ensure sidewall bolting, and by 10° to the front and back so as to ensure an appropriate inclination of the axis of the bolt holes.

So as to obtain the above presented work parameters, it was suggested that the already reliable elements from the automatic drilling-bolting turret Fletcher should be used in the design process of a new solution of a working system. Whereas the structural solution of the jib was worked out as a new one, on the basis of experience that had been acquired while constructing similar solutions in other machines of this type.

During the preliminary design, the design engineers used advanced software packages such as ProEngineer and AutoDesk Inventor. These packages allow us to create spatial models of the designed complexes and machinery and combine them into one piece. At the same time they allow us to make flat drawings and determine overall dimensions of machines and subassemblies and their weight.

A preliminary design of a working system in a spatial version that was worked out with the use of the above mentioned packages is presented in fig. 5. A simulation let the designers claim that the assumed parameters of the jib's operation would be possible to be met, in terms of the value of extension, lifting and turning.

Next, the design engineers created a preliminary design of the chassis and the bodywork of a new solution of a roof bolter for medium layers. It was assumed in accordance with the approved guidelines and assumptions that the construction of the chassis would be jointed and would be divided into two subassemblies, i.e., a tractor and a working platform. The elements of the bodywork will be mounted on these subassemblies, creating an integral whole. In accordance with the approved assumptions and guidelines, the minimal height of the vehicle while it moves is 1.72 m. The operator's post will be placed in a closed air-conditioned cabin placed on the front frame, on the working platform.

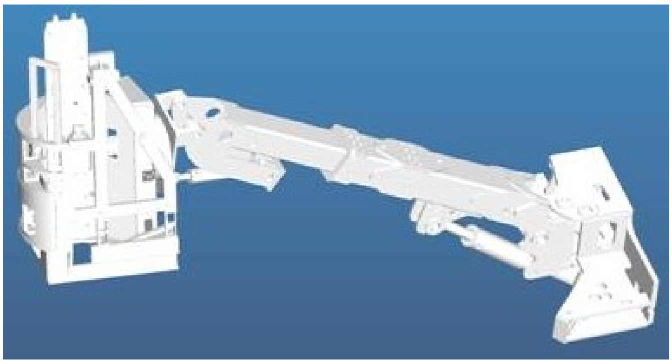


Figure 5: Spatial model of the preliminary design of a working system of a new solution of a roof bolter for medium layers

The chassis will be equipped with a power transmission system Power Shift (axle, torque converter, gearbox made by Clark) enabling four-wheel drive. The transmission system will be powered by a diesel engine BF4M 2012C made by Deutz. The transmission system will be operated from the operator’s control desk by mean of the Orbitrol system with a steering wheel. The chassis will be equipped with principal multi-plate wet brakes that are operated hydraulically per all four wheels and emergency and parking brakes – spring ones, released hydraulically with a system of emergency unblocking. On the tractor there will also be elements of the hydraulic system such as a hydraulic multi-piston pump Oilgear (25 MPa), oil tank and an electric engine (36 KW). Additionally, the tractor will be equipped with a reel of the supply cable, SMC type, capacity 80 m. The chassis must be equipped with 4 pieces of hydraulic floor outriggers, so as to ensure stability of the machine during operation.

So as to obtain the above mentioned parameters of operation of the chassis and bodywork assembly, it was suggested that the already reliable solutions, subassemblies and elements used while constructing similar solutions in other machines of this type should be used in the design process. The preliminary designs of the tractor and the working platform were created separately.

Figure 6 shows the preliminary design of the tractor in a spatial version that was based on the above mentioned assumptions and guidelines, whereas figure 7 shows the design of the working system in a spatial version.

Using the preliminary designs of the tractor and the working platform, designers created a drawing of the chassis and the bodywork of the new solution of a roof bolter for medium layers, which is presented in fig. 8. This drawing also shows the basic overall dimensions.

On the basis of the drawings and spatial models of a working platform, tractor and a working platform, the designers worked out a preliminary design of a new solution of a roof bolter for medium layers. It is shown in fig. 9, whereas figure 10 shows an aerial view with the basic overall dimensions.

Similarly to the design process of a bolting turret with a jib, the design engineers also used the experience of Mine Master and Fletcher while working out the system for supplying and steering the turret. On the basis of an analysis, the engineers decided that the hydraulic system for transmission, steering the jib and the bolting turret with the drilling head will be powered from a two-section, multi-piston pump, working in a load-sensing system, which ensures energy-saving and precise supply for the hydraulic system.

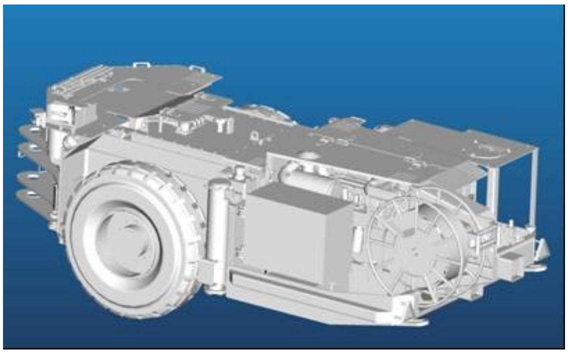


Figure 6: Spatial model of a preliminary design of a tractor of a new solution of a roof bolter for medium layers. A view from the back, left hand side

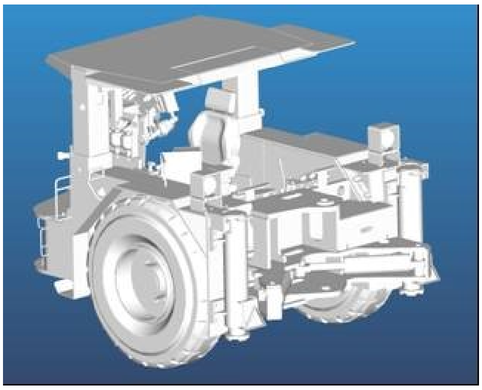


Figure 7: Spatial model of a preliminary design of a working platform of a new solution of a roof bolter for medium layers. A view from the front of the driver's cabin

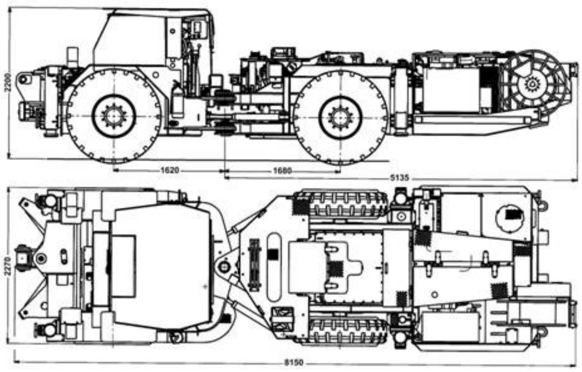


Figure 8: Preliminary design of a chassis and bodywork a new solution of a roof bolter for medium layers, overall dimensions

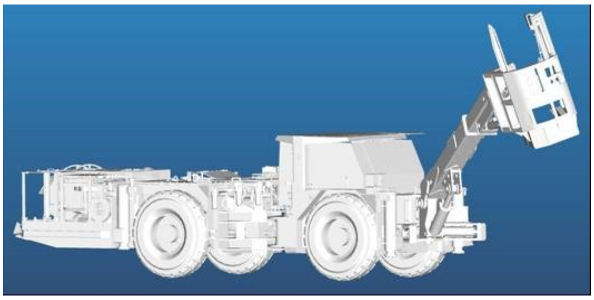


Figure 9: Spatial model of a preliminary design of a new solution of a roof bolter for medium layers –side view

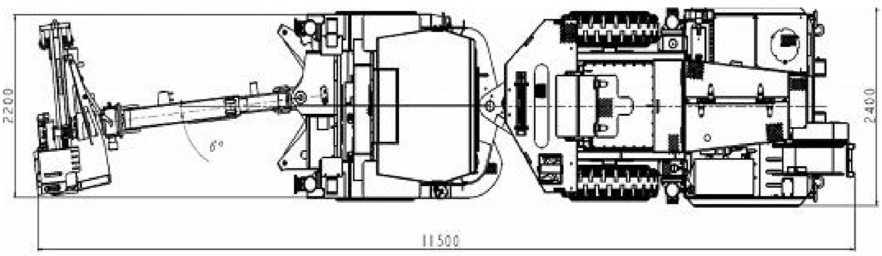


Figure 10: Model of the designed solution of a roof bolter with the values of its maximum width and length, with the jib and the turret being turned by 6°

For a precise control of the jib movements, the engineers used a proportional (5), sectional valve made by Hawe, installed near the operator's control desk. For a control of the drilling head, head feed, centralizer movements, arm of the feeder and the floor support, the engineers used a 6-section proportional valve made by Hawe. A control of the directional valve is electric and mechanical, which enables a quick diagnosis of the hydraulic system and the service reaction.

For a control of the directional valves of the jib, the rotation and the feed, the engineers used two biaxial hydraulically and electrically controlled joysticks, which were ergonomically installed in the driver's cabin on the control desk. The position of the joysticks which are used for controlling the jib, rotations and the feed is shown in fig. 11

Within the design of the control system of the automatic turret for deposits of medium thickness and on the basis of an analysis of products of the JHF Fletcher Company, the designers selected control components which are fully protected from mechanical damage resulting from falls in the mine face.

The electronic control components include three separately connected computer modules, i.e., superior module, which has a display, monitoring the whole cycle of automatic bolting and allowing the operator to carry out the whole cycle manually by means of appropriate buttons, and two subordinate modules to which all controls from the directional valves and electrical bunches from all sensors on the turret are connected. The signals are then converted and displayed on the screen in the superior unit.

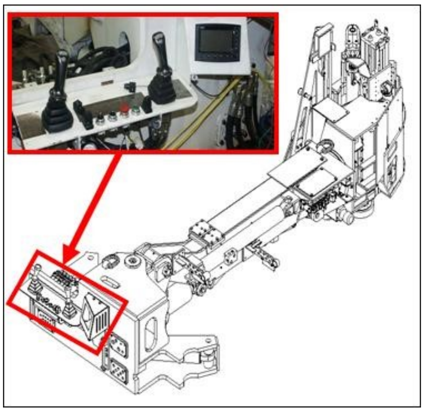


Figure 11: Position of joysticks for controlling the jib, rotations and the feed on the control desk in the operator's cabin

It was assumed that the control system would carry out a fully automatic cycle of bolting. An automatic cycle of bolting is based on drilling a hole and installing a mechanical bolt or a glue-in one without the operator's intervention, however, the insertion of the glue substances is carried out from the operator's cabin. If the course of the cycle is correct, the operator just controls the course of bolting. The automatic cycle of bolting is carried out by taking a sequence of steps. Taking a step is based on achieving a specified objective by a given component. The specified objective can be time, position or pressure, controlled by the automatic system of control. All of the steps are grouped into over 20 states, which must be carried out if we want to complete the automatic cycle of bolting. The automatic cycle of bolting is carried out step by step, and each subsequent step can be started once the previous one is completed. While a cycle is being carried out, the present state and its short description are displayed on the screen. If there is a problem that hinders a cycle during a particular state, we can compare the description of the current state with the course of the cycle so as to quickly find the cause of failure. During the automatic cycle of bolting, we can see a screen of this process. The screen displays information that is important for the operator – it shows the operation of the turret and current operation parameters. It also shows the depth and drilling durations as well as the levels of measurement signals from the sensors. The screen also informs the operator about each event occurring while bolting. The colour of the icons changes during the automatic cycle of drilling and it doesn't change during the manual control.

During the design phase, there were numerous simulations and analyses whose aim was to check if the main subassemblies worked correctly. In addition, there was a strength analysis and possible collision spots while driving and bolting were determined. At first, there was an analysis of strength of the construction of the telescopic jib which is exposed to dynamic and static pressures. The analysis was carried out by the finite-element method, and in terms of dynamics it included a case in which the machine ran over a 75 mm-high obstacle at a maximum speed of 12 km/h. There was also a static analysis of strength for a case which was based on determination of the effort of a construction which was weighed down by the maximum force of feed. Both during the dynamic and static simulations of operation of the jib in a transport position, in a pulled-out position with a feed force of 20kN which was perpendicular to the axis of the jib and in a pulled-out position with the jib being lifted by 40° with a feed force of 20kN at the angle of 40° in relation to the jib axis, the engineers found no cases of exceeding the limit of plasticity of the elements of the jib for its assumed material, i.e., steel S355J2G3. For defined conditions of load, the construction of the jib meets the requirements concerning immediate strength in terms of dynamics and statics.

Using the design of the vehicle for automatic bolting, the design of the bolting turret along with the jib as well as the control system, engineers carried out spatial simulations of the machine operation. They were worked out for the following positions of the roof bolter:

- simulation of kinematics of the working system with an automatic turret in the mine face during the complete cycle of installation of bolts,
- simulation of rides of the machine in underground dog headings,
- simulation of field of vision of the operator from an air-conditioned cabin during rides and during operation in the mine face,
- simulation of layout of the operator's control desk for the drilling process – bolting in terms of ergonomics of the operator's work.

The simulation of the kinematics of the working system with the automatic turret in the mine face during a complete cycle of bolt installation was carried out for the most unfavorable position of the machine, in a 4000 mm-high working whose width below the roof was 7000 mm. There were no difficulties while installing any bolt in a row, especially while installing bolts near the sidewall. The result of this simulation is shown in fig. 12

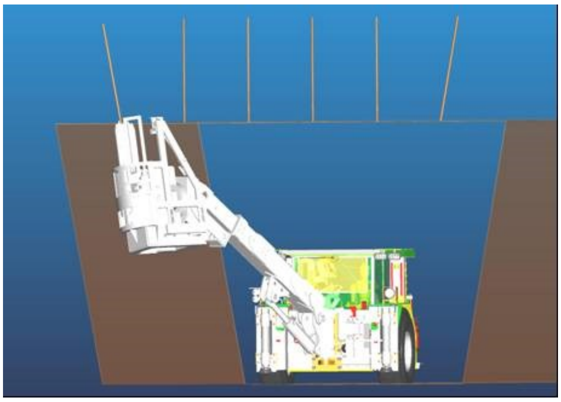


Figure 12: Result of a simulation of an installation of bolts near the right sidewall

A simulation of the machine's rides in underground 2500 mm-high dog headings for a case with an elevated roof of the operator's cabin also showed no cases of collisions. The machine is capable of going through almost every dog heading that would be exploited in 'Glogow Gleboki'. The turning system lets the machine turn at an angle of 90° in the case of 3800 mm-wide workings. The result of this simulation is presented in fig. 13.

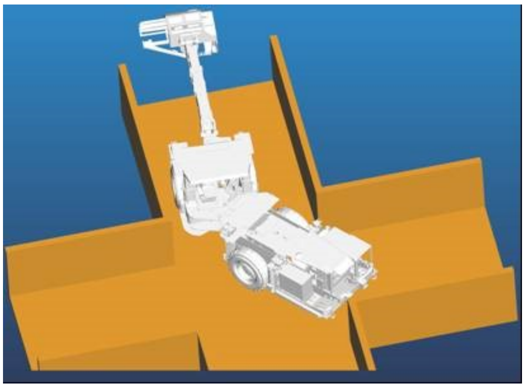


Figure 13: Simulation of a ride in dog headings intersecting at an angle of 90º without a need to cut off the corners

Whereas after a simulation of the field of vision from the operator's cabin during rides and during operation in the mine face, it was found that the operator has a good vision in each case of drilling and bolting. The operator has also an opportunity to follow the process of bolt installment, which gives him a full control of the bolting process.

The result of the simulation of the field of comfort in the operator's cabin during the drilling and bolting processes as well as during rides also turned out to be positive, i.e., the operator has a good visibility and an easy access to all the elements of the control system. The result of this simulation during the operator's work is presented in fig. 14

Figure 14: Result of a simulation of the operator's access to the control desk during the drilling-bolting processes in terms of ergonomics of the operator's work during operation in the mine face

1.4 Summary

As a result of approved guidelines and assumptions and a created preliminary design of a self-propelled roof bolter on a wheel chassis with an automatic turret for medium layers, the design engineers achieved a structural solution of a machine which will be characterized by the following structural and technical parameters:

1. Total mass of the machine 18000kg
2. Transport height 1800mm
3. Total length of the machine equipped with a bolting turret 11400mm
4. Width of workings in which the machine can ride 4500mm
5. Width of the machine 2200mm
6. Turning radius of the machine: inner 3500mm, outer 5900mm
7. Drive axel base 3100 mm
8. Inclination angle of self aligning axle 10°

9. Approach angle of the tractor 12°
10. Approach angle of the front platform 24°
11. Ground clearance 325mm
12. Turning angle of chassis 42°
13. Turning angle of the jib during a ride 15°
14. Turning angle of the jib during operation 42°
15. Mass of the jib 2500kg
16. Mass of the automatic turret 2000kg
17. Height of the turret being pulled back 2082 mm
18. Capacity of the bolt magazine 8 pieces

We can estimate that the new solution of a self-propelled roof bolter should help to achieve the following organizational and kinematic parameters:

1. Possibility to install 6 bolts in one row every 1.5 m, distance from the sidewall 0,5m,
2. Diameter of drilled holes Ø38mm,
3. Drilling Speed no lower than 1m/min,
4. Duration of a complete cycle of installment of an expansion 1.6m-long bolt no longer than 3 minutes,
5. Duration of a complete cycle of installment of a glue-in 1.6m-long bolt no longer than 3.4 minutes,
6. Transport speed: maximum 13 km/h, 1st gear 4 km/h, 2nd gear 10 km/h

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ASECAREA FORMAŢIUNILOR ACVIFERE DIN CÂMPURILE DE EXPLOATARE SUBTERANĂ ŞI LA ZI A ZĂCĂMINTELOR DE LIGNIT DIN OLTENIA

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ABSTRACT

Activitățile de asecare și evacuare a apelor din cariere au o importanță deosebită cu implicații majore în:

-asigurarea condițiilor normale de lucru;

-asigurarea realizării capacităților orare ale utilajelor de excavare;

-reducerea timpilor de intervenție la utilajele conducătoare și pentru realizarea lucrărilor tehnologice (ripări și montări de transportoare, trecerea excavatoarelor peste bandă, manevre ale utilajelor pentru schimbarea fronturilor de lucru etc);

-securitatea carierelor în ansamblu, care se dezvoltă în zone cu condiții hodrogeologice grele și foarte grele;

Având în vedere costurile ridicate realizate cu aceste activități, în lucrare se face o analiză temeinică la nivelul fiecărei cariere, a volumului lucrărilor de asecare realizate, a numărului stațiilor de pompe folosite, a capacităților acestora și a timpilor de funcționare etc, ținând seama de volumul precipitațiilor din zonă înregistrate în ultimii ani, în vederea raționalizării și optimizării activităților de asecare și evacuare a apelor din cariere.

KEYWORDS

Asecare, lignit, Oltenia

1. INTRODUCERE

Teritoriul României are o structură geologică foarte complexă și conține în subsolul său bogate și variate resurse de substanțe minerale utile, printre care cărbunii au o importanță cu totul deosebită, întrucât, pe lângă alte utilizări, aceștia contribuie la producerea a aproximativ 40 % din energia electrică a țării. Zăcămintele de lignit și cărbune brun din România sunt răspândite în trei zone distincte, figura.1, după cum urmează:

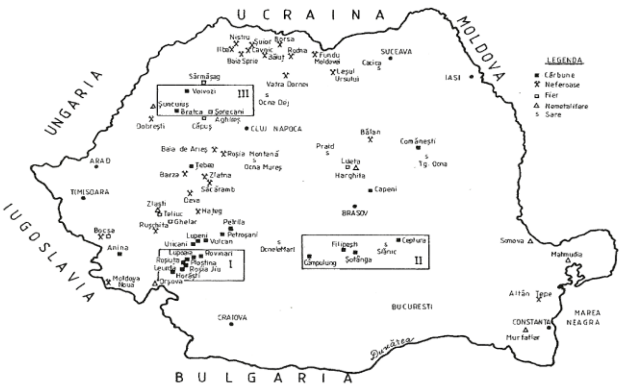

Figura 1: Răspândirea principalellor exploatări miniere din România

Zona I – aflată în depresiunea subcarpatică a podișului Getic, între Olt și Dunăre, cuprinde zăcămintele de lignit din bazinele Mehedinți, Motru, Rovinari și Berbești –Alunu.

Zona II – situată în depresiunea precarpatică, între râul Olt și Valea Buzăului, cuprinde zăcămintele de lignit de la Câmpulung, Șotânga, Filipești de Pădure și Ceptura. Această zonă se completează cu bazinele miniere din Carpații Orientali: Barolt-Vârghiș-Căpeni –lignit și Comănești –Bacău –cărbune brun.

Zona III –este dezvoltată în depresiunea Panonică din nord-vestul Transilvaniei și cuprinde zăcămintele de cărbune brun și lignit de la Sărmășag, Voevozi, Surduc și Borod.

Zăcămintele de lignit din România reprezintă principala sursă de combustibil energetic.

În zona I de răspândire a zăcămintelor de lignit din România sunt cantonate aproape 90% din rezervele de lignit ale țării.

Din totalul rezervelor industriale de lignit cunoscute în zona I, peste 80% sunt exploatabile în mod rentabil la suprafață, în carieră, iar restul de 20% sunt exploatabile prin mine subterane.

În toate bazinele miniere de lignit din România, stratele de cărbune exploatabile au grosime de 1,0÷8,0 și au atât în culcuș cât și în acoperiș formațiuni acvifere cu apă cu nivel liber sau sub presiune, ceea ce conduce la o serie de dificultăți și cheltuieli suplimentare, atât în faza de deschidere, cât și în cea de pregătire și exploatare datorită lucrărilor de asecare necesare de realizat.

Zăcămintele de lignit din România sunt cantonate în regiuni în care se dezvoltă predominant formațiuni geologice tinere (daciene, levantine și cuaternare) constituite din roci moi, coezive și necoezive de tipul marnelor, argilelor și nisipurilor.

Zăcămintele de lignit din Oltenia sunt constituite din 21 de strate de cărbune de grosime și extindere variabilă. Grosimea stratelor variază de la 1,0 m până cel mult 8,0 m prezentându-se sub formă compactă sau sub forma unor bancuri de cărbune, ce alcătuiesc complexul unui strat, figura 2.

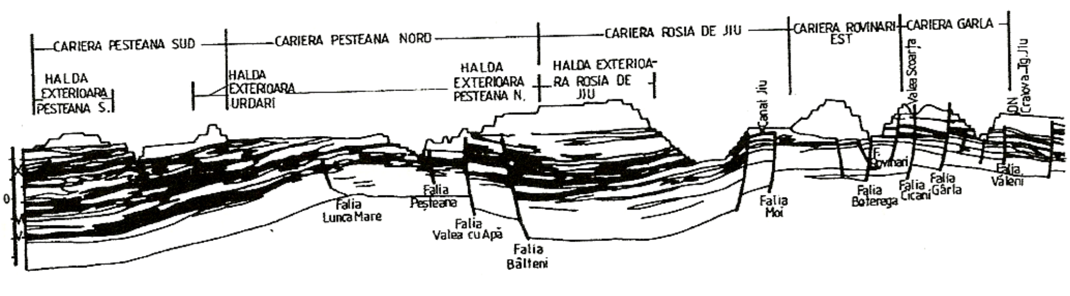

Figura 2: Profil geologic prin Bazinul Carbonifer Rovinari

Din cele 21 de strate de lignit sunt exploatabile în zonele de luncă stratele V-VIII, iar în zonele colinare startele V-XII.

Zăcămintele de lignit sunt grupate după criterii geologice, geografice și economice în 5 bazine miniere, figura 3. În fiecare bazin minier au fost delimitate mai multe perimetre de exploatare, în funcție de particularitățile zonale ale zăcământului și de posibilitățile de exploatare.

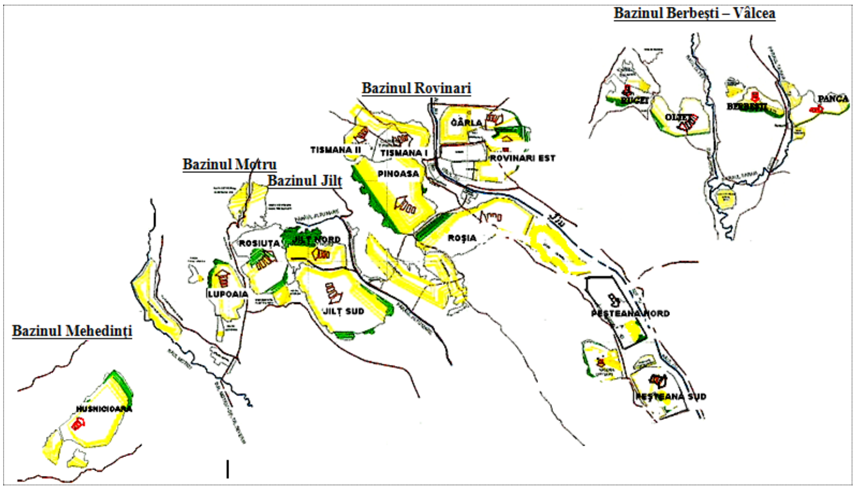

Figura 3: Bazinele miniere ale Olteniei cu perimetrele de exploatare

Carierele din Oltenia pot asigura o producție de 30÷35 milioane tone de lignit pe an, în funcție de cerințele pieței.

În prezent în Oltenia sunt active 17 perimetre miniere de suprafață care funcționează în cadrul Complexului Energetic Oltenia și Complexului Energetic Govora.

Depresiunea Getică, care cantonează zăcămintele de lignit din Oltenia, formează un bazin hidrogeologic de mari dimensiuni în care se întâlnesc o serie de orizonturi și complexe acvifere, ale căror caracteristici sunt dependente de poziția lor pe verticală, litologia și grosimea stratelor și bancurilor de nisip precum și de caracteristicile hidrogeologice și hidrodinamice ale apelor subterane.

Prin lucrările de foraj hidrogeologic s-au pus în evidență trei orizonturi acvifere, figura 4.

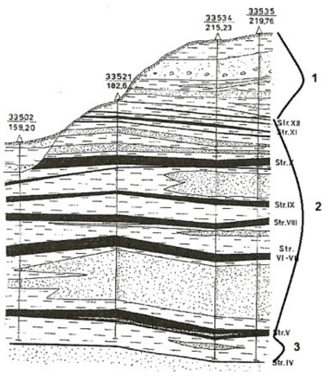

Figura 4: Orizonturile acvifere separate în câmpurile miniere din Oltenia (1. Orizontul acvifer freatic, 2. Orozontul acvifer din complexul cărbunos, 3. Orizontul acvifer freatic)

<u>Orizontul acvifer freatic</u>, este situat la adâncimi mici, fiind legat de depozitele de aluviuni din terasele râurilor și luncilor. Sursa de alimentare o reprezintă precipitațiile și prezintă caracter captiv, în zonele în care depozitele acoperitoare sunt formate din roci argiloase impermeabile. Coeficienții de filtrare stabiliți experimentali au valori de 2,5 ÷96 m/zi, iar debitele se încadrează între 0,1 ÷8,5 l/sm, orizontul fiind considerat ca o resursă importantă de apă dinamică.

<u>Orizontul acvifer din complexul cărbunos</u> este format din intercalațiile nisipoase dintre stratele XII-V. Adeseori, intercalațiile nisipoase sunt de formă lenticulară; cu lungimi variabile cuprinse între 200 și 700 m și grosimi de până la 20 m.

Ape mai apar și în fisurile stratelor de cărbune, ca urmare a contactului lor direct cu stratele acvifere.

Orizontul acvifer din complexul cărbunos are contact direct cu orizontul freatic din care se alimentează. Nivelul apei este ascensional și uneori artezian. Coeficienții de filtrare determinați pentru toate tipurile de roci întâlnite între stratele de cărbune variază de la 0,02 ÷2,0 m/zi până la 3,0÷5,0 m/zi.

Orizontul acvifer artezian este situat în culcușul stratului IV de cărbune, fiind cel mai dezvoltat orizont acvifer din regiune. Apele captive și arteziene provoacă adesea fisuri în stratele de protecție, generând afluențe mari de apă în zonele superioare. Orizontul are uneori grosimi de peste 100 m cu o mare arie de răspândire, ceea ce sugerează prezența unui mare bazin artezian, cantonat în partea inferioară a Dacianului. Alimentarea acestuia se face în jumătatea de nord-vest a depresiunii intercolinare Tg-Jiu.

Rezerva de apă este practic inepuizabilă ca urmare a suprafeței mari de alimentare a stratelor. Coeficienții de filtrare stabiliți experimental variază între 3,0÷16,0 m/zi, cu debite specifice de aproximativ 3 l/s.

Presiunea hidrostatică depășește, în multe locuri, cu mult rezistența ecranului protector, ceea ce face necesar detensionarea orizontului acvifer artezian.

În tabelul nr.1 se prezintă caracteristicile generale ale orizonturilor acvifere din Oltenia iar în tabelul nr.2 sunt arătați parametrii hidrogeologici ai câmpurilor miniere exploatate prin cariere în zona Olteniei

Tabel nr.1: - Caracteristicile orizonturilor acvifere din Oltenia

Orizontul acvifer	Grosime Cumulată (m)	Cota NH (m)	Presiune pe culcuş (m.col.apă)	Coef.de filtrare -k (m/zi)	Coef.de cedare (%)	Debit specific - q (l/s/m)
Freatic	5-25	144-150	5 -25	30 - 80	20-25	1-5
Acoperiş str.X	0,4-28	144-149	42 - 44	0,16	5-16	0,02-0,06
Str.IX – X	5 -17	153-161	18 - 74	0,3 - 1,5	5-27	0,002-0,08
Str. VII– IX	0,3-20	153- 161	25 - 80	0,5 - 3,0	4-17	0,015-0,35
Str.VII- VIII	0,3-31	151- 158	30 - 100	0,4 - 3,1	3,5-20	0,02-0,15
Str.(V-VI) - VII	3,5-31	158- 159	20 - 141	0,3 - 2	4,5-15	0,15-0,36
Str. IV – V	0,1-29	151-158	25 - 150	0,03-0,4	4-11	0,004-0,05
Culcuş : Str. IV	20-30	164- 165	40 - 180	4-16	5-24	0,07-2,8

Orizonturile acvifere se grupează în două categorii: orizonturi acvifere cu extindere regională, localizate în Dacian sub stratul VII cărbune, cu alimentare în zonele marginale ale regiunii, fără posibilități de drenare și orizonturi acvifere din Romanian și Pleistocen, care au zone de alimentare și drenare atât în zonele marginale ale bazinului hidrogeologic, cât și în zonele interne pe văile care traversează regiunea.Orizontul acvifer cel mai puternic este cel din culcușul stratului IV cărbune.

Din punct de vedere al constituției litologice, orizonturile acvifere sunt foarte diferite, iar variații ale rocilor se constată în mod frecvent și în cazul aceluiași orizont, de la un perimetru de exploatare la altul sau chiar în cadrul aceluiași perimetru.

Dacă în orizontul acvifer freatic se întâlnesc nisipuri grosiere sau amestecuri de nisipuri cu prundișuri specifice teraselor aluvionare, în celelalte două orizonturi acvifere se întâlnesc nisipuri care variază de la cele medii la nisipuri fine, prăfoase sau argiloase, care cedează greu apa și sunt caracterizate de coeficienți de filtrare foarte reduși. Existența apei sub presiune le face în schimb foarte periculoase din punct de vedere al posibilităților de erupție sau de rupere a ecranelor protectoare.

Din analiza tabelului nr.2 se observă că în cazul perimetrelor Roșia de Jiu și Peșteana Nord se întâlnesc cele mai defavorabile condiții de exploatare din punct de vedere hidrogeologic.

1.1 Lucrări de asecare efectuate în perimetrele de exploatare din Oltenia

Exploatarea stratelor de lignit in bazinele miniere ale Olteniei a fost și este condiționată de executarea lucrărilor de asecare a orizonturilor și complexelor acvifere cu ape cu nivel liber și a lucrărilor de detensionare și chiar de asecare a orizonturilor acvifere cu ape sub presiune.

Primele lucrări de asecare s-au făcut la punerea în exploatare prin lucrări miniere subterane a principalelor strate de lignit din zona Olteniei.

Schemele de asecare folosite au urmărit:

-asigurarea traversării în siguranță a nisipurilor acvifere cu lucrările de deschidere;

-asigurarea condițiilor normale de lucru și evitarea erupțiilor de borchiș în lucrările miniere de deschidere, pregătire și abataj;

-înlăturarea pericolului de inundare a lucrărilor miniere.

La început, la exploatările de lignit din țara noastră s-a aplicat asecarea ,,brutală" a orizonturilor acvifere din acoperișul stratelor de cărbune prin executarea unor camere în care, prin prăbușirea forțată a acoperișului , avea loc erupția nisipurilor acvifere care producea o reducere a presiunii piezometrice. Această metodă dădea totuși rezultate nesatisfăcătoare. S-a constatat că, după crearea depresiunii, drenul rezultat în zona de prăbușire se colmata și după un timp se refăcea presiunea piezometrică inițială, ceea ce explică de altfel repetarea viiturilor de borchiș la anumite intervale în zona respectivă.

Mai târziu s-au folosit lucrările miniere subterane executate pentru asecare, în special galeriile simple sau prevăzute cu filtre penetrante care erau plantate în tavanul sau vatra galeriilor în funcție de poziția orizontului acvifer ce trebuia drenat, figura 5.

Tabel nr.2 –Parametrii hidrogeologici ai perimetrelor de exploatare a lignitului din Oltenia

Cariera	Orizonturi acvifere	PARAMETRII HIDROGEOLOGICI							
		Caracterul apelor subterane	Coeficientul de filtrare k_f (m/zi)	Coeficientul capacitatii de cedare k_e (%)	Presiunea piezometrică H (m col. H_2O)	Coeficientul afluxului de apă $k_{a\,(m^3/t)}$	Debitul specific $q_{(m^3/zi)}$	Grosimea ecranului h (m)	Gradul de tectonizare (accidente /ha)
Rosia de Jiu	Orizontul freatic	nivel liber	10-15	0,2-0,3	-	12,63-16,32	30-150	-	Absent
	Complex VI	ascensional	0,1-1,0	0,05-0,1	10-30		10-80	0-4,0	Absent
	Complex V-VI	ascensional	0,3-2,3	0,1-0,15	70-100		8-60	1,0-5,0	Absent
	Culcus V și artezian	artezian	0,356-3,0	0,05-0,13	70-200		20-100	5,0-20,0	Absent
Pinoasa	Orizontul freatic	nivel liber	1,0-5,0	0,2-0,3	-	3,7	1-5	-	Redus
	Complex VI-X	ascensional	0,1-1,0	0,05-0,1	-		1-15	5,0-7,0	Redus
	Complex V-VI	ascensional	0,009-3,17	0,1	3,7-28,6		5-15	2,0-8,0	Redus
	Culcus V și artezian	artezian	0,172-18,86	0,15	14,7-170,8		5-20	5,0-20,0	Redus
Rovinari Est	Orizontul freatic	nivel liber	3,8-8,0	0,2-0,3	-	4,9-5,41	5-15	-	Moderat
	Complex V-VIII	nivel liber	0,3-1,0	0,05-0,1	-		5-10	1,0-4,0	Moderat
	Culcus V și artezian	artezian	1,3-3,0	0,15	50-150		10-50	10,0-20,0	Moderat
Peşteana Nord	Orizontul freatic	nivel liber	15,0-20,0	0,2-0,3	-	12,87	30-200	-	Redus
	Complex V-VI	ascensional	0,3-1,0	0,05-0,1	50-80		5-50	0-10,0	Redus
	Culcus V și artezian	artezian	1,0-3,0	0,15	7-150		10-70	5,0-15,0	Redus
Jilţ Sud	Orizontul freatic	nivel liber	3,0-0,8	0,2-0,25	-	1,7	5-15	-	Redus
	Complex VI-XII	captiv	0,1-0,8	0,05-0,1	5-15		3-5	0-5,0	Redus
	Culcus VI	sub presiune	0,2-1,0	0,05-0,1	20-40		5-10	0-10,0	Redus
Lupoaia	Orizontul freatic	nivel liber	4,0-6,0	0,2-0,23	-	0,7	-	-	Absent
	Complex V-VIII	nivel liber lentiliform	0,1-0,5	0,05-0,1	-		3-5	0-5,0	Absent
	Culcus V	ascensional lentiliform	0,2-1,0	0,05-0,1	0-5		2-5	0-10,0	absent
Olteţ	Acoperiş str. II	nivel liber lentiliform	0,02-0,7	0,1-0,11	0-20	0,8	0,54-2,10	2,0-15,0	absent
	Acoperiş str. I	nivel liber	0,1-1,42	0,1-0,11	20-100		2,29-7,58	0-10,0	absent

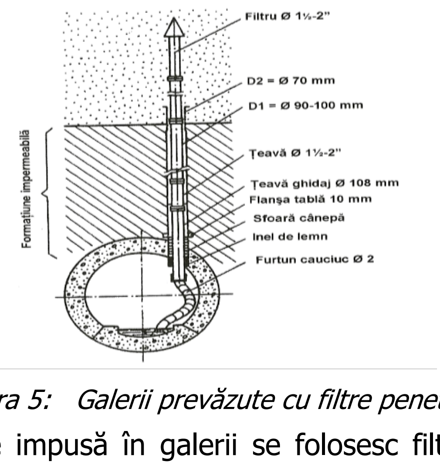

Figura 5: Galerii prevăzute cu filtre penetrante

În funcție de viteza de asecare impusă în galerii se folosesc filtre penetrante simple sau se recurge la o asecare forțată prin folosirea filtrelor penetrante simple și a filtrelor cu aer, figura 6 sau a filtrelor penetrante vacumate, figura 7.

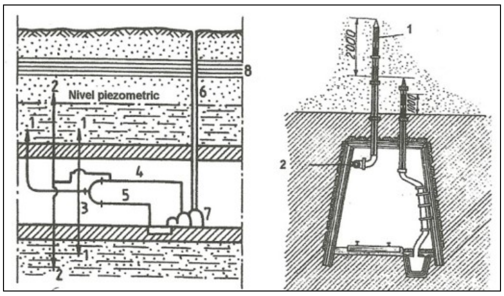

Figura 6: Schema instalației de asecare prin filtrele penetrante alterând cu filtre de aer (1-filtru penetrant, 2-filtru de aer, 3-conductă colectoare, 4-conductă sub presiune, 5-conductă de amestec, 6-conductă de evacuare, 7-agregat de pompare, 8-strat impermeabil).

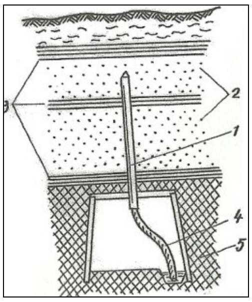

Figura 7: Schema de asecare prin filter, cu vacuum individual prevăzut cu sifon (1-filtru penetrant, 2-strate acvifere, 3-strate impermeabile, 4-furtun de cauciuc, 5-strat de cărbune).

În aceste două variante de lucru, prin introducerea aerului comprimat în strat sau prin diminuarea presiunii în filtru, datorită vacumării, se ajunge la accelerarea procesului de asecare, debitul instalațiilor de drenaj crescând de 2-3 ori față de debitul filtrului simplu și astfel se reducea timpul de drenaj.

Deasemenea, pentru asecarea orizonturilor acvifere cu presiuni inițiale mari (30÷40 atm) amplasate în culcușul stratului de cărbune se foloseau destul de des puțuri de drenaj, figura 8.

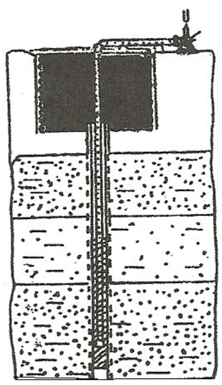

Figura 8: Puţ de drenaj

Atunci când formațiunile acvifere erau situate în acoperișul zăcământului la distanțe mari față de tavanul galeriilor care nu se puteau aseca cu filtre penetrante, se foloseau filtrele de cădere.

Filtrele de cădere sunt filtre special amenajate în interiorul unor găuri de sondă forate de la suprafață până la la tavanul galeriilor de drenaj, figura 9. Găurile de sondă au diametrul de 150÷300 mm. Ele se tubează și în interiorul lor se introduce o coloană filtrantă cu diametrul cuprins între 75÷150 mm.

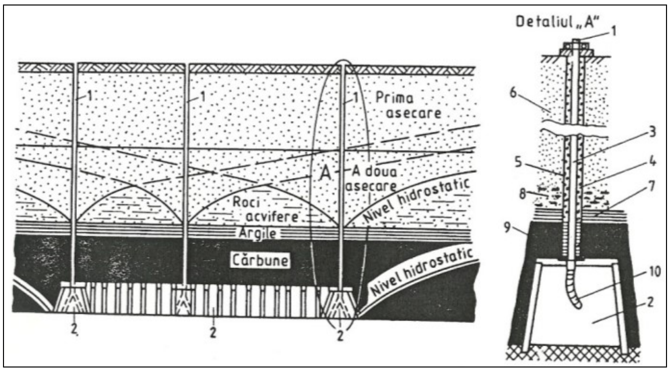

Figura 9: Asecarea prin galerii de drenaj și filtre de cădere

1-Filtre de cădere; 2-galerii de asecare; 3-tub filtrant; 4-umplutură de pietriș; 5-orificii de pătrundere a apei; 6-umplutură extraordinară; 7-roci impermeabile; 8-roci nisipoase acvifere; 9-strat de cărbune; 10-tub flexibil.Puţ de drenaj

În spațiul dintre tubaj și coloana filtrantă se contruiește filtrul din pietriș cu granulație adecvată de 2÷10 mm diametru.

Filtrele de cădere permit asecarea simultană a mai multor strate acvifere din acoperișul stratului de util, având debite care pot să ajungă la 3000 l/min. În anumite situații s-a lucrat cu filtre de cădere cu vacuum care duceau la accelerarea procesului de asecare. Apa drenată era dirijată prin lucrările miniere subterane în bazin de colectare de unde era evacuată la suprafață.

Pentru asecarea formațiunilor acvifere din câmpurile de exploatare la zi s-au folosit și se folosesc în continuare tranșeele de asecare pentru orizontul freatic, forajele de mare diametru și adâncime dotate cu pompe submersibile, pentru asecarea formațiunilor acvifere din complexul productiv, forajele orizontale executate de pe treptele de lucru pentru asecarea lentilelor de nisip cu apă din copertă sau complexul cărbunos și foraje fără filtru cu erupție la nivelul vetrei pentru detensionarea orizonturilor acvifere sub presiune din culcușul zăcământului, figura 10.

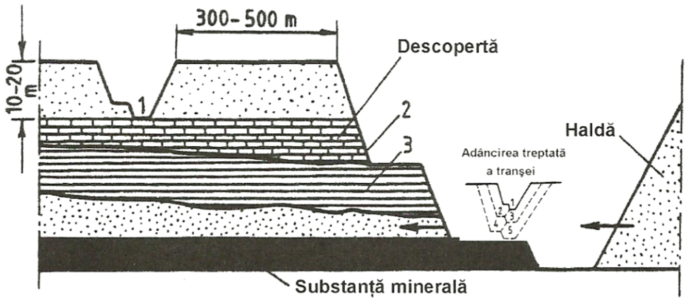

Figura 10: Tranșee de asecare executată în fața fronturilor de lucru 1-tranșee de asecare; 2-treaptă de lucru; 3 rocă impermeabilă

Tranșeele de asecare se aplică acolo unde, orizontul acvifer are o grosime mică și se află situat aproape de suprafață. În funcție de morfologia terenului și direcția curenților subterani tranșeele de asecare pot fi executate pe una, două sau chiar pe toate laturile exploatării la zi.

Tranșeele de asecare frontale, fig. 10, parcurg frontul de descopertă cu circa 300÷500 m și pe măsură ce frontul avansează ele se distrug după ce în prealabil s-a executat în fața frontului o nouă tranșee.Tranșeele de pe marginea carierei se țin în funcțiune până la terminarea exploatării.

Tranșeele se sapă în stratul de rocă stabilă și impermeabilă, însă adâncimea lor nu depășește 20÷25 m. Execuția lor se face cel mai adesea cu echipament de draglină, materialul săpat depunându-se pe una sau ambele berme. Asecarea cu foraje de dreanare de mare diametru se aplică în perimetrele de exploatare la zi cu cantități importante de ape subterane, figura 11.

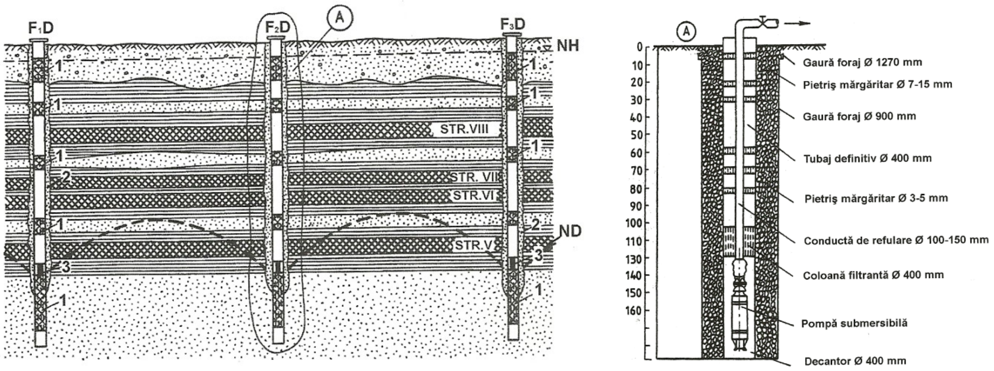

Figura 11: Asecarea cu foraje de mare diametru 1-filtru (burlan slituit și matisat; 2-strat filtrant; 3-pompe subemersibile (detaliu privind construcția și amplasarea forajelor de mare diametru)

Găurile de sondă au diametru de 900÷1200 mm, adâncimi care pot să ajungă la 200÷300 m și sunt săpate cu instalații speciale de foraj de mare randament de tipul: FA-12; FA-12,5; FA125DR; FA20; FA6,3 și FSC 2,5.

În tabelul nr. 3 sunt prezentate principalele caracteristici ale instalațiilor de foraj folosite.

Tabel nr.3: Instalații de foraj din dotarea UEF Motru –Sisetm de foraj , diametrul de săpare, adâncimi de săpare- folosite la Sucursala Divizia Minieră Tg-Jiu

Nr. Crt	Denumire instalatie de foraj	SISTEM DE FORAJ	Diametrul de sapare (mm)	Adancimea de sapare (metri)
1	Instalatie de foraj FA12	circulatie inversa	444 mm - 1800 mm	330 m - 40 m
2	Instalatie de foraj FA12,5	circulatie inversa	444 mm - 1800 mm	330 m - 40 m
3	Instalatie de foraj FA125DR	circulatie inversa	444 mm - 1200 mm	250 m - 60m
4	Instalatie de foraj FA20	circulatie inversa	444 mm - 1200 mm	250 m - 60m
5	Instalatie de foraj FA6,3	circulatie inversa, directa, snec, bhorsapa	350 mm - 640 mm 90 mm - 350 mm 90 mm - 444 mm 350 mm - 1200 mm	90 m - 50m 180 m - 120m 60 m - 25m 25 m - 15m
6	Instalatie de foraj FSC 2,5	circulatie directa	90 mm - 350 mm	150 m - 50m

Găurile de sondă se tubează și în interiorul lor se realizează filtrele din pietriș, în baza relației:

$$D_1 = \frac{D_2}{2,5-4} = \frac{D_3}{10-16} \qquad (1)$$

-în care: D1 este diametrul mediu al nisipului acvifer; D2 –diametrul pietrișului; D3 –diametrul orificiilor tubului filtrant ș.a.

În afară de filtrele de pietriș realizate prin turnare, în practica asecării se mai folosesc filtre din pietriș care se confecționează la suprafața terenului și apoi se lansează în gaura de sondă. Așa sunt filtrele de pietriș consolidate cu diferite cleiuri speciale, lacuri badelitice, bitumate.

Găurile de sondă sunt adânci și au diametrul mare pentru a permite instalarea în interiorul tubului filtrant a pompelor submersibile care refulează la suprafață apa filtrantă. În exploatările la zi din țara noastră folosim pompe submersibile de diferite mărimi de fabricație indigenă sau străină.

Forajele de mare diametru sunt echipate cu aparatură automată de pornire oprire și de înregistrare a timpului de funcționare. Alimentarea cu energie electrică a pompelor submersibile se face la tensiunea de 380 V prin conductori cauciucați. Introducerea și scoaterea pompelor submersibile din forajele de drenare se face cu ajutorul unor automacarale. Reviziile și reparațiile pompelor se fac numai în ateliere dotate special în acest scop. În funcție de direcția curentului acvifer subteran, în schemele de asecare folosite, forajele de drenare sunt amplasate pe linii de drenare succesive, pe contur sau în rețea.

În condițiile carierelor din Oltenia, forajele de asecare au fost plasate cel mai adesea într-o rețea de 200 X 100 m, iar adâncimea acestora a fost funcție directă de grosimea orizonturilor acvifere deschise prin forajele de drenare și care a variat între 35 și 150 m.

Asecarea câmpului carierei în condițiile carierelor adânci cu mai multe trepte prin foraje de drenare care deschid toate orizonturile acvifere nu se recomandă deoarece tăierea acestora pe trepte și repunerea în funcțiune de mai multe ori nu este eficientă chiar dacă se execută cu cea mai mare atenție. În astfel de cariere s-au executat foraje de drenare în trepte, care făceau asecarea a cel mult două trepte din carieră, figura 12.

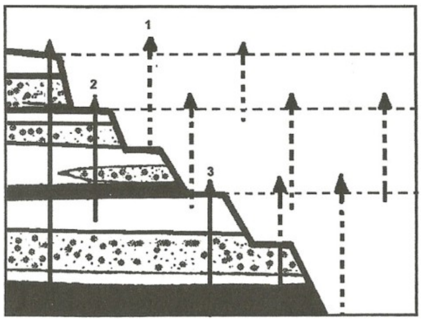

Figura 12: Schema de asecare în trepte (1-prima treaptă; 2-a doua treaptă; 3-a treia treapta de drenare)

Asecarea cu foraje orizontale se practică ca procedeu ajutător de asecare, figura 13. Găurile de sondă orizontale au lungimi de 20÷50 m, o pantă spre gură de cca 2,5 % și se execută cu intalații speciale de forat.

Ele se execută atât în substanța minerală utilă cât și în roca sterilă acviferă.

De multe ori găurile de sondă orizontale executate în stratul acvifer, de pe bermele treptelor pregătite pentru exploatare, nu se tubează și funcționează astfel până la completa lor închidere. Se aplică pentru drenarea orizonturilor acvifere subțiri.

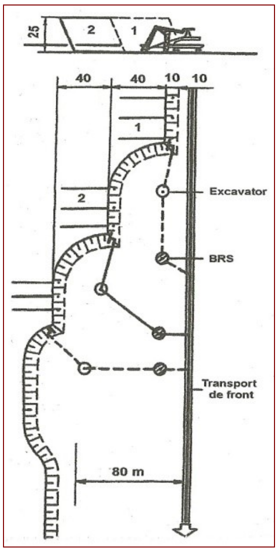

Figura 13: Schema de amplasare a forajelor orizontale în treptele de excavare

Dacă nisipul sau pietrișul acvifer se află cu culcușul mai sus de baza taluzului și nu pot fi executate foraje orizontale, atunci se folosesc foraje înclinate la 25-450 executate de pe berma superioară cu instalații speciale de forat, figura 14.

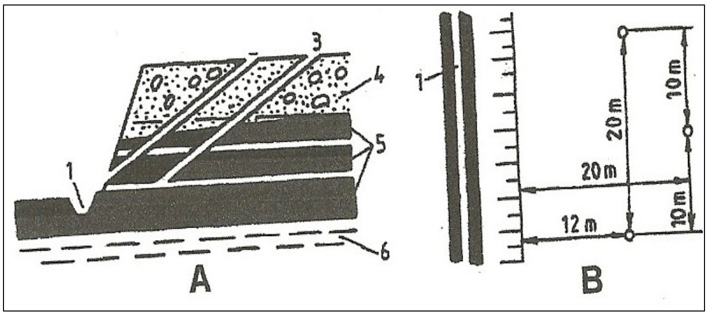

Figura 14: Schema de execuție a forajelor înclinate: A-secțiune; B- vedere în plan;

1-canal de taluz; 2-foraj înclinat activ; 3-foraj înclinat inactiv; 4-nisip acvifer; 5-cărbune; 6-argilă

Prezența în culcușul str. V de cărbune a unui orizont acvifer cu caracter artezian și ascensional, practic cu rezerve de ape inepuizabile, impunea găsirea unor soluții tehnice care să asigure exploatarea în siguranță a stratului principal de cărbune din bazinul Rovinari. În mod practic s-a pus problema detensionării orizontului acvifer din culcușul stratului V cărbune, până la limita evitării ruperii ecranului protector.

O eventuală rupere a ecranului protector ar avea drept consecință pătrunderea apei în mod dezordonat în carieră și compromiterea totală și definitivă a acesteia, figura 15

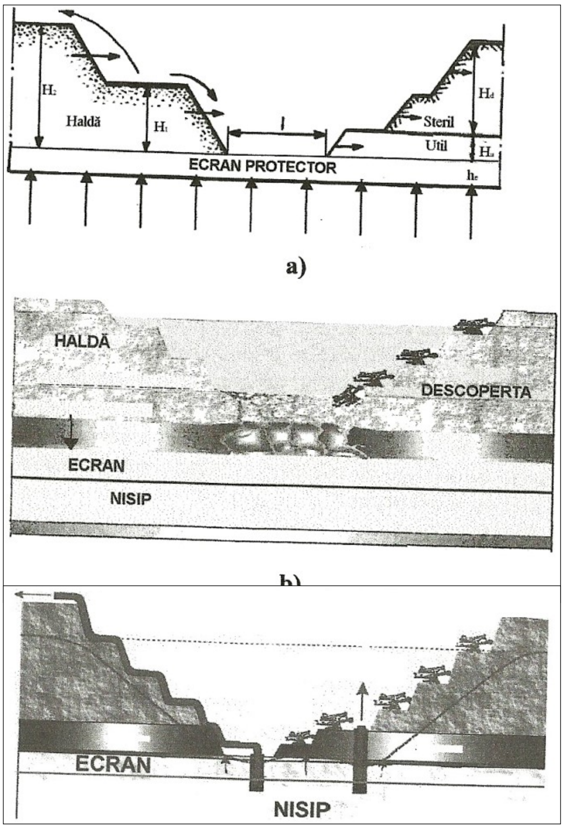

Figura 15: Influența existenței unui orizont acvifer sub presiune asupra exploatării în carieră a unui zăcământ de lignit

a) schița de principiu a situației din teren; b)consecința posibilă nereducerii presiunii orizontului acvifer din culcuș; c) desfășurarea exploatării în condiții de siguranță simultan cu cu reducerea presiunii orzontului acvifer

În faza inițială s-a încercat detensionarea orizontului acvifer din culcușul stratului V cărbune folosind forajele de mare diametru dotate cu pompe submersibile. După numeroase încercări și experimentări, rezultatele obținute nu au fost cele așteptate. Ca urmare s-a impus găsirea unei alte soluții de detensionare a orizontului acvifer artezian și astfel s-a recurs la aplicarea detensionării și asecării cu foraje fără filtru, cu erupție liberă executate la nivelul vetrei carierei, soluție care se aplică și astăzi în toate câmpurile de exploatare la zi cu condiții hidrogeologice grele și foarte grele, figura 16.

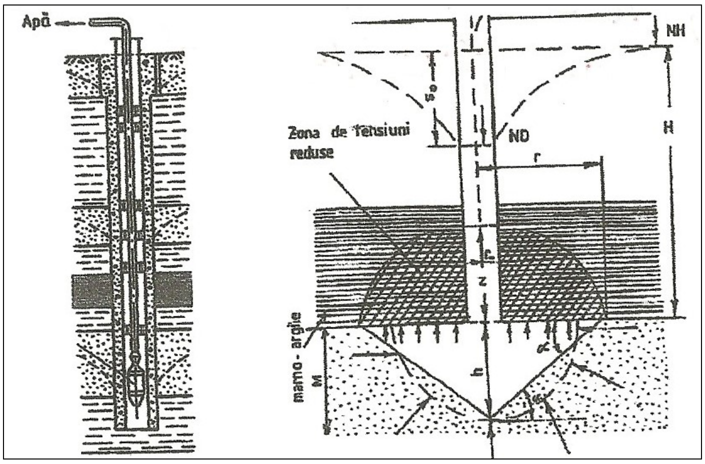

Figura 16: Detensionarea orizonturilor acvifere sub presiune

În decursul anilor au fost monitorizate debitele de apă evacuate din fiecare foraj de asecare și de detensionare, scăderea nivelului piezometric pe linia forajelor și în interiorul câmpurilor miniere, razele de influență ale forajelor și fezabilitatea tehnică și economică a metodelor de lucru folosite.

Dacă este să ne referim la activitatea de asecare și evacuare a apelor din carierele din Oltenia în decursul ultimului an, trebuie arătat în primul rând că în anul 2014 au funcționat în total un număr de 11 cariere. Pentru evacuarea apelor provenite din precipitații, din orizonturile acvifere de suprafață și din orizonturile acvifere de adâncime sub presiune, a fost proiectată o capacitate de evacuare de 102.400 m3.

Capacitățile de evacuare pe cariere și dotarea acestora cu pompe și conducte ca și o serie de indicatori realizați sunt prezentați în tabelul nr.4.

Tabel nr.4: Situația funcționării pompelor pentru evacuarea apei din carierele din Oltenia

SUBUNITATEA	Capacitatea de evacuare (mc/h)		Cantitatea de apă evacuată (mii mc)	Cantitatea de apă evacuată ptr. 1 tonă de cărbune (mc apă/t)	Consum de energie pentru activitatea de evacuare ape (MWh/an)	% din consumul total de energie	Numar pompe în funcțiune				Conductă folosită (mm)		
	Proiectată	Existentă					Instalații de pompare >1000 mc/h	Instalații de pompare <1000 mc/h	Nr. foraje	Nr. st. pompe	Metalică Ø 220-508	PVC Ø 90-315	TOTAL
UMC Roșia	29.500	31.520	14.547,63	4,89	12.174,0	14,31	23	7	8	16	6.795	0	6.795
UMC Rovinari	8.500	10.525	1.640,0	1,65	308,2	0,73	9	2	3	6	3.350	0	3.350
UMC Tismana	8.000	13.250	1.338,0	0,63	537,25	0,95	10	0	3	8	7.920	0	7.920
UMC Pinoasa	6.300	5.100	1.118,16	1,06	457,254	0,86	4	3	5	6	1.915	0	1.915
UMC Peșteana	18.500	20.375	9.746,81	5,13	14.103,18	20,25	13	8	6	13	7.780	0	7.780
Peșteana Sud	9.000	11.250	3.846,67	5,19	4.936,11	7,08	8	2		5	3.805	0	3.805
Peșteana Nord	9.500	9.125	5.900,14	5,0	9.167,07	13,17	5	6		8	3.975	0	3.975
UMC Roșiuța	5.000	3.750	602,7	0,21	164,67	0,27	3	0	5	2	0	578	578
UMC Lupoaia	1.800	3.750	232,0	0,10	169,78	0,43	3	4	2	3	0	1.200	1.200
UMC Jilț Sud	5.200	5.970	1.854,26	0,74	1.921,82	2,40	5	6	2	4	0	6.650	6.650
UMC Jilț Nord	9.800	10.000	588,44	0,33	396,77	0,09	8	0	0	5	275	2.328	2.603
UMC Husnicioara	1.800	1.800	540,0	0,45	500,0	0,02	2	1	2	2	810	390	1.200
UMC Berbești	8.000	6.800	1.800,0	1,17	370,0	1,73	4	4	6	6	1.482	0	1.482
TOTAL SDM TG-JIU	102.400	112.840	34.008,0	1,58	31.102,924	4,91	84	35	42	71	30.327	11.146	41.473

Cantitatea de apă evacuată în anul 2014 din carierele din Oltenia a fost de 34.000.000 m3, ceea ce înseamnă că pentru fiecare tonă de cărbune extrasă s-au evacuat 1,58 m3 apă.

O situație aparte s-a înregistrat în carierele Roșia de Jiu, Peșteana Sud și Peșteana Nord, unde datorită detensionării orizontului artezian din culcușul stratului V prin foraje cu erupție liberă executate de pe acoperișul startului V, cantitatea de apă este mult mai mare. Astfel, la extragerea unei tone de cărbune au fost evacuate următoarele cantități de apă: 4,8 m3 la cariera Roșia de Jiu, 5,19 m3 la cariera Peșteana Sud și 5 m3 la cariera Peșteana Nord.

La celelalte cariere situate în zone colinare, probleme cu evacuarea apei au apărut doar în perioadele cu precipitații abundente. Cantitatea de apă evacuată din aceste cariere, raportată la tona de cărbune, se situează între 0,10 m3 la cariera Lupoaia și 1,65 m3 la cariera Rovinari.

Consumul de energie la nivelul tuturor carierelor în anul 2014 pentru activitatea de evacuare a apelor a fost de 31.102.924 kWh, reprezentând 4,91 % din totalul de energie la nivelul carierelor (633.213.960 kWh), valorile maxime fiind înregistrate la cariera Roșia de Jiu, respectiv 14,31 %, din consumul total la nivelul carierei și de 20,25% la cele două cariere Peșteana raportat la consumul total de energie de la cele două cariere. La celelalte cariere consumurile au fost mai mici.

CONCLUZII

Activitățile de asecare și evacuare a apelor din cariere au o importanță deosebită cu implicații majore în:

-asigurarea condițiilor normale de lucru;

-asigurarea realizării capacităților orare ale utilajelor de excavare;

-reducerea timpilor de intervenție la utilajele conducătoare și pentru realizarea lucrărilor tehnologice (ripări și montări de transportoare, trecerea excavatoarelor peste bandă, manevre ale utilajelor pentru schimbarea fronturilor de lucru etc);

-securitatea carierelor în ansamblu, care se dezvoltă în zone cu condiții hodrogeologice grele și foarte grele;

Având în vedere costurile ridicate realizate cu aceste activități, se impune o analiză temeinică la nivelul fiecărei cariere, a volumului lucrărilor de asecare realizate, a numărului stațiilor de pompe folosite, a capacităților acestora și a timpilor de funcționare etc, ținând seama de volumul precipitațiilor din zonă înregistrate în ultimii ani, în vederea raționalizării și optimizării activităților de asecare și evacuare a apelor din cariere.

Achiziția de pompe noi și selecționarea unor furnizori serioși de servicii pentru repararea pompelor și în general a întregului utilaj folosit în aceste activități.

Contorizarea riguroasă a consumului de energie și materiale realizată pentru aceste activități în fiecare carieră din cadrul Sucursalei Divizia Minieră Complexului Energetic Oltenia.

În perspectivă, ținând cont de creșterea adâncimii carierelor și dezvoltarea acestora în perimetre cu condiții hidrogeologice din ce în ce mai grele, se impune dezvoltarea asecării carierelor de lignit în câteva direcții principale și anume:

- îmbunătățirea permanentă a tehnologiilor și materialelor foosite în asecare;

- asigurarea automatizării funcționării și controlul procesului de asecare a apelor din cariere;

- protejarea perimetrelor de exploatare la zi împotriva apelor de suprafață și subterane, prin executarea unor lucrări adecvate;

- protejarea apelor subterane împotriva poluării;

- utilizarea în economia națională a apelor extrase prin procesul de asecare a carierelor de lignit.

În orice caz, realizarea în bune condiții a asecării formațiunilor acvifere este o problemă specială și permamentă pentru exploatările la zi de lignit din România.

Nu se pot prescrie apriori soluții valabile pentru toate condițiile valabile pentru toate condițiile existente în diferite cariere și bazine miniere. Condițiile hidrogeologice sunt foarte variate și deosebite, înglobând elemente specifice concrete. Este recomandabil ca, pe baza experienței din țară și străinătate și a parametrilor determinați și măsurați, să se stabilească pentru fiecare caz în parte metoda, schema și tehnologiile de lucru care trebuie aplicate.

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ENVIRONMENTAL RISK ASSESSMENT, TAILING DAM KURBNESH, MIRDITA DISTRICT-ALBANIA

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Abstract

The interruption of the copper ores extraction and processing at 1996 year was accompanied by the total abandonment of care for the dressing plants tailings' dams. Besides the one, all plants and their tailings dams were abandoned, started to be damaged constantly. One of these, which was the first built dam in Albania and today is out of control, it' s Kurbnesh dressing plant` tailings dam. The data of this dam are:

- ✓ Country occurrence, Kurbnesh, Albania.
- ✓ The construction deposition started in 1961 .
- ✓ The deposition was finished in 1994
- ✓ 2 million tons of tailings have been deposed
- ✓ The total area is 7.2 ha
- ✓ Content heavy metals- at 0.15% Cu; Zn; S; Al; As; Co; etc.
- ✓ The material is very fine 0-200 micron
- ✓ Located near Uraka River and at the banks passes an autoroad.

From lack of maintenance, since the years of 1994-2015, in this dam are destroyed and out of use the main infrastructure parts as follows:

- ✓ Water diversion channel.
- ✓ The main collector and parts of the side collector.
- ✓ The front of the dam, its sides is split in three places creating considerable space for the removal of tailings.
- ✓ Consequently there are created 6 deep holes of 6-8 m, in the north part of the dam body
- ✓ The creation of canyons and holes is associated with removal of about 70 000 tons of tailings from dam. This amount of waste has gone into Uraka river which lies 8 m away, parallel to the dam.

Lack of maintenance, expansion of canyons and holes, is associated with the removal of tailings, creating premises for the collapsing of the dam. Such a phenomenon is associated with accidents and ecological disasters.

The movement of large masses of tailings will harm the road, as well as could fill the Uraka riverbed with those, polluting the water of the river with the dam elements, Cu, Zn, As, Pb, etc.

This contamination exceeds the limits of the area because the water of Uraka River is poured in Mat River which flows into the Adriatic Sea.

Finally, this pollution makes necessary emergent intervention for the rehabilitation of the Kurbnesh tailings dam, to prevent accidents and ecological disaster.

Keywords: Collapse, environment, risk assessment, rehabilitation, tailing dam

Introduction

The mineral of copper is found in the central and South-East zones of Albania, in the districts of Mirdita, Puka, Kukes, Has, Shkoder and in the district of Korca in the South-East of country. In the district of Mirdita the copper ores are situated in some deposits as Kurbnesh, Spaç, Kacinar, Thirrë, Rubik etc.

Copper ores Extractive and Processing Industry started in Albania from the year of 1935. In that year was opened the first copper mine in Rubik, and after one year was built the first copper smeltery near to the mine for the copper ores extracted from these mine.

This industry was widely developed after the years of 1960-s, that have been opened some copper mines Kurbnesh, Kacinar, Spac, Perlat, Kulme, Thirrë, Gurth in the district of Mirdita; Gjegjan, Gdheshtë, Shmëri in the district of Kukes; Nikoliq, Golaj, Krumë in the district of Has; Tuc, Lak Roshi, Munellë, Kcirë in the district of Puka; Palaj & Karmë in the district of Shkodra and Rehova in the district of Korca.

Opening of the mines brought the increasing of amount of copper extracted and also presented the necessity for their beneficiation and melting. During the period 1950 up to 1990, were built seven beneficiation plants and three copper ores smelters

History

The first copper ores enrichment plant (dressing plant) was built in the town of Kurbnesh, 2 km far away from the copper mine Kurbnesh. The town of Kurbnesh is located in Central-North part of Albania, with a hill-mountainous relief. This dressing plant was built at the year of 1959 and started the operation in the year of 1961. Copper ore enrichment in this plant was applied by the flotation method. [3]

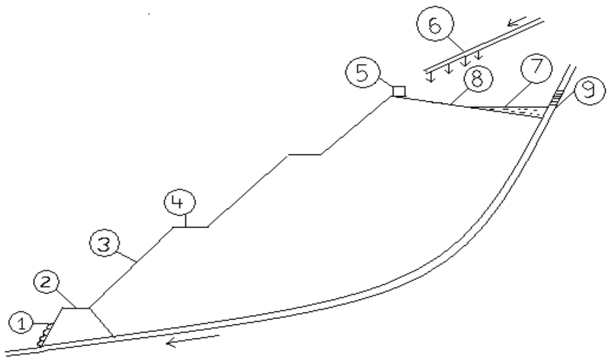
Copper ores enrichment Plant was in operation from the year of 1961 up to 1994. This dressing plant was supplied with copper ores in amount 80% from the mine of Kurbnesh. Copper ore of Kurbnesh deposit was composed by the minerals as follows:

Chalcopyrite, pyrotine dhe pyrite. The content of copper in the mineral is 1.20% Cu and of sulphur 7%

At the year of 1994 the copper mine Kurbnesh was closed, interrupting the supply of copper ore of the plant. During this period in the copper dressing plant Kurbnesh have been processed about 3 585 649 tons copper ores. In the Table No. 1 are given the data on the processing capacity of the plant.

Table No. 1. Copper ore processed, concentrate and quality:

No.	*Description*	*Unit*	*Value*
1	*Ore processed amount*	*ton*	*3 585 649*



1-Coverage with stones of the embankment

2- Embankment from clay

3-Sloped surface of the dam

4-Horizontal surface of the damp`s sub floor.

5-Temporary embankment coming from sterile

6-Furnishing pipe used for tailings

7-Surface of water mirror of the dam

8-Surface of the dam

9-Collector of water discharges

Schematic overview of dam elements in Kurbnesh.

Actual Situation.

At the year of 1990 the enrichment plant ceased the operation, and at the same time stopped the deposing the plant wastes in the tailings dams. From the year of 1961 up to 1994, at the same time with plant wastes tailings deposing has been carried out also persistent maintenance of dam and its elements.

From the year of 1994 up to present times the dams have not been maintained. The situation of the dams and its main elements in general actually is as follows:

All dam area has the view of a desert. Regardless of very long time passed, in the dam is not observed any kind of vegetation, and this phenomenon shows clearly for the composition of wastes material of dams.[4]

In the dam body are created deep holes (cracks) cross to dams in three places and parallel with dam in a case. These holes are widened and deepened persistently as result of water erosion.

High Waters Channel, which protects the dams from over floods and control them during the precipitations period, is overfilled and out of operation .

In the body of No.1 dam are created 6 holes of diameters from 5 to 13 meters and of depth from 6 to 8 meters. These holes are widened more and more.

The embankment of the dam is split in three places. These cracks are of great sizes and persistently are widened. Pictures 1, 2 and 3 shows the view from dam.

As result of the cracks and holes, from the dams are displaced and poured in the Uraka River hundreds and hundreds tons wastes of tailings. This kind of process is still continuing and it is depended to the precipitations available.

In the Uraka River are poured all waters drained from these two dams. From the measurements results that these waters have a high acidic properties with p.H 3-4. These waters make difficult the life of biota (organisms). The pollution of the river with those acidic waters is persistent

Cracks, holes and further erosion in the dam structure are going to be more and more problematic and dangerous for pollution of all the zone and Uraka River.[5]

Persistent widening (extension) of holes and cracks sizes is a serious problem for dam sustainability. As result of cracks and holes from the dam has been displaced an amount of about 70 000 tons wastes.

Fig Nr 1.

Hole in the dam body

Fig. nr 2

Canyon created by water erosion

Fig. Nr 3

Crack in embankment

Risk assessment

Destruction of High Waters Channel, cracks of embankment, deepenings in the dam body and creation of holes in dam structure as result of water erosion favour further the erosion towards total destruction of the dam.

The situation near the river and with the hillside at the back are not favorable in terms of protection against erosion and transportation ways to the river. The site is exposed for erosion and the short distance to the river gives small opportunities to sedimentation or remediation.

The high pollution level in the soil sample taken in front of the small stream (created on body of the tailing dam) shows that the stream is transporting contaminates (tailing material with heavy metals) from the site into the river. This transport is verified in the river sediment sampling programme where high metal content have been revealed in the sediments outside the tailing dam. Finally it is not know if the tailing is secured against an event of extreme high flood.[1]

Review of long term safety of dams

The release from a tailing dam under operation has been controlled by the mining personnel and can be kept at a reasonable level. If no attempts are made of securing the dam after the closure the weathering will increase, slowly at the beginning but accelerating when the dam's buffering capacity etc. is used.[2] In order to prevent the release to increase the control system during operation should be replaced by natural systems.

In the long-term safety three mechanism of dam failures needs considerations.

- ✓ Extreme events such as floods, earthquakes and high winds etc.
- ✓ Slope failures in the foundation or dam sides.
- ✓ Slow deterioration actions such as water and wind erosion, weathering.

The probability of extreme events is based on statistics and is best dealt with during the planning and design phase of a dam. An existing dam will be secured by double or triple the security on slope sides, interception ditches for rainwater etc. If an extreme event happens the release from the dam is often on a natural catastrophe scale. A rescue and remediation plan should be worked out in advance. [1]

Mechanics of slope failures

The mechanics of a slope failure and how to prevent this is described in international literatures and are not part of this solid waste and reconnaissance programme.

Factors that affecting the shear stability may, however be summarised as follows:

2	*Quality of ore supplied, Cu*	*%*	*1.98*
3	*Concentrate produced*	*ton*	*199 550*
4	*Quality of concentrate, Cu*	*%*	*16*

For deposing of tailings (wastes) of the plant, near to it were built 2 dams. The tailings dams were built in the elevations of +745 m up to +785 m. In these two dams for all the period have been deposed about 2 million tons of plant wastes. In the Table No. 1 are given the data on the dams. [3]

Table No. 2. Data on the tailings dams:

No.	*Description*	*Unit*	*Value*
1	Horizontal Area	m^2	66 900
2	Inclined Area	m^2	5 600
3	Total Area	m^2	72 500
4	Volume	m^3	980 900
5	Volumetric Weight of deposed tailings	ton/ m^3	1.82
6	Amount of deposed tailings	ton	1 786 238

Tabela Nr 3. The content of elements in the dam

No.	*Description*	Content in %
1	Cu	0.15
2	Zn	0.07
3	Pb	0.05
4	Fe_2O_3	17.32
5	S	6.20
6	As	

Dam Building and elements

Waste deposing dams were built close to plant, in a flat terrain, starting from the elevation of + 745 m, near to Uraka River and continuing towards the hills in the southern direction up to the elevation + 785 m. the dams have been built parallel with the river and as separating border served the rural road connecting the town of Kurbnesh with the villages around it.

For dams building was applied the classic method with constituent, according to the scheme as follows: [6]

No.	Unit/Mine	Emission source	Pollutant/ measured parameter	Ventilator no.	Pollutant emissionparameters				Emission parameters according to Order 462/1993		Emission parameters overrate according to Order 462/1993		Observation - environment conditions (T,W) - discharge shaft section - upset h
					Pollutant concentration [mg/m^3]	Effluent flow [m^3/min]	Weigh rate [g/h]	Speed [m/s]	Emitted pollutant weight rate [g/h]	Maximum admitted concentration [mg/m^3]	Pollutant weight rate [ori]	Maximum admitted concentration [ori]	
1.	Lupeni Mine	Venting station SUITOR CENTRAL	Dusts	V1	0,918	3.161,4	174,129	5,38	500	50	-	-	S_{etl}= 9,786 m^2 v_{etl}=5,385 m/s T_{med} = 20,6 ^{0}C W = 79% h_{fagure} = 9,08 m $h_{st.\ vent}$ = 4,90 m Q=3.161,4 m^3/min O_2=20,4 % vol
			SO_2		0,9135		173,2		5000	500	-	-	
			NO_2		1,41		267,6		5000	500	-	-	
			CO		1,1455		217,28		NN	NN	-	-	
			CO_2		89,97		17.065,8		NN	NN	-	-	
			CH_4		49		9.294,51		NN	NN	-	-	
			Dusts	V2	0,875	3.432	180,18	5,5	500	50	-	-	S_{etl}= 10,40 m^2 v_{etl}=5,5 m/s T_{med} = 21,8 ^{0}C W = 71% h_{fagure} = 9,08 m $h_{st.\ vent}$ = 4,90 m Q=3.432 m^3/min O_2=20,3 % vol
			SO_2		0,261		53,745		5000	500	-	-	
			NO_2		0,94		193,56		5000	500	-	-	
			CO		1,7175		353,667		NN	NN	-	-	
			CO_2		53,98		11.115,56		NN	NN	-	-	
			CH_4		81,79		16.842,19		NN	NN	-	-	
2.	Uricani Mine	East venting station	Dusts	V1	0,914	2.874,75	157,65	4,1	500	50	-	-	S_{etl}= 11,686 m^2 v_{etl}= 4,1 m/s T_{med} = 24 ^{0}C W = 57,8% h_{fagure} = 3,8 m $h_{st.\ vent}$ = 3 m Q=2.874,7 m^3/min O_2= 20,4 % vol
			SO_2		0,3915		67,52		5000	500	-	-	
			NO_2		0,90		155,23		5000	500	-	-	
			CO		1,7175		296,24		NN	NN	-	-	
			CO_2		107,97		18.623,20		NN	NN	-	-	
			CH_4		206,13		35.554,33		NN	NN	-	-	
			Dusts	V2	1,031	2.497,12	154,476	3,93	500	50	-	-	S_{etl}= 10,69 m^2 v_{etl}=3,93 m/s T_{med} = 24 ^{0}C W = 77% h_{fagure} = 3 m $h_{st.\ vent}$ = 3,8 m Q=2.497,2 m^3/min O_2=20,4 % vol
			SO_2		0,522		78,212		5000	500	-	-	
			NO_2		0,94		149,84		5000	500	-	-	
			CO		2,290		343,115		NN	NN			
			CO_2		125,97		18.874,3		NN	NN			
			CH_4		196,3		29.412,02		NN	NN			

All tree processes go on simultaneously but often one process dominates depending on the pH value. All tree are also influenced by the presence of oxygen over a longer period time.

Chemical oxidation by oxygen

When pH is neutral the chemical oxidation by oxygen is the dominating process. Pyrite is reacting with oxygen and water and iron ions are produced together with sulphuric acid. The acid decreases the pH and the weathering increases. Simplified the reaction is:

$FeS_2 + O_2 + H_2O = Fe^{2+} + SO_4^{2-} + H^+$

Chemical oxidation by iron.

The iron ion produced i the former reaction can be oxidised into ferric iron. The Fe^{3+} ion is an exellent mediuom of oxidation and doesn`t need pxxygen to function. The two reactions are:

$Fe^{2+} + O_2 + H^+ = Fe^{3+} + H_2O$

$Fe^{3+} + FeS_2 + H_2O = Fe^{2+} + SO_4^{2-} + H^+$

In condition with a fluctuation water table in the tailing dam this two reactions are importance. When the water level is low the first reaction produces Fe^{3+} ions. When the water level is high this “bank’ of Fe^{3+} ions will continue to oxidise the sulphide minerals.[5, 6]

Bacterial oxidation

Bacterial oxidation occur in the pH interval between 0.5-6 but is most effective pH 2-3 and is then the dominating process. The oxidation is partly direct on the sulphide mineral and partly on iron depending which type of bacteria that is active. Three different bacteria are of importance:

Thiobacillus thiooxidans	oxidise sulphur
Thiobacillus ferrooxidans	oxidise sulphur and ferrous iron (Fe^{2+})
Ferrobacillus ferrooxidans	oxidise ferrous iron

Weathering due to bacterial processes is 10 times up to 1 billion times faster than chemical oxidation by oxygen.

Buffering capacity.

The dissolving or mineralising of minerals and metals are dependent of the pH. As will as the sulphide minerals weather, other mineral with buffering capacity (mainly calcite) are also weathering. The oxidation of the sulphide mineral takes place at the surface of the tailing dam. Often an enrichment zone is established beneath the oxidised zone. If the buffering minerals exceed the acid forming minerals the leakage of metals from tiling dam are small, but to neutralise a certain amount of sulphur ions demands three time as much Calcite ions.

The buffering capacity therefore is often only delaying the leakage and the real environmental impact from a tailing dam can be revealed first after 50-100 years.

Ways of preventing weathering.

In order to prevent weathering the transport of oxygen must be stopped or reduced. Important means of oxygen transport is diffusion in air (and water), air-density variation, movements of oxygenated water.

A barrier preventing these oxygen movements must be constructed. Two methods are used internationally.

- ✓ A capping layer of a non-permeable soil material
- ✓ A permanent water coverage of at least 1 metre depth.

The first method will minimise the seepage out of the dam and increase the stability of the dam, as the groundwater table will sink. The capping material must be dense with a relatively high water holding capacity to avoid oxygen diffusion. The material could be natural material as clay, silty, clay, peat or glacial till. It could also be cement mixed with ashes (cefyll) or geo- textile. Other possible material are tailing material where the Pyrite is removed or limestone grinded into a silt fraction using the production line in the dressing plant.

The second method is only applicable when the dam is situated where a pond or lake naturally could exist. That is where the water balance is positive. This method is not recommended if the oxidation of the tailing material has been in progress for some time. This because of the increased seepage will induce.

In dry areas with a water deficit a tailing dam with fine material will have a negative water balance and not emit leakage from bottom of the dam. The fine material will prevent oxygen diffusion under a certain depth and a soil profile will be establish with a oxidised layer at surface followed by an enrichment layer and unoxidised material underneath. This profile resembles a podzol profile found in natural soils in moist tempered areas. It`s important that the oxidised layer not gets eroded and thus exposing more Pyrite to oxidation.

Finally, another way of preventing leakage of metals and acid is to raise the pH by lime. The lime could either be spread on the surface of the dam or put into a deposit pond at the outlet. This method demand maintenance and can not be recommended in a long-term operation.

Rehabilitation

To prevent the deterioration of the situation and to stop the further erosion it is necessary immediate intervention according to a rehabilitation of it

Implementation of rehabilitation project will enable the interruption of deterioration of dams' situation (state), will arrange all elements of dams and will save these dams from their inevitable collapse.

If it`s possible to establish vegetation on the dam this is the most coat-effective way of preventing erosion.

Conclusions and recommendations

The dams are deposing places of the wastes of copper dressing plant Kurbnesh.
In these dams are deposed about 2 million tons tailings (wastes).
These dams are not maintained from the year of 1994.
In the body of dams are created cracks in the form of canyons and holes which continuously enlarge.
The material of dams from the cracks and holes has gone and still is going in Uraka River.
The dams are a potential polluting source for the zone around and for Uraka River.
The pollution from the dams of Kurbnesh is transmitted from Uraka River to the Ulza artificial lake, in the Mati River up to the Adriatic Sea.
The state (situation) of dams is going to be deteriorated more and more, towards a possible collapse.
It is recommended an immediate intervention for situation improvement.
It is recommended the compilation of a Project for Rehabilitation of dams.

Litterature:

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The managing system used to construct the dam, e.g. by subaqueous or subareal deposition.

The geotechnical characteristics of the deposited tailings, which include characteristics that arise from the methods of deposition and operation. [3]

Features built into the outer slope, e.g under-drainage systems, possible underlining systems etc.

The rate of rise of the tailings (which controls the pore water pressures and should be appropriate for other features in the design). The presence or absence of seismic activity.

An assessment of short and long-term erosion from the slopes.

Slow deterioration actions. Erosion

Erosion of tailings caused by water can be both internal and external. The internal erosion occurs where hydraulic gradients exist and where a flow path such as an abandoned buried pipe is present. External erosion occurs mainly at the slopes and the erosion rate is influenced by factors like slope gradient, slope length, compactness of tailings and precipitation. The slope angle is not only important for stability reasons.

In order to prevent erosion, controlling the precipitation flow is the most important single task. A crest wall at the dam front prevents the precipitation falling in the top of the dam to ruf off the slope at the dam front. [4] Dividing walls on the top will also control water movements but this will keep the water on the top of the dam and in some case influence the stability of the dam in a negative way. Runoff from surroundings should be kept away from the dam by tranches, channels etc.

Siltation or sedimentation of fine material in the open channels ditches etc, is a problem for-long term safety and must be taken into consideration. Adequate capacity and freeboard should be built in the constructions or ongoing post closure maintenance will be required.

Weathering

Weathering of sulphide minerals is due to oxidation and can be both chemical and biological. Factors that control or enhance weathering is:

- ✓ Oxygen content
- ✓ The minerals tendency of weathering
- ✓ Moisture of tailings
- ✓ Temperature
- ✓ pH

Pyrites have the highest tendency of weathering and other minerals as Chalcopyrites and Sphalerites obtain enhanced weathering by Pyrite.

The weathering products are sulphate-and hydrogen ions and metal ions as iron, copper and zinc. The production of hydrogen ions will lower the pH value and the weathering will accelerate. A low pH will keep the heavy metals in solution and these follow the water movements in the tailing dam.[1]

Weathering processes.

As mentioned above weathering is due to both chemical and biological processes. Manly there are tree different processes that can weather sulphide minerals.

Chemical oxidation by oxygen

Chemical oxidation by ferric iron (Fe^{3+})

Bacterial oxidation

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DETERMINATION OF THE ATMOSPHERIC RADIATION INTHE PROXIMITY OF THE MUD-SETTING PONDS FROM THE THERMAL POWER PLANT PAROSENI AND POSSIBLE EFFECTS ON THE VEGETATION DEVELOPMENT

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ABSTRACT

Through exploitation the coal are brought to the surface some of the radioactive elements in the earth's crust. Coal used in the process of Thermo-electric power station (CET) Paroseni produce from burning slag and ash, which is deposited in the Valley Caprisoara. It is known that, radioactive elements in the coal not burn and not oxidize, so that radioactive waste of ash is more concentrated. In this paper we propose to determine the distribution of radionuclides in ash and slag in deposits and surrounding areas. As a case study to observe atmospheric radiation effects on plants, was irradiated wheat in different stages of development. These measurements are necessary because the nature and energy of radiation emitted are conditional of ways the irradiation of organisms. Type your abstract in this field based on the following rules and it must be in English language. It should concisely state what was done, how it was done, principal results, and their significance. The abstract is limited to 400 words in length and cannot contain equations, figures, tables, or references. It should be written in a single column as justified and words should not be hyphenated. The author could provide up to 5 keywords (in alphabetical order) to help identify the major topics of the paper.

KEYWORDS

radioactivity, ash and slag, environment pollution

1. INTRODUCTION

Assessment of environmental factors in an area at a time is given by air quality, water, soil, the health of the population, the scarcity of plant and animal species recorded. The man contributes to the environmental changes through its various activities, household or technological. The mining and energy industries are the most powerful factors of environmental pollution they are responsible for air, water and soil pollution. The mining operations of coal, by technological activities, bring to the surface natural radioactive isotopes found in the depths of the Earth. Natural radioactive isotopes can enter into the chemical elements of the biosphere or stand as material deposits, raising the level of radioactivity in the area above the normal.

2. THEORETICAL CONSIDERED

Thermo-electric power station Paroseni is one of the sources of pollution in the Jiu Valley by emissions on the chimney and ash stored in the deposits of ash and slag that results from technological process.

Thermo-electric power station Paroseni is situated on a lower terrace on the right bank of the river Jiu, near the town of Vulcan, at 8-10 m from the railway Vulcan – Paroseni – Lupeni. This location was determined by the existence of numerous coal mining in the area. It is bordered to the north with the railway Livezeni – Lupeni, south with Route DN 66 Livezeni - Uricani, east access road to Paroseni Mining Exploitation and west of the river Jiu of West. Thermo-electric power station Paroseni is a electrical plant of heating with cogeneration that provides electricity and heat. Works with coal as a base fuel and provides heat for the residents of the four mining towns in the area, namely: Petrosani, Vulcan, Lupeni, Aninoasa. For producing electricity the power plants use as a source of primary fuel, fossil fuels. The chemical elements that by reaction with oxygen develop heat (exothermic reactions) are coal, hydrogen and sulphur. The final product resulting from the burning of coal is carbon dioxide, water and sulphur dioxide. Solid fuels, towards others fuel, contain and much sterile, which is to be found in the process of combustion in the form of slag and ashes. All products resulting from the combustion of solid fuel are pollutants, in the sense that they are changing the balance in the external environment, or acting directly on the animal and plant kingdom.

Solid fuels contain natural radioactive isotopes in natural concentrations which by burning lead to concentration in the combustion products. Radioactive isotopes in the products of combustion, which escapes into the atmosphere (gas, smoke and fly ash), broadcasts under the action of air currents and they are lodged gradually on soil, water and vegetation, causing the radioactive contamination of them.

By burning coal, results slag that settle on the furnace bottom the ash that escapes from filters of the chimney and get into the atmosphere, from where they are deposited on the soil, and hot gases and volatile.

Radioactivity of the coal and ash is mainly given by the content of uranium, thorium, potassium, and radium (over 80%) (Mauna & Mauna Aren, 2008). The average concentration of 238U and 232Th in charcoal is 20 Bq/kg and that of 40K is 50 Bq/kg, but can vary by orders of size (UNSCEAR, 2000). So, the accumulation of uranium in coal can vary from place to place depending on the deposit and the geological period in the region. In the coal of Romania were found value to six times more and for 40K and for 238 U the values are twice as large. (Botezatu et al., 2002). In addition one can find radionuclides by 235 U, 214 Pb, and trace amounts of bismuth, polonium etc. After the data provided and published by Bradley (1993) it shows that these radionuclides are mainly responsible for the emission of radiation.

The filters installed at the chimneys of power stations do not fully retain fly ash and radon, which are released entirely into the atmosphere, which leads to an increasing atmospheric radioactivity. To this increased radioactivity it is added the contribution of its descendants 210Pb, 214B, which are fixed on aerosols. This power plant that uses solid fuels to produce electricity burn huge amounts of fuel, which leads to emanations of fly ash and radioactive isotopes in atmosphere that can not be neglected because they are causing radioactive pollution of the environment. The produced radioactive pollution should not be neglected because it is continuous pollution. Population living in areas affected by radioactive pollution produced by power plants based on burning fossil fuels annually receive an additional dose of 300-500 μSv/year.

3. EXPERIMENTAL RESULTS

Radioactive isotopes of potassium 40K and radioactive elements by uranium and thorium series are the main elements that give natural radioactivity to rocks. The energies of gamma radiation emitted by the radioactive elements are distinct for each item. Potassium emits gamma radiation with energy of 1.46 MeV while uranium and thorium series emits gamma radiation of different values. Fly ash released trough the chimneys, the fine dust of ash driven by the wind from the dumps of slag-ash and the coal dust derived from deposits of coal or from the transportation and its preparation together constitute a solid contaminant, that is found in the form of aerosol, are the pollution factors from Thermo-electric power station Paroseni area. Monitoring reports to environmental factors prepared by Environmental Protection Agency Western Region shows that the dumps produce, especially in summer, a important pollution of air with powders (because ash is dry and the wind is taken). To determine the radioactive pollution of the atmosphere in the Thermo-electric power station Paroseni area, measurements were performed gamma absorbed dose rate in air during the months of July and November 2014, with Gamarad-DL7 radiations detector.Measurements were performed in the Thermo-electric power station Paroseni area and in downtown Vulcan and the results are presented in the graphs in figures 1 and 2.

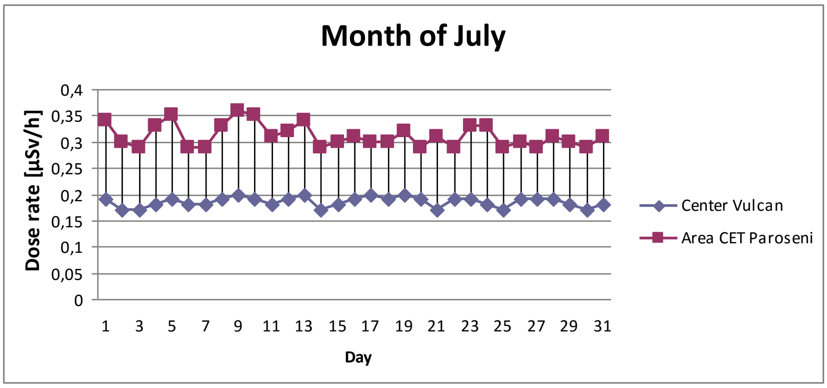

Figure 1: The radioactive pollution of the atmosphere in the month of July

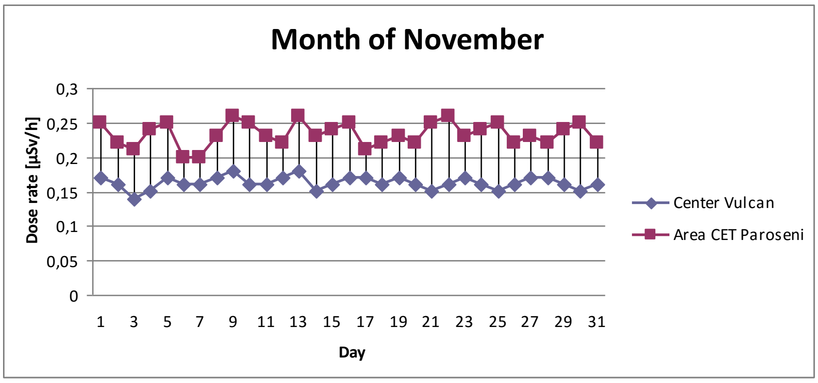

Figure 2: The radioactive pollution of the atmosphere in the month of November

From experimental measurements is observed the flow rates dose are high in the Thermo-electric power station Paroseni area, exceeding permissible limit value 0.250 µSv / h, while the town of Vulcan measured values are below the limits set for the European Union.Flow rates of the dose are high in the ash and slag deposit due to the presence in it of radioactive elements exceeding permissible limit value 0.250 µSv/h, even in neighbouring areas (figure 3). Plants are living organisms that accumulate radiation from environment. An exceeded limit radiation in the atmosphere can lead to the decrease in the ability to achieve plant photosynthesis, which reduces the level of development of plants, and can also lead to death.

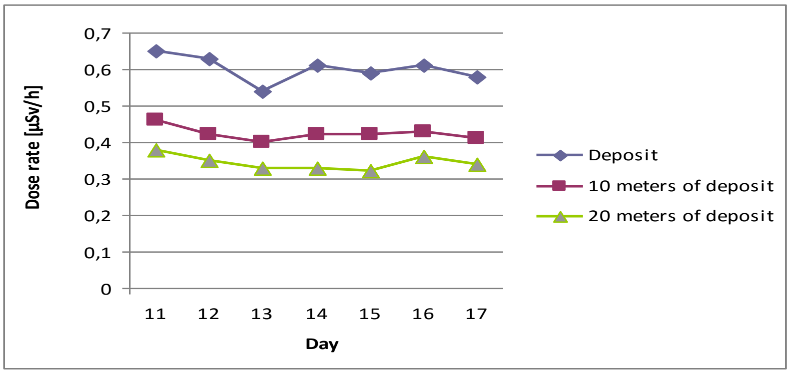

Figure 3: The radioactive pollution of the atmosphere in the month of November The radioactive pollution of the atmosphere in the ash and slag deposit, and the surrounding areas

Depending on the time of exposure and the amount of accumulated radiation there are studies showing that plants may suffer genetic mutations affecting the descending generations.

4. CONCLUSIONS

Following the technological process of Thermo-electric power station Paroseni radioactive elements are released into the atmosphere with fly ash and radon, which cannot be retained by the filters in the chimneys. Of measurements made during two months it observed a higher dose rate in the Thermo-electric power station Paroseni towards centre of Vulcan, faster growth in the month of July, when we add the dust pollution high from slag and ash deposits. The slag and ash from furnace falling into a water bath, is off, removed and inserted into a crusher for shredding. From crushing the slag is mixed with water and transported in ash and slag deposit from Caprisoara Valley. Dose rate measurements in this area indicate a high content of radioactive elements, both on the surface of the deposit and the surrounding areas. Even if the dose rate values are not very large, radioactive pollution is an important factor of pollution by the large amount of ash and slag discharged (about 130,000 m3). Radionuclides existing in the environment can be transferred to humans through water or food, great importance has 40K by fact it is primarily responsible for radiation dose received by humans. Radon is stored in the atmosphere air, in the particles of dust and water droplets, and by inhalation, reaches the lungs being a high risk of disease. Atmospheric radiation exceeding the maximum allowable may have adverse effects on vegetation. Atmospheric radiation reduces the development of the plants, leading even to death.

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PLOTTING DISPERSION MAPS OF POLLUTANT CONCENTRATIONS RESULTED FROM MINING ACTIVITIES WITH THE USE OF SPECIALISED SOFTWARE

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ABSTRACT

Ensuring the balance between economic growth and environmental protection for social and perspective development represents the new concept, based on which the governments of many countries are rethinking their economic strategies, concept called "sustainable development", presented for the first time in the Brundtland Report - "Our common future ".

Mining industry, through the activities developed, discharges significant quantities of dust and gases into the atmosphere, with impact both on human health and the surrounding areas.

Pollutant emissions can be estimated by applying methods for estimating harmful substances dispersion into the atmosphere (based on emission factor "e") or by computer programs and dispersion modeling.

The present paper presents the monitoring of main pollutants (CH4, CO, CO2, NO2, particulate matter) and drawing of pollutant concentrations dispersion maps using the Austal View program that allows the viewing of the pollutants distribution on the surface under study.

KEYWORDS

dispersion maps, environment, pollution, software, dusts, gases.

1. Overview

Nowadays, environment protection must be treated as a major community problem. Human desire to harness natural resources always affected environmental condition.

From environmental protection perspective, industry represents the most important area of human activity. Industrial development hadn't had in mind the fact that actual progress of human society depends not only on the goods it offers, but also on the damage caused to the environment.

Through its various branches, industry affects all environmental factors (air, water, soil, flora, and fauna), causing damage to human health, property or the environment.

Mining industry causes environmental damage both during extraction phase as well as during transport, storage and preparation stages. Surface drawing requires impairment of important areas of land, together with adjacent flora and fauna. Underground extraction involves excavations that weaken soil stability, including the area's resistance to earthquakes, influencing groundwater condition. Extraction, as well as other phases mentioned above, is accompanied by both significant emission of dusts and gases having major impact on human health and surrounding areas, and occurrence of environmental factors pollution.

To a larger or smaller extent, all industrial activities affect all environmental factors, leading to pollution and environmental impact phenomenon, almost every technological process having the design described in fig. no. 1.

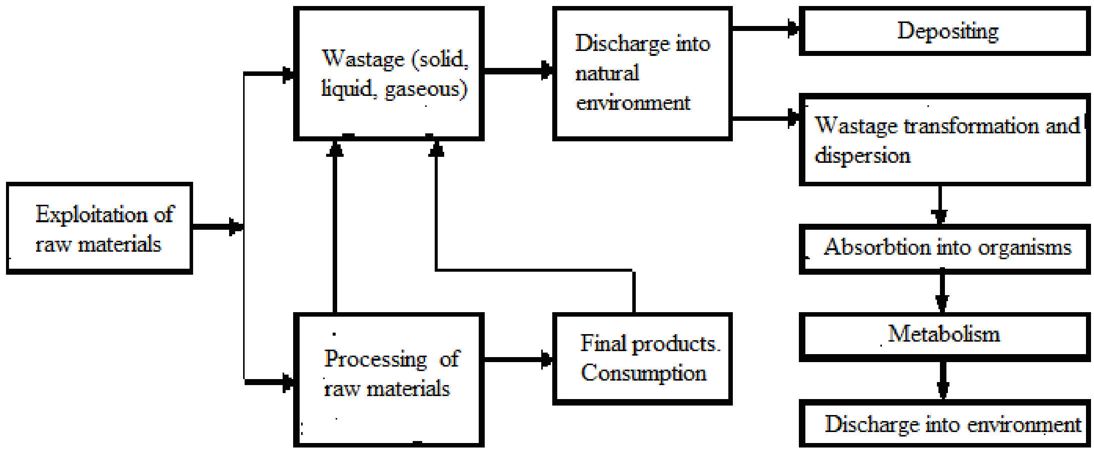

***Fig. 1** Interaction between industrial processes and environment*

Mining activity, regardless of how it is performed, always leads to long term negative effects for the environment.

Extracting useful minerals produces obvious effects when performed using explosives, either by noise pollution (noise) or by large amounts of dust emissions, causing major damage to vegetation in surrounding areas. Extracting by mechanical means produces noise due to equipment operation (permanent noise).

Depending on geomechanical properties of rocks, operational depth and methods used, exploiting underground deposits can lead to terrain sinking, thus affecting agricultural land and forestry, construction, hydrographic and communication networks etc.

Typical steps of the ore deposit extraction process are extraction, followed by ore processing and not least the transport and management of waste left over from processing.

All types of activities taking place in mining industry adversely affect flora and fauna and, generally, the entire ecosystem of the area in which the extraction takes place. The impact may be direct or indirect, immediate or deferred, its effects only rarely being limited to the place of the extractive activity, them being also extended to the surrounding territories. Usually, affecting a single environmental factor has effects upon the entire ambient system.

2. Sources of pollution in mining industry

The main sources of air pollution with industrial dust and gases are: emissions of dusts and gases from mine venting stations, particulate matter from quarry blasting operations, from tailing loading and unloading operations, from ore pre breakage and in particular from tailings and mineral substances technological transport using cable ways, belt conveyors, dumpers or quarry cars inside operating buildings or processing plants. Also, in many cases particulate matter pollution is observed, originated from ore and coal dry preparation plants, particulate and fire gases pollution originated from thermal power plants using solid or liquid fuel, operating within mining and preparation units, pollution with gases resulted from technological processes etc.

Over the years, systematic measurements of air pollution generated by industrial activities were made in Romania's main mine grounds, results of analyzes and measurements leading to the conclusion that in each unit there are areas where concentrations of pollutant gases and content of particulate matter exceed thresholds established by Romanian norms in force.

The concept of Mine Life Cycle Management (Life Cycle Management - LCM) refers to incorporating and addressing all stages of the mine's life, in terms of environmental management and sustainable development (FOURIE ŞI BRENT, 2006).

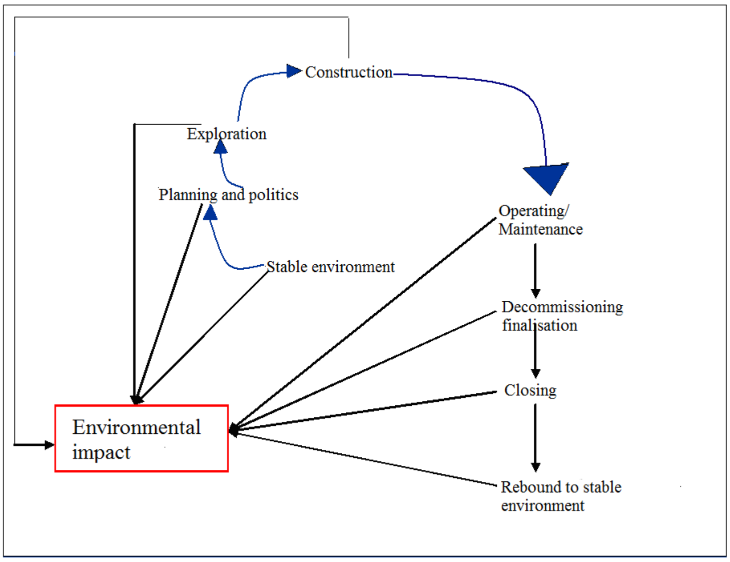

***Fig. 2** General model of a mine's life cycle (after FOURIE ŞI BRENT, 2006 –modified)*

The impact of mining and extractive industries on the environment can be analyzed by reference to the following statistical issues associated with mining cycles (Fig. 3).

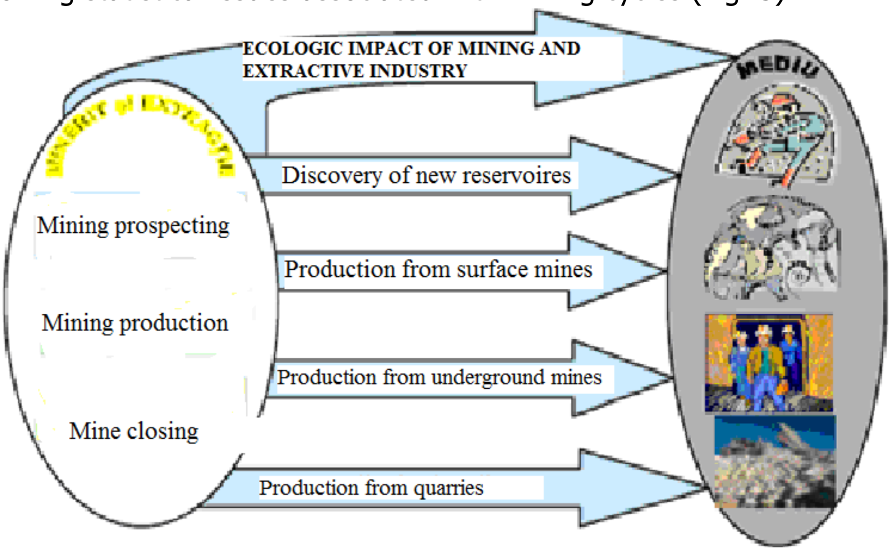

***Fig. 3** Ecologic impact of mining and extractive industry (Grădinaru, 2002)*

Environmental impact assessment is crucial for remediation and ecological restoration, representing the basis for management practices. Environmental assessment ranges from local biota inventory, determination of contaminants in the environment and organisms, environmental impact assessments up to environmental risk assessments for a given substance or any other disruptive factor.

3. Pollutant dispersion and dispersion models

Emissions of air pollutants do not remain at the sources where they were released. As the move away from their source, they are dispersed into the air due to physical or chemical phenomena. In some areas they are deposited on the ground or decomposed, self-purification of the atmosphere being achieved.

Distance at which atmospheric air properties can be restored is dependent on one hand on pollutants concentration, and on the other hand on meteorological and topographical factors.

In Romania, air pollution was regulated by STAS 12574/87 issued by the Ministry of Health and by Law 104/2011 on ambient air quality. Air quality is defined by the maximum allowable concentrations (C.M.A. $\mu g/m^3$) of various pollutants in protected areas air.

Pollutants dispersion has been extensively studied and based on researches conducted various laws and relations were established, subsequently used in calculating concentration of pollutants in the atmosphere.

Although the number of factors that influence the phenomenon of pollutants dispersion in the environment is high, attempts were made, within certain simplifying assumptions, to model the process on short, medium or long term. It is of great importance that models are certified by in situ measurements and statistical processing.

Dispersion models can be diagnostic or prognosis models.

The biggest problems in practical analysis of air pollution occur in urban areas where air flow is significantly altered by the roughness of surfaces covered by buildings.

There are many theoretical methods for forecasting the diffusion, for comparison with field measurements and with laboratory diffusion experiments. These methods include models based on spectral diffusion and turbulent motion and small perturbations simulations. Thus, we mention the following dispersion models: Gaussian, Taylor, Carlo, Langevin etc.

The most practical applications of dispersion models use a simple model, namely "Gaussian plume model" in which determination of pollutant concentration is calculated using the formula

$$C = \frac{Q}{2\pi\sigma_y\sigma_x}\exp\left(-\frac{y^2}{2\sigma_y^2}\right)\left[\exp\left(-\frac{(z-H)^2}{2\sigma_z^2}\right)+\left(-\frac{(z-H)^2}{2\sigma_z^2}\right)\right] \quad (1)$$

Where:

C – Pollutant concentration (kg/m^3);

Q – Pollutant weight rate in spot source (kg/s);

H – Actual stack height above ground (m);

y – Side distance from plume center (m);

z – Height above ground (m).

Lately special attention is given to studying dispersion of pollutants emitted into the atmosphere by multiple or isolated pollution sources, with continuous or accidentally operation mode, because it is increasingly clear that human activities have caused a "disruption" of environmental equilibrium.

One of the least expensive ways of action against air pollution is mathematical modeling. Mathematical modeling of pollutant dispersion in the atmosphere consists in estimating concentrations of pollutants on soil and in air depending on the characteristics of pollution sources, weather conditions, physical and chemical transformation processes that may occur to pollutants in the atmosphere and their interaction with ground surface.

4. Pollutant dispersion modeling for areas surrounding venting stations using a specialized program

Underground and surface activities generate significant amounts of dusts and gases that pollute both mining area and the environment.

Both underground gases (CH_4, SO_x, NO_x, CO şi CO_2) and particulate matter are largely discharged on surface through venting stations. It is noted that CH_4 and CO_2 result naturally from bedding and dusts and other gases are the result of underground technological work / processes.

Given that mineral substances and rock material extraction activities have a negative impact on the environment by discharging air pollutants, the staff of Laboratory of Environmental Protection within INSEMEX NRDI Petrosani conducted a series of measurements regarding gas concentrations emitted by main venting stations in Jiu Valley mines.

Measurement of particulate and gas emissions were made gravimetrically (for dusts) and instrumentally (for gases) using the ISOSTACK BASIC automatic isokinetic sampling system and Multigas Orion Plus portable devices.

5. Drawing dispersion maps

Any complete monitoring system for air quality and environment in general should be structured in four parts, following the pollutants causal chain ***"generation - transfer - air quality - effects"***.

Thus, the structure of air quality monitoring system is based on four modules:

- Monitoring of pollutants emissions and sources (EMISSIONS);
- Monitoring of decisive parameters for pollutants transfer and diffusion (TRANSFER);
- Monitoring imissions (IMISSIONS);
- Monitoring of air pollution effects (EFFECTS).

Pollutant dispersion and deposition are strongly influenced by weather conditions (*air temperature and pressure*, etc.) such as wind speed and direction and atmospheric turbulence.

Pollutant dispersion modeling techniques represent a very useful tool in solving the issues of being in the known and assessment of air quality, techniques whose application requires an inventory of emissions. Results derived through mathematical modeling, either compensate or make up for results obtained through monitoring.

Austal View program allows dispersion modeling for pollutants emitted from one or more sources and also completes a chart of the current situation as well as forecast critical scenarios, proposed by the operator.

Software entry data take into account:

- Selection at source of dust and gas emissions area;
- Representation of the source position based on its coordinates in the selected plan;
- Location of targets, respectively receptors (height and form of construction);
- Determination of dispersion calculation grid;
- Pollution source Technical parameters (H, S);
- Gaseous effluent aerodynamic parameters (effluent flow, pollutants weight rate, air speed);
- Source state parameters (T, W);
- Climatic parameters (T, ambient $W_{air,}$ Pb, prevailing wind speed and direction);
- Pollutant nature (40 dust and gas pollutants);
- Pollutant concentration;
- Characterization of land morphology.

Using the obtained values and microclimate parameters needed to assess / analyze dispersion, measured pollutants concentration dispersion (dust, CO, NO_2 and SO_2) was plotted by using Austal View specialized software and by implementation of isoconcentrations over the site plan.

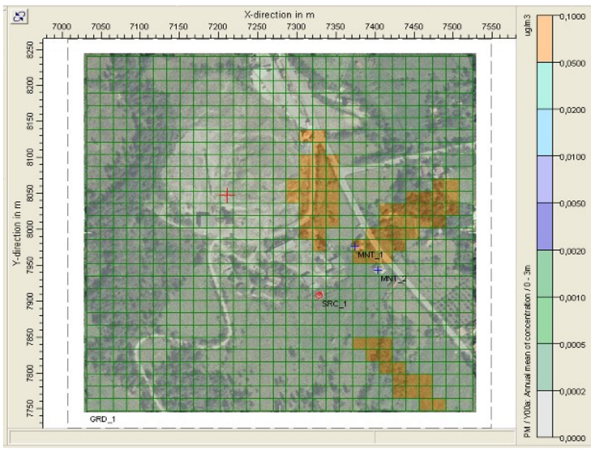

Fig. 4 *Dust concentration dispersion plotting*

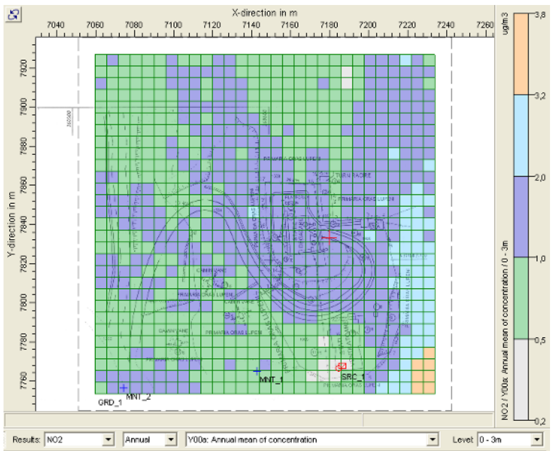

Fig. 5 *NO_2 concentration dispersion plotting*

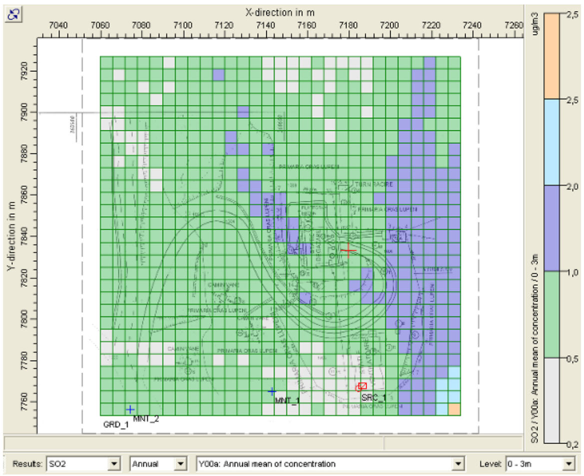

***Fig. 6** SO_2 concentration dispersion plotting for venting station Suitor Central – Lupeni mine – ventilator V1 emission source*

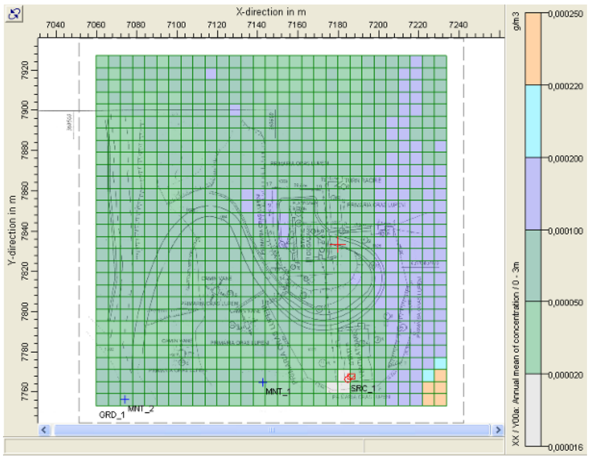

***Fig.7** CO_2 concentration dispersion plotting for venting station Suitor Central – Lupeni mine – ventilator V1 emission source*

From the graphical representation it is noticeable that dust and gas imissions generated by pollutants emission from venting station Suitor Central – Lupeni mine and venting station Put Est-Uricani mine do not exceed the limit value and / or threshold established by Order no. 104 /2011.

5. Conclusions

Operational system for air pollution forecasting consists of a number of different air pollution modeling, with the most important pollutants, at different scales.

The use of dispersion models able to predict the pollution degree allows for the development of strategic plans to ensure the security zone around major pollution sources.

The main objectives of the system are: air pollution forecasts, now casting, scenarios, retrospective analysis, as well as public information and warning in case of pollution exceeding the maximum allowed concentrations.

Maximum allowed concentrations of pollutants emissions, specified by Order 462/1993 issued by Ministry of Waters, Forests and Environmental Protection (now replaced by Law 278/2013) are designed to protect people and ecosystems from harmful effects of these substances.

Meteorological agents (horizontal air movement and upward convection, precipitation) have the leading role in the diffusion and dilution of pollutants, in air self-purification.

Measurements of gas and dust emissions made during July and August for both studied venting stations were performed gravimetrically (for dusts) using the ISOSTACK BASIC automatic isokinetic sampling system and instrumentally (for gases) using the Multigas Orion Plus portable equipment.

The measured values of particulate and gas **emissions** at the mentioned venting stations do not exceed the pollutants weight rate or the maximum permissible concentration specified by Order 462/1993 issued by MAPPM.

Graphic representation of measured pollutant dispersion (dust and gases) was performed by using the Austal View specialized software and by implementation of isoconcentrations over the site plan of Suitor Central premises pertain to venting station SUITOR CENTRAL, respectively over de site plan of Put Est premises.

The measured values of particulate and gas **imissions** for venting station SUITOR CENTRAL (Lupeni mine) and venting station Put Est (Uricani mine) do not exceed the limit value and / or the threshold established by Law 104/2011 on ambient air quality.

Table 1 shows emissions of particulate and gases station measured at venting station SUITOR GENERAL (Lupeni mine) and venting station Put Station East (Uricani mine).

ISOSTACK BASIC automatic sampling system allows particulate and gases sampling at discharge shafts in isocinetism conditions; this means that the sampling rate must be set so that speed of effluent entering the sampling nozzle and velocity of the gas in the shaft are equal. In choosing the location and distribution of sampling points we had in view that the gas flow is not always laminar, and the granulometric distribution of particulates is not uniform.

Table no1 shows that measured values of gas and particulate emission at aforementioned venting stations do not exceed the pollutant weight rates or maximum permissible concentration specified by Order 462/1993.

We also had in view that explaining dust and gases emission data, must be made according to the technological processes carried out underground (which represent the main sources of dust and gas formation) such as e.g. drilling, blasting, cleaning + reinforcement, coal unloading from bench, lifting beams, taking of props and so on.

Given either the distances from foreheads to ventilation furnace, or the small quantities of ammunition used in blasting or the use of effective countermeasures systems (sprays discharges, fog curtains, etc.) there were slight differences in dust and gas concentrations values during monitoring interval. Thus, concentrations of particulate for main dust generating activities (shearer cutting, punching, cutting from CA, sections stepping, coal unloading from bench, taking of props etc.) is up to 2.94 times higher than the activities not representing dust sources. During the time after blasting, gas concentration measured at the ventilation comb is higher, as follows:

- For SO_2 of 1.14 times;
- For NO_2 - 0.68 times;
- For CO_2 - 1.32 times;
- For CO - 1.02 times.

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EVALUAREA IMPACTULUI ACTIVITĂȚILOR MINIERE, DIN CARIERELE BAZINULUI JILȚ, ASUPRA SUPRAFEȚELOR DE TEREN ȘI SOLUȚII DE REABILITARE

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ABSTRACT

Exploatarea minieră la zi afectează mediul înconjurător, pe de o parte, prin modificarea peisajului, iar pe de altă parte, prin intervenţia brutală a carierelor în procesele şi ritmurile naturale, ale ecosistemelor. Toate aceste efecte au condus la apariţia unui conflict de interese între necesitatea extragerii materiilor prime minerale şi cerinţele privind protecţia mediului într-o asemenea măsură încât întreprinderile miniere au început să fie privite ca "distrugătoare de mediu".

Cu toate că efectele negative ale exploatării miniere la zi sunt importante şi de necontestat, această ramură industrială are la îndemână posibilităţi multiple de minimizare a impactului negativ asupra mediului şi, mai mult decât atât, de reconstituire a zonelor afectate.

KEYWORDS

exploatări miniere la zi, suprafețe, activitate haldare, evaluare impact, reconstrucție ecologică.

1. DATE GENERALE

Terenurile reprezintă o resursă finită, fragilă şi neregenerabilă şi includ solul, care este important în special pentru agricultură; coperta vegetală, care este importantă pentru mediu şi peisajele, care reprezintă o componentă importantă a habitatului uman şi a bunăstării. Noţiunea de "teren" desemnează, pe de o parte, suprafaţa disponibilă pentru o anumită utilizare, iar pe de altă parte, o formă concretă de prezentare a suprafeţei Pământului. /Lazăr M., 2010/

Astfel terenul poate fi considerat ca fiind: zona delimitabilă a suprafeţei terestre a Pământului, care cuprinde toate atributele biosferei aflate imediat deasupra sau sub această suprafaţă, inclusiv climatul din apropierea suprafeţei, solul şi formele de relief, apele de suprafaţă (inclusiv lacurile puţin adânci, râurile şi mlaştinile), stratele de roci sedimentare aflate aproape de suprafaţă şi asociate resurselor de ape subterane, comunităţile vegetale şi animale, modelul rezidenţial uman şi rezultatele fizice trecute şi prezente ale activităţii umane (terasări, rezervoare de apă sau structuri de canalizare, drumuri, clădiri etc.).

2. AMPLASAREA GEOGRAFICĂ

Only Din punct de vedere administrativ, bazinul minier Jilţ este situat în partea sud-vestică a judeţului Gorj, pe teritoriul comunelor Mătăsari, Dragoteşti, Slivileşti şi Negomir.

Se întinde între aliniamentele localităţilor Brădeţel, la nord, Ştiucani, Miculeşti şi Slivileşti, la vest, Corobai şi Strâmtu la sud şi Negomir şi Timişeni la est, pe o suprafaţă de cca. 65 ha.

În figura 1 este prezentată o vedere de ansamblu a celor două cariere, Jilţ Sud şi Jilţ Nord, cu încadrarea lor în bazinul Jilţ, precum şi cu extinderea actuală.

Figure 1: Carierele Jilț Sud și Jilț Nord Equations

3. IMPORTANŢA ANALIZELOR DE IMPACT

Pentru înţelegerea problemelor şi conceptelor unui proces de evaluare a impactului asupra mediului, trebuie definite noţiunile şi termenii de bază cu care operează acesta /Lazăr M., Dumitrescu I., 2006/.

A. Procedura de evaluare a impactului asupra mediului este un instrument – proces pentru realizarea unei politici preventive şi reprezintă o aplicaţie a principiului "cea mai bună politică ecologică constă în evitarea de la început a poluării şi a altor accidente ambientale, mai degrabă decât combaterea succesivă a efectelor ".

B. Procedura de evaluare a impactului asupra mediului este un sistem suport al deciziilor. Studiile de impact nu pot fi reduse la faza de descriere, ci trebuie să ajungă la o evaluare, pentru a oferi autorităţilor competente elementele de decizie, stabilind în mod ştiinţific efectele posibile asupra mediului înconjurător ale acţiunilor ce trebuie întreprinse.

C. Procedura de evaluare a impactului asupra mediului, în ceea ce priveşte procesul de decizie, explică potenţialurile majore ale mai multor alternative între care se face alegerea; adică pune problema definirii alternativelor proiectului, cuprinzând şi alternativa zero, a analizării impacturilor ţinând seama de durata prevăzută pentru proiect şi a comparării alternativelor în cadrul unui sistem dat de obiective şi/sau conexiuni.

D. Există evaluări ale impactului asupra mediului cu diferite nivele de aprofundare, în funcţie de momentul procesului decizional în care se află procedura: faza iniţială (studiu de fezabilitate), faza intermediară (proiect de principiu), faza finală (proiect executiv).

E. Prin intervenţii sau acţiuni care trebuie supuse procedurii de evaluare a impactului asupra mediului, nu se înţeleg numai lucrările aferente unui proiect, ci şi instrumentele de plan, programele, normele, deciziile care afectează direct sau indirect mediul înconjurător.

F. Există diferite persoane implicate în procesul de evaluare a impactului asupra mediului.

G. Procedura de evaluare a impactului asupra mediului trebuie înţeleasă ca un proces de participare a publicului, aceasta fiind una dintre funcţiunile principale ale procedurii.

H. În scopul unei serii de verificări ştiinţifice şi a unei participări constructive, elaborarea studiului de evaluare a impactului asupra mediului trebuie să fie întotdeauna un proces corijabil şi, deci, cât se poate de transparent.

4. IMPACTURI NEGATIVE MANIFESTATE ASUPRA TERENURILOR

4.1. Ocuparea suprafețelor de teren și modificarea peisajului

Totalitatea alterărilor reversibile sau ireversibile, produse mediului este subordonată tehnicilor şi tehnologiilor adoptate pentru extragerea cărbunelui, existând foarte multe similitudini dar şi particularităţi specifice fiecărei cariere din bazinele miniere din Oltenia.

În funcţie de locul de amplasare al exploatărilor miniere s-au scos din circuitul agricol, silvic (figura 2) şi de alte folosinţe, suprafeţe mari de teren. (în tabelul 1)

Table 1: Situaţia suprafeţelor de teren ocupate de activitatea minieră în Bazinul Minier Jilț

<table>
<tr><th colspan="13">Suprafețele de teren ocupate de activitatea minieră în Bazinul Minier Jilț</th></tr>
<tr><th colspan="13">în perioada 1973-2014</th></tr>
<tr><th rowspan="5">Nr. Crt.</th><th rowspan="5">Unitatea / Obiectivul</th><th rowspan="5">Perioada</th><th colspan="10">Suprafața (Ha)</th></tr>
<tr><th rowspan="4">TOTAL BAZIN JILȚ</th><th colspan="9">din care:</th></tr>
<tr><th rowspan="3">Silvic</th><th colspan="7">Agricol</th><th rowspan="3">Alte terenuri</th></tr>
<tr><th rowspan="2">Total</th><th colspan="5">din care:</th></tr>
<tr><th>arabil</th><th>livezi</th><th>vii</th><th>fânețe</th><th>pășune</th></tr>
<tr><td></td><td>Bazinul Minier Jilț -total</td><td>1973-2014</td><td>2146.62</td><td>350.97</td><td>1751.18</td><td>613.22</td><td>46.83</td><td>30.62</td><td>317.06</td><td>743.45</td><td>44.59</td></tr>
<tr><td>1.</td><td rowspan="3">Jilț</td><td>1973-1990</td><td>1687.90</td><td>294.00</td><td>1375.10</td><td>454.60</td><td>40.00</td><td>22.00</td><td>198.00</td><td>660.50</td><td>18.80</td></tr>
<tr><td></td><td>1990-1999</td><td>335.80</td><td>38.02</td><td>278.90</td><td>113.50</td><td>3,28</td><td>4,42</td><td>91.40</td><td>66.30</td><td>18.50</td></tr>
<tr><td></td><td>1999-2014</td><td>122.92</td><td>18.95</td><td>97.18</td><td>45.12</td><td>3,55</td><td>4,20</td><td>27.66</td><td>16.65</td><td>7,29</td></tr>
</table>

Influenţele activităţilor de decopertare şi apoi de haldare asupra solului şi stabilităţii terenului se manifestă prin modificări ale microreliefului, prin sistematizări, nivelări ale terenului şi prin schimbarea categoriei de folosinţă şi a potenţialului de producţie al solului existent.

Figure 2: Suprafaţă de teren scoasă din circuitul silvic

Depozitarea sterilului provenit din activitatea de excavare în halde provoacă alterări funcţionale sau distrugerea terenului în care este amplasată halda.

4.2. Impactul asupra solului şi subsolului

Impactul produs de activităţile de exploatare la zi a cărbunelui asupra solului şi subsolului este un impact local şi zonal în suprafaţă şi volum, de lungă durată şi se referă la:

1. deranjarea echilibrului fizico-chimic al mediului geologic, produsă de prospecţiunile geologice, hidrogeologice şi geo-tehnice prin foraje, etc
2. afectarea solului şi subsolului prin activitatea de construcţie de clădiri, drumuri, etc;
3. distrugerea mediului geologic natural:
   - stratul de sol este recuperat de pe terenuri agricole dar imposibil de recuperat de pe terenurile forestiere defrişate, şi ca urmare acesta este distrus;

- stratele de roci sunt dislocate, excavate, transportate şi depozitate pe amplasamente pe adâncimi de ordinul zecilor şi chiar sutelor de metri;
- masele miniere rezultate, steril şi util, dobândesc caracteristici geo-tehnice, diferite de roca de bază;
- dezechilibrul fizico-chimic în subsol produs de lucrările de excavaţii şi haldare se extinde şi în zonele limitrofe perimetrului minier.

4.3. Activitatea de haldare

Amplasarea haldelor în bazinul minier al Olteniei, s-a făcut ţinându-se cont într-o mică măsură de impactul asupra mediului – impact vizual neplăcut, distrugerea şi ocuparea de mari suprafeţe de teren, scoaterea acestor suprafeţe fie temporar fie pe o durată mai mare de timp din circuitul economic, dar primordial a fost criteriul distanţă cât mai mică faţă de câmpul carierei, în cazul haldelor exterioare, ulterior după dezvoltarea carierelor creându-se condiţiile tehnologice s-a aplicat haldarea interioară.

La exploatarea lignitului în carierele din Oltenia /Fodor, D., 1995/, utilizând tehnologii în flux continuu, construirea haldelor se face cu maşini de haldat de mari dimensiuni, de construcţie specială cu funcţionare continuă, transbordoare cu braţ în consolă tip ARSB şi A2RSB, aceste utilaje depun sterilul în haldă sub forma a două trepte – o treaptă înaintaşă şi o supratreaptă (fig. 3).

Figure 3: Activitatea de haldare

Haldele de steril, în afara impactului negativ asupra mediului, al depozitelor de steril, pot constitui, atunci când sunt amplasate sau construite necorespunzător, reale pericole pentru zona adiacentă, datorită riscurilor de deformare şi alunecare care pot apărea.

5. EVALUAREA IMPACTULUI

Evaluarea impacturilor este faza în care se trece de la o estimare a impacturilor prevăzute asupra diverselor componente ambientale, la o evaluare a importanţei pe care valoarea prognozată pentru acea componentă sau factor ambientale o are într-un anumit context.

Se pune întrebarea dacă valoarea prognozată pentru diferiţi indicatori utilizaţi în fazele de descriere şi prognoză şi pentru diferitele alternative vor produce variaţii semnificative ale calităţii mediului şi, în măsura în care este posibil, de indicare a unei mărimi faţă de o scară convenţională (de exemplu 1 -3) care permite compararea magnitudinii diferitelor impacturi şi de stabilire a unei serii de operaţii pentru evaluarea impactului complex /Lazăr M., Dumitrescu I., 2006, Lazăr M., Faur F., 2011/.

Pentru a evalua impactul asupra terenului generat de activitatea minieră din bazinul Jilț am propus matricea prezentată în tabelul 2.

Table 2: Matrice de impact pentru activitatea de exploatare a lignitului în bazinul minier Jilț

Componenți ambientali	Acțiuni specifice exploatării lignitului								Reconstrucţie ecologică
	Defrișări	Descopertare	Exploatare lignit	Transport	Haldare	Asecări	Devieri	**Impactul cumulat asupra factorilor de mediu**	
Sol	-	-3	-	-1	-3	-1	-	**-8**	+3
Subsol	-	-3	-3	-	-	-	-	**-6**	-
Ape de suprafaţă	-	-	-	-	-	-2	-2	**-4**	-
Ape subterane	-	-	-	-	-	-3	-	**-3**	+2
Vegetație	-3	-1	-1	-1	-2	-2	-	**-10**	+3
Faună	-3	-	-	-2	-2	-	-1	**-8**	+2
Ecosisteme	-3	-2	-2	-1	-2	-1	-2	**-13**	+2
Nivel de zgomot	-1	-1	-1	-2	-1	-	-	**-6**	-
Morfologie	-	-3	-3	-	-3	-	-1	**-10**	+1
Peisaj	-3	-3	-3	-1	-3	-	-1	**-14**	+2
Mediu socio-economic	-2/+1	-	+3	-	-	-	+1	**-2/+5**	+2
Microclimat	-2	-1	-1	-1	-1	-1	-	**-7**	+1
Calitatea aerului	-2	-1	-1	-1	-1	-	-	**-6**	+1
Disponibilitate de resurse	-3	-2	-3	-	-	-	-2	**-10**	+2
Riscuri	-	-1	-1	-1	-3	-1	-	**-7**	-
Impactul cumulat al activităţilor asupra terenului	**-22/+1**	**-21**	**-19/+3**	**-11**	**-21**	**-11**	**-9/+1**	**-114/+5**	**+21**

Se poate observa majoritatea impacturilor generate de activitatea minieră sunt negative, multe dintre ele fiind și ireversibile sau reversibile pe termen lung.

Impacturile pozitive țin de stimularea mediului socio-economic atâta timp cât activitatea minieră susține majoritatea populației din zonă și de scăderea riscului de producere a inundațiilor ca urmare a regularizării și devierii cursurilor de apă.

Așa cum se poate observa în cazul defrișărilor putem aborda o dublă interpretare:

- pe de-o parte, odată defrișate pădurile nu mai constituie o sursă de venit (de importanță medie) pentru populație, iar refacrea acestora este una de lungă durată;

- pe de alta, valorificarea lemnului disponibil în momentul extinderii carierelor este o sursă de venit pe termen scurt.

Cu alte cuvinte defrișările nu sunt un mod durabil de gestionare a pădurilor.

Pe baza documentaţiilor studiate, caracteristicile mediului natural în zona studiată, parametrii calitativi ai factorilor de medi și a observaţiilor directe efectuate personal în zona bazinului minier Jilț, am efectuat o analiză, ţinând cont de componenţii ambientali şi sursele de poluare identificate care a stat la baza acordării notelor de bonitate.

APA

- disponibilul de apă - 7
- indicator fizico-chimici de calitate - 8
- bilanțul hidric – 6
- debitul anual – 7

Valoare medie 7

SOLUL ȘI SUBSOLUL

- relieful și topografia (panta terenului) – 6
- suprafața de teren afectată (față de suprafața concesionată) – 5
- disponibilul de resurse neregenerabile – 4
- contaminarea solului – 7
- distrugerea echilibrului solului – 4
- capacitatea agrochimică – 7

Valoare medie 5,5

ATMOSFERA

- calitatea aerului – 8
- regimul termic – 8
- regimul pluviometric – 7
- regimul eolian – 7

Valoare medie 7,5

VEGETAȚIA ȘI FAUNA

- suprafața defrișată și ocupată (față de suprafața concesionată) – 4
- densitatea speciilor vegetale – 6
- densitatea speciilor animale – 5
- distrugerea habitatelor naturale – 4

Valoarea medie 4,75

POPULAȚIA

- indicatori demografici - 8
- starea de sănătate și calitatea vieții – 7
- fenomene sociale – 8

Valoarea medie 7,66

Metoda grafică, propusă de V. Rojanski constă în determinarea indicelui global de impact prin raportul dintre suprafaţa ce reprezintă starea ideală a mediului şi suprafaţa ce reprezintă starea actuală a mediului, astfel:

$$I_{GI} = \frac{S_I}{S_a} \quad (1)$$

unde: SI – suprafaţa stării ideale a mediului;

Sa – suprafaţa stării actuale a mediului;

În situaţia analizată, indicele global de impact s-a estimat prin raportarea suprafeţelor celor două poligoane, reprezentate grafic în figura 4, valoarea indicelui global de impact fiind IGI = 2,26.

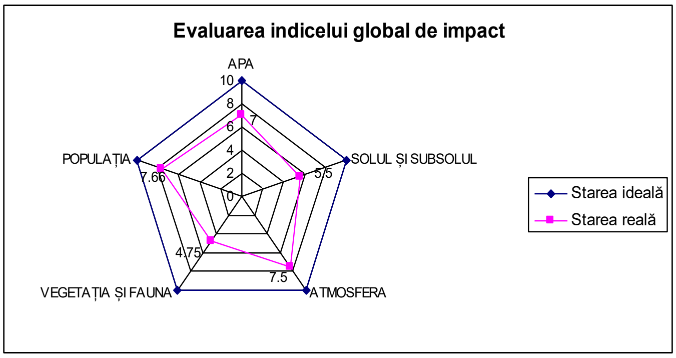

Figure 4: Indicele global de impact

Această valoare, de 2,26 ne indică (în funcție de scara de apreciere a impactului) că avem de-a face cu un mediul supus activităţii antropice este afectat, provocând stare de disconfort formelor de viată.

6. SOLUŢII DE REABILITARE

O reabilitare reuşită a zonelor afectate de activităţile miniere trebuie să răspundă unei finalităţi clare (*zonă naturalistică, zonă recreativă, zonă industrială*) şi în cazul în care obiectivele nu sunt compatibile între ele, este necesar să se aleagă alte alternative bine motivate.

Este important să se abordeze problema reconstrucţiei ecologice ţinând cont de posibilitatea recuperării multiple a terenurilor. Utilizarea multiplă a terenurilor presupune suprapunerea diferitelor utilizări şi funcţiuni ale terenului şi cel mai important aspect – aceste funcţiuni să se completeze reciproc şi să se încadreze ambiental cu zonele vecine.

Oricare dintre tipurile de recuperare posibil de aplicat, trebuie să aibă la bază un plan general de amenajare însoţit de aprobările necesare.

În ceea ce priveşte recomandarea pentru redarea în circuitul economic, se ţine cont de o serie de factori, dintre care cei mai importanţi sunt, recomandările din planul general de amenajare aprobat şi pantele rezultate în urma modelării suprafeţei, cunoscut fiind faptul că pentru terenurile acoperite cu vegetaţie forestieră, acestea nu trebuie să depăşească 30%, iar pentru terenurile pretabile circuitului agricol, pantele trebuie să se situeze în intervalul 0–18%.

Recultivarea nu înseamnă neapărat cultivarea unor culturi asemănătoare cu cele de pe terenurile zonale înconjurătoare, ci utilizarea acelor specii, tehnici de cultivare, de amendare, fertilizare şi semănat care să permită evoluţia pozitivă a materialelor din halda amenajată, acumularea de materie organică şi, în final, dobândirea fertilităţii.

Pentru instalarea cu succes a vegetaţiei pe haldele rezultate din exploatările miniere la zi Jilt Sud si Jilt Nord este necesară aplicarea unui sistem de fertilizare și amendare specific. Eterogenitatea materialelor haldate datorită excavării și depunerii neselective în haldă, conduce la o variabilitate foarte mare a caracteristicilor fizico-chimice ale substratului supus recultivării. Plantare a puieţilor de salcâm se execută toamna sau primăvara, după efectuarea lucrărilor de nivelare, afânare prin scarificare, arare şi grăpare.

Una din soluţiile moderne de reutilizare a terenurilor degradate de activitatea minieră pe care am *propus-o şi acceptată de comunitatea din zona Jilț* o reprezintă înfiinţarea unei plantaţii *de Paulownia* pe una din haldele carierelor Jilț.
O altă soluție este Miscanhtus Giganteus, cunoscută şi sub numele de Iarba elefantului, este o plantă perenă ce provine din Asia, iar pentru calităţile energetice deosebite a fost adoptată cu succes şi în Europa.
De asemenea, s-a efectuat un studiu bibliografic asupra cerinţelor speciilor şi soiurilor de pomi şi de arbuşti fructiferi faţă de lumină fiind necesar la amplasarea lor pe terenurile în pantă, în raport cu punctele cardinale, la stabilirea distanţelor optime de plantare, a desimii şi formei coroanei etc.
Crearea zonelor verzi, reprezintă un mijloc important de combatere a acţiunii factorilor poluanţi, şi de ameliorare a mediului de viaţă al oamenilor.
Pentru reuşita recultivării şi accelerarea acestui process, tratarea unitară a suprafeţelor care urmează să fie redate, realizarea unui landşaft corespunzător din punct de vedere economic şi estetic, care să nu distoneze cu cadrul natural, este necesar ca pentru noile exploataţii miniere la zi, odată cu elaborarea documentaţiilor pentru deschiderea noilor cariere să fie elaborat şi un studiu preliminar privind destinaţia terenurilor care vor fi deveni libere de sarcini tehnologice şi urmează să fie reintroduse în circuitul economic.

CONCLUZII

Această activitate de evaluare a impactului este una deosebit de importantă în cadrul politicilor de mediu la nivel național, european și internațional în special în procesul decizional cu privire la autorizarea unor activități, în cazul de față exploatrea zăcământului de lignit prin lucrări în carieră.
Pentru descrierea, identificarea și evaluarea impactului au fost utilizate metodele indicate de literature de specialitate, și anume: metoda listelor de control, metoda rețelelor și metoda matricilor de impact.
În urma aplicării acestor metode se poate afirma că impactul asupra terenurilor se manifestă în carierele de lignit din bazinul Jilț, la nivelul tuturor factorilor ce intră în componența acestora apă, aer, sol, subsol şi implicit a vegetaţiei, faunei, aşezărilor umane şi populaţiei.

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GEOTECHNICAL EVALUATION OF A NICKEL DEPOSIT IN THE DEVOLLI DISTRICT, ALBANIA

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ABSTRACT

Different companies are planning to exploit nickel ore in the Devolli district in Albania which with the quantity of reserves of 110 million tons is one of the most important of Albania. Therefore, several objects and deposits have been investigated. To confirm the technical parameters as a prerequisite for ore extraction, the reopening of the former exploration adit in the Bilishti area it haze been planned to make a lot of different geotechnical investigation with the scope to define some of the technical and technological parameters for the later management of mining activity.

A lot of samples and analyses are made according the following services:

Multistage triaxial test for Mohr Coulumb failure criteria (C, Phi, E and v)

Detailed geological and structural mapping of the structures including scan lines, geotechnical rock-classification and classification of type of rock etc. in the existing adit (about 50 m) and of 2 crosscuts (of 40 m each)

Rock Structure Rating

Rock Mass Rating

Rock Mechanic Tests

Recommendation for the expected development work and for a mining concept, including geotechnical definition of pillars, etc.

KEYWORDS

laterite, saprolite, weathering crust, triaxial test, Mohr Coulomb failure criteria …

1. GENERAL GEOLOGICAL INFORMATION OF THE DEPOSIT OF BITINCKA

The Devolli deposits lie on the Greek border in the Devolli district of South-eastern Albania and is part of the western belt which passes through Albania, entering from Kosovo near Kukes in the northeast and exiting near Bilishti into Greece in the southeast.The ultimate source of FeNi and NiSi in Albania is the weathered crust of Jurassic peridotites and harzburgites

In general, there are two types of iron nickel deposits in Albania: [3]

a) In-situ primary laterites located between the weathering crust on the footwall and Cretaceous limestone in the hanging wall. These deposits occasionally have nickel silicates below the iron nickel.

b) The other type are allochthonous, transported, laterites that have been mobilised from the primary material and deposited in sedimentary basins either over un-or partly weathered peridotites or over Cretaceous limestone.[3]

2. WORK CARRIED OUT

During this visit time one geotechnical and mining engineer, and one geologist/mineralogist, took the geotechnical and geological/structural measurements, evaluated the general geological setting of the deposit and selected the samples for the geotechnical laboratory testing and forwarded them to the specialized laboratory of University of Bochum.

2.1.Geotechnical Work

The geotechnical situation has been investigated during the above mentioned field visit.

After the reopening, a clearance of the main adit and the adjacent galleries took place. The adit was secured with timber which was weathered due to the long exposure and lack of maintenance. At the time of visit, all workings had been cleared, except for some big rock falls. The adit is not secured in hazardous areas, which will be absolutely necessary in case of further underground activities.

The survey carried out provided parameters and technical observations which should support the planning process and the anticipated exploitation test work. Considering the proximity to the surface and the presence of the major fault, the test exploitation mine is placed in a rather unfavourable location with difficult ground conditions, which are typical for areas that are influenced by significant faulting.

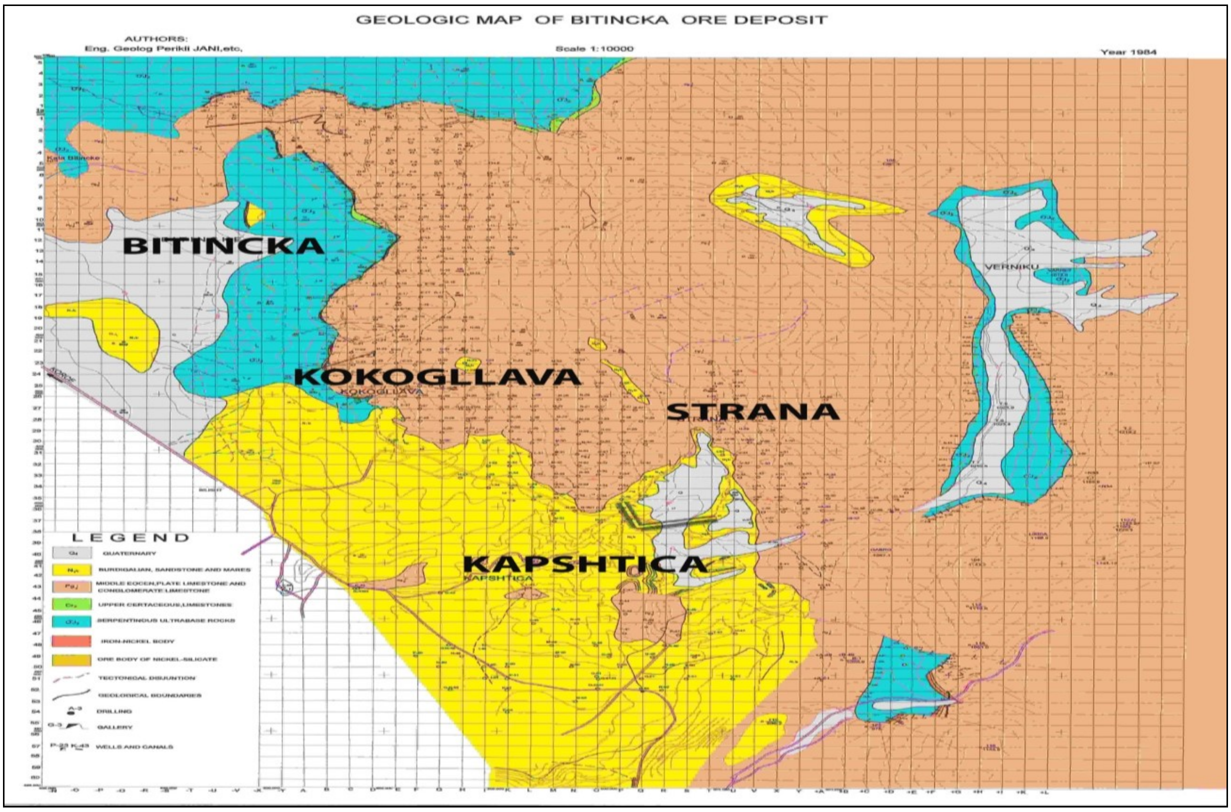

Figure 1-1: Geology of the Bilishti Area (according Jani P.and al)

The area proposed for the big scale mining is situated near by on the opposite hillside. Mining will have to face similar lithological and regional structural conditions but the local structural overprinting will be most probably not as intensive as in the investigated drifts.

2.1.1. Adit A01

In summary, the adit A01 can be divided into four segments:

- Entrance Adit A01 (distance to Main Drive 28.0 m to 39.0 m). The entrance shows a high grade of disruption
- Silicified laterite; bounded by two shear zones (distance to Main Drive 21.0 m to 28.0 m). This zone has been intensively stressed by tectonic events.
- Serpentinite both with and without laterite; also bounded by shear zones (distance to Main Drive 11.0 to 28.0 m)
- Laterit (distance to Main Drive 0.0 to 11.0m) This segment can be subdivided into two sections, the first section (0.0 m to 6.0m with intensive fracturing and in a second section (6.0 m to 11.0 m) without any collapse features.

A prominent dislocation runs parallel to the Eastern and Western extension of the Main Drive. The structural-stability of the gallery is affected by this dislocation.

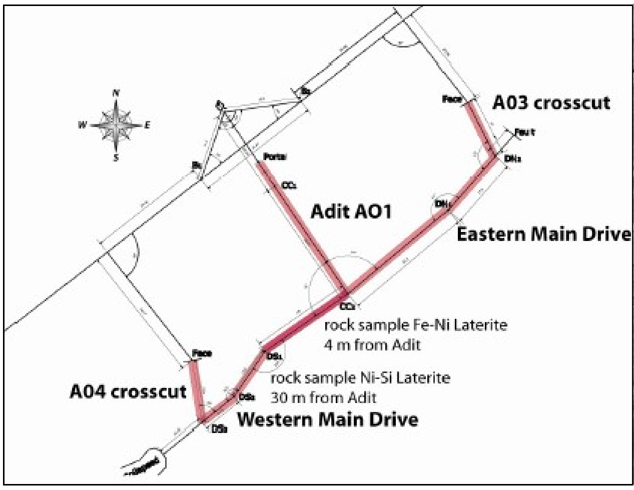

Figure 2.1: Overview of Devolli Mine Surveyed Section (not in scale)

Figure 2.1.1-1: : Portal with closely jointed Rock Adit A01

2.1.2. Adit A01

The most prominent geotechnical characteristic for the Main Drive is its southern boundary, namely a SSE dipping fault

In particular the gallery - crossing with the Main Drive is affected. Due to the existing structural weakening the pillars are fissured. This has been described in literature under slabbing or spalling. [1]

Additionally, access of water can be observed. The results of the Schmidt-Hammer Tests confirmed these results for the transition to the surrounding rocks as well. Considerable rock falls (Fig. 2.1.2-1) have been observed whereas the existing crosscuts and the A01 adit appear to be free of rockfalls.

The rock falls from the roof reach more than 2 m above the former timber lining.

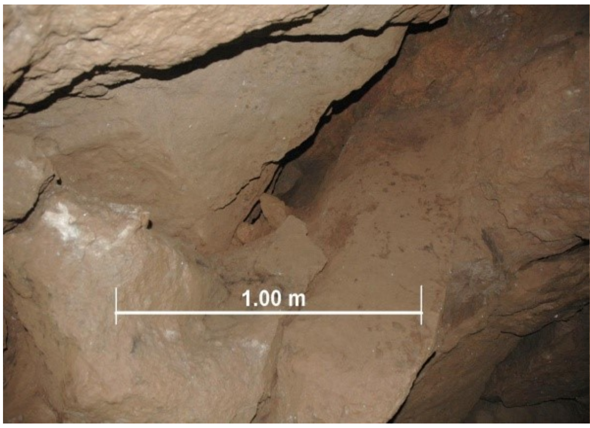

Figure 2.1.1-2: Rock Blocks with Open not Filled Joints (max. 30-40 cm) Adit A01

Figure 2.1.2-1: Eastern Main Drive with Roof Collapsing Features

The structural security is not given in both Main Drives (west and east), in particular where in the gallery intersects the crosscuts (A04 and A03). The present pillars at the intersection of the galleries are fissured to a minimum depth of 1.5 m to 2 m. The roof is instable (with hanging loosened blocks).

At about 20 m south from the intersection of Adit A01 and the Main Drive, relatively strong iron-rich laterite rock can be found. From this point on towards the intersection, no rock falls are present. After the 20 m mark, conditions in the Eastern Main Drive are similar to those found in the Western Main Drive.

In general, the conditions are similar to those found in the Eastern Main Drive. The western end cannot be accessed, because the drive collapsed. (see Fig. 2.1.2-2). The complete intersection area of A04 and Western Main Drive are prone to collapse and must be secured.

The effects of the disruption on the rock strength is clearly visible. The soft laterite rock surface is easily removable by scratching with a hammer. The rock strength is mostly lower than 10 MPa.

2.1.3. Crosscut A03

From a geotechnical point of view, the crosscut does not show any particular features. The rock contains laterite with inclusions of serpentinite. The original lining is weathered and does not provide any support.

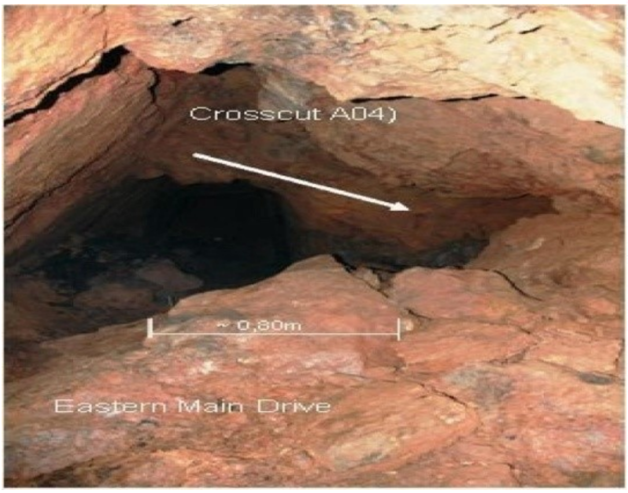

Figure 2.1.2-2: Main Drive with significant Rock Eastern Main Drive with Roof

Figure 2.1.3-1: Crosscut A03, without Wall Collapsing

2.1.4. Crosscut A04

The two edges with the Main Drive are highly deformed. The corners are collapsed and the stability of the roof is reduced.

The laterite rock is compact and only shows few joints and fractures. Nevertheless surrounding rock is rather soft and has been overprinted by tectonic deformation.

Feature but with Signs of former Timber Supports

The rock contains laterite with inclusions of serpentinite.

The original lining is weathered and does not provide any support. The roof seems to be stable, no hanging rocks can be observed

Considering the long period after opening of the crosscut, the geotechnical stability is still given. The geotechnical situation develops analogous to the adit approaching the Main Drive. The rock falls present in the Western Main Drive close to the entrance to the crosscut express an increasing destabilisation of the drive. This section is prone to collapse.

2.2. Geotechnical Work

The Adit A01 follows a short section of 40 m from relatively unweathered serpentinite to lateritic rock. Overlying the lateritic rock a thin layer of iron - rich dark laterite is found (Fig. 2.2-1).

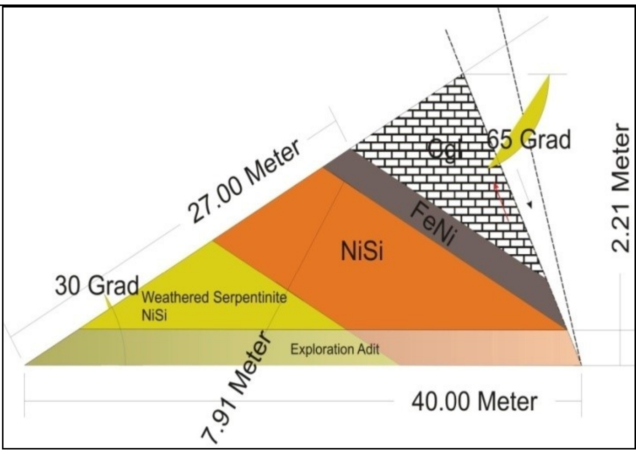

Figure 2.2.1: Geological cross-section along Adit from NNW(left) to SSE(right)

The adit ends where it is intersected by a major fault in a nearly perpendicular position to the adit, cutting the laterite, dipping 60° SE. The western and eastern main drives follow the strike of this fault. The short crosscuts A04 and A03 can be found intersecting the main drive at the western and eastern end.

2.3. Geotechnical Laboratory Work

The Albanian Nickel Group supplied drill core samples include 4 different mineralogical types with specified.

The cores were selected and prepared by ISRM for testing on tensile strength by the brazilian test, uniaxial compressive strength and triaxial strength for arriving at strength properties, i.e. cohesion c and friction angle φ with the Mohr-Coulomb strength envelope as well as uniaxial compressive strength, Young’s Modulus E and Poisson’s ratio.(Fig 2.3.1-2.3.3) [2]

3. RESULTS

3.1. Geotechnical Evaluation

Additionally to the geotechnical survey, joints were investigated with the so called Schmidt-Hammer Test method.

Measured sections are the Adit A01, the Western and the Eastern Main Drive, as well as the Crosscut A04. No measurements have been done in the Crosscut A03.

Fig. 2.3.1: Closely jointed Hematite Sample

Fig. 2.3-2: Disintegrated Block after Drilling of the Test Samples

Fig. 2.3-3: Drilling Samples in the Nickel-Silicate Block

The high values for the silicified laterite rock are purely rock strength values and cannot be transferred to evaluate the surrounding lithologies.. The results from the other rock types coincide with the standards. The relatively large deviations in the second section (5 – 13 m) are due to mineralisation of joint fractures. Because of the low amount of good data, in Eastern Main Drive, a statistical evaluation is not possible.
In Western Main Drive, in contrast to the eastern section, iron-rich laterite is exposed in the Western Main Drive. Properties of the reddish laterite rock and iron-rich laterite rock are different. There is sufficient data from the iron-rich laterite rock, but no enough from the reddish laterite rock.. The influence of the major fault, analogous to the Eastern Main Drive, is clearly visible.
Due to the rock condition no representative in-situ measurements had been taken. Result for the crosscut A04 are comparable to the measurements from Adit A01.

Table 3.1.1: Summary of Schmidt-Hammer Test results for the Adit A01

Section	Lithology	Mean for the uniaxial compressive strength	Standard deviation
m		MPa	MPa
0 -5	Weathered Ser-	11,26	0,86
5- 13	Serpentinite	35,54	14,21
13-18	Silicified Laterite rock	41,84	12,79
18-24	Serpentinite	15,89	4,38
24-37	Laterite rock	15,67	5,39

Table 3.1.2: Summary of Schmidt-Hammer Test results for Western Main Drive

Section (m)	Lithology	Mean value uniaxial compressive strength (MPa)	Standarddeviation (MPa)
0 -20	Iron-rich	26,58	10,57
20 -29,5	laterite rock	20,60	
29,5 -32,5	laterite rock	-	-
32,5 - 34	laterite rock	22	-
34 -42	laterite rock	-	-
43 -44	laterite rock	15,90	-
44 -50	laterite rock	-	-

3.2. Rock Mass Classification

During the feasibility and preliminary design work, at a stage when very little detailed information is available, the use of a rock mass classification scheme can be of considerable benefit. The evaluation was made following the geotechnical classification after Bieniawski (1989). For the evaluation of the rock mass the following

characteristics and structural descriptions have been considered:

1. Uniaxial compressive strength of rock material
2. Rock Quality Designation (RQD)
3. Spacing of discontinuities
4. Condition of discontinuities
5. Groundwater conditions
6. Orientation of discontinuities

The results of the RQD – evaluation on the drill holes are took into in consideration The weakening of the rock formations in the transition zone from conglomerate to laterite.

The results of the rock mass classification after Bieniawski can be summarized as follows:

1. The rock quality of the conglomerate is fair, parallel and orthogonal to the main fault direction
2. The rock quality of the weathered serpentinite is poor, orthogonal as well as parallel to the main fault direction.
3. The rock quality of the ore hosting laterite (Ni-Si and Ni-Fe) is poor in the drifts parallel to the faulting and jointing and fair orthogonal to the joint and fault direction.

3.3. Means of Support in Relation to Rock Qualities

Roofbolting in combination with timber lining could well be an alternative for a situation with a rock quality as found in the exploration adit; shotcreting is not an alternative. The evaluation by Bieniawski is conservative and does not consider the exploitation method. So it's proposed already an exploitation method using a road header, which is a much more gentle exploitation method than the drilling and blasting mining technology.

3.4. Rock Mass Classification

The rock structure evaluation and classification after Wickham at al. (1972) was applied to selected sections of the Adit A01, where structural data appeared homogenous and representative.[5] This investigation included the serpentinite section and the reddish laterite rock section in Adit A01.

Table 3.4.1: The recommendations for the adequate support according to Dr. Hoek

Rock mass	Excavation	Rock bolts	Shotcrete	Steel sets
Fair rock R MR : 41-60	Top heading and bench 1.5-3 m advance in top heading. Commence support after each blast. Complete support 10 m from face.	Systematic bolts 4 m long, spaced 1.5 - 2 m in crown and walls with wire mesh in crown.	50-1 00 mm in crown and 30 mm in sides.	None.
Poor rock R MR : 21-40	Top heading and bench1.0-1.5 m advance in top heading. Install support concurrently with excavation 10 m from face.	Systematic bolts 4-5 m long, spaced 1-1.5 m in crown and walls with wire mesh.	100-150 mm in crown and 100 mm in sides.	Light to medium ribs spaced 1.5 m where required.

Source: [Dr. Hoek. 2007]

3.5. Evaluation of The Rock Mechanical situAtion

Three discontinuity systems are present (Tab. 3.1.6-1), two of them are dominant (Fig. 3.2.1). Considering that these directions are representative for the entire deposit this will have consequence for the dimensioning of the pillars.

4. CONCLUSIONS

Rock mechanical testing has been carried out with the results summarised in the following table.(3.1.6.2).

Tab. 3.1.6-1: Main Joint and Fracture Directions

Joint andFracture	Direction of	Inclination
K1	SSE	60°-80°
K2	W -SW	60°-80°
K3 (shear	SW - SSW	30°-60°

Following conclusions for test exploitation can be made, considering the Schmidt- Hammer Test results geological-structural relationships and observations made in the mine:

The adit is located very close to the surface, < 20 m. (The full-scale mine however will be located under a general cover of 100 to 700 m of calcareous conglomerate)

Tab. 3.1.6-2: Summarised rock mechanical testing .

Mineralogy	Uniaxial Compressive strength	Brazilian test	E-Modulus uniaxial	Cohesion c
	[MPa]	[MPa]	[GPa]	[MPa]
Conglomerate	72.35	5.9	47	10.6
Weath.Serpentinite	21.1	*1 .7*	12.9	4.0 ')
Ni-Si Laterite	33.6	3.23	12.9	6.4 ')
Ni-Fe Laterite	24.3	1.18	14.2	2.3 ')
	Poisson' ratio v	E\ - Modulus	Friction angle 4>	Density
		[GPa]	**n**	fa/cm']
Conglomerate	0.23	11.4 ')	10.0 ')	2.65
Weath.Serpenti	0.26		14.0 ')	2.54
Ni-Si Laterite	0.26	12.9 ')	15.0 ')	2.4
Ni-Fe Laterite	0.28	4.7 ')	8.7 ')	2.41

2. The surrounding rock is strongly tectonically deformed

3. The construction of a test mine is possible, even subject to unfavorable conditions. Nevertheless. pillars and rock cover near the mine entrance will have to be designed to compensate these effects. This implies for the extraction a reduction of mineable reserves.

4. In spite of the strong tectonic deformation prevalent, the Adit A01 and the Crosscuts A03 and A04 in their present orientation are stable.

5. The section in the fault zone (Main Drive) of the test mine have to be secured by a timber lining.

The results vary widely. The conglomerate shows lowest readings for compressive strength at 13.1 M Pa and highest at 131.0 M Pa. This is a range of 117.9 M Pa.

The test results for the laterite and serpentinite samples show a wide range, too wide to qualify for a representative sample. It is recommended to use in-situ geotechnical drillhole methods in future if similar structural conditions are expected.

The drillhole was drilled close to a fault, most of the results are strongly influenced by faulting, fracturing and veining. Tectonic elements are dominant. The collection of larger core samples from less structurally overprinted areas is recommended. The current results are not representative for the general rock conditions. Additional sampling and analytical work is recommended.

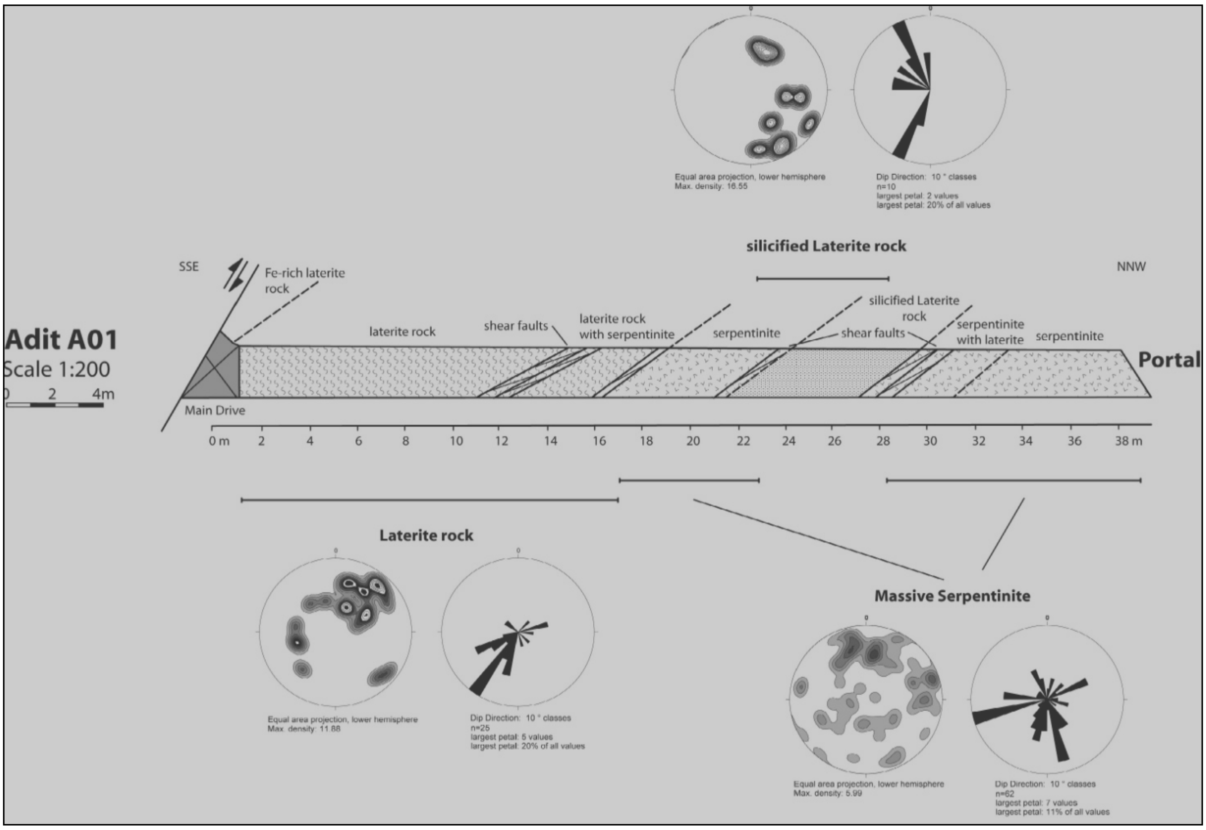

Figure 3.2.1: Southern face of A01 Adit with Density and Rose Diagrams of Structures mapped

The following steps are recommended:

1. Core drill holes with a diameter between 100 and 150 mm
2. Geotechnical laboratory tests on larger samples in order to get statistically supported characteristics
3. Definition of the dip and dip direction of the drill holes in order to get an oriented 3D-picture
4. Dilatation tests in drill holes to determine the deformation module
5. Deformation measurements on the pillars in the test mining area in combination with dilatation test

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BARITE MINERALIZATION IN IRAN

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ABSTRACT

The special geological setting of Iran caused various types of barite resources have occurred in the country. The persistence of different geologic environments during the geological history of Iran in miscellaneous locations has created the necessary conditions to forming different types of barite deposits. Barite mineralization in Iran can be subdivided in four mineralization phases, including Late Precambrian-Early Cambrian barite mineralization phase, Permian-Triassic barite mineralization phase, Cretaceous barite mineralization phase and Tertiary barite mineralization phase. This paper gives the information on these barite mineralization phases, types of barite deposits, their distribution in Iran and geological setting of the barite deposits.

For achieving to the abovementioned information, in addition to collecting geological and exploration data about the different Iranian barite resources, thirty three site visits from the most important various barite deposits have been conducted and necessary field geologic data have been studied.

The results of this study indicate that the barite mineralization phases have occurred in four main geostructural zones of Iran, including (1) Metamorphic & volcanic domains of Sanandaj-Sirjan geostructural zone, (2) Volcano-sedimentary domain of Alborz geostructural zone, (3) Sedimentary domain of Central Iran geostructural zone, and (4) Volcanic & sedimentary domains in the Micro-continent of Central Iran geostructural Zone. From the viewpoint of deposit types, the studied barite resources include these types: (1) Vein-type barite deposits, (2) Stratiform (SEDEX) barite deposits, (3) Epigenetic carbonate-hosted (MVT) barite deposits, and (4) Volcanogenic massive sulfide (VMS) type barite deposits.

KEYWORDS

Barite mineralization, Barite deposit types, Geological setting of barite deposits, Iran

1 INTRODUCTION

Barite (barium sulphate) is characterized by high specific gravity, low hardness and low reactivity. Barite is primarily used in drilling fluids for oil and gas exploration wells. World production of barite in 2014 was 9.260 Mt [10]. In 2014, the major world producers of barite were China (4.100 Mt), India (1.600Mt), Morocco (1.000Mt), USA (0.720Mt) respectively [10]. In this year, Iran with 0.420Mt of barite production was ranked fifth in the world.

Barite deposits are most commonly classified into bedded (stratiform) deposits, veins and cavity fillings, and residual deposits [1] & [8]. Bedded barite deposits are commercially the most significant because of their large size, and amenability to modern large-scale mining methods. Barite occurs in bedded deposits either as a principal mineral or cementing agent, or associated with stratiform massive sulphide deposits [6]. Most bedded deposits occur in sequences of sedimentary rocks characterised by abundant chert and black siliceous shale and siltstone, known as 'black bedded barite'. They range in age from Precambrian to Tertiary, but are usually Early to Mid-Palaeozoic [9]. Individual beds are massive to laminated, fine-grained and may contain from 50% to 95% barite that can be used with little or no treatment other than grinding. Bedded barite deposits were divided by Clark et al. [2] into five types.

(1) With base metal sulphides (cratonic rift type), associated with alkali volcanic rocks, e.g. Meggen and Rammelsberg, Germany; Ballynoe and Silvermines, Ireland; Selwyn Basin, Canada; and Red Dog, Alaska, USA.

(2) Without base metal sulphides (continental margin type), e.g. Arkansas and Nevada, USA; Quinling District, China.

(3) In volcanic sequences, e.g. Kuroko, Japan.

(4) Stratiform barite deposits, e.g. Sardinia, Italy; Andhra Pradesh, India.

(5) Exogenetic barite deposits, e.g. Krakow area, Poland.

Veins and cavity fillings Barite deposits are deposited from hydrothermal fluids or deep-seated brines occurs in faults, joints, bedding planes, breccia zones, solution channels and cavities. The resulting veins are characterised by sharp contacts, extensive pinching and swelling, and extreme variations in length, depth and attitude. Because of complex geometry, mining vein deposits can be difficult and expensive. These deposits are generally smaller than the stratiform deposits. Vein barite is usually extracted as a by- or co-product of lead–zinc mining — as in Sardinia, Italy, and the United Kingdom.

Residual barite occurs in surficial deposits in which the barite is present as loose fragments embedded in residual clay. The barite and the clay are derived from weathering of the underlying rock, generally dolomite. Barite fragments range in size from sand size to lumps weighing 100 kg or more. Residual deposits of commercial grade are found in the USA (in Georgia and Missouri).

The special geological setting of Iran caused various types of barite deposits have occurred in the country. The persistence of different geologic environments during the geological history of Iran in miscellaneous locations has created the necessary conditions to forming different types of barite deposits. More than 100 barite deposits have been identified in Iran. Their ages range, as implied from datings of their host rocks, from Late Precambrian to Miocene [4]. A wide variety of barite mineralizations in Tertiary volcanic rocks occur in association with volcano-sedimentary successions in the southern Central Alborz Mountain Range (Azerbaijan) and in the Urumieh-Dokhtar magmatic arc [3]. Barite mineralization in dolomitic rocks is widespread in central Iran, the Alborz Mountain Range and the Sanandaj-Sirjan Zone (SSZ) [4].

This paper aims to give the information on these barite mineralization phases, types of barite deposits, their distribution in Iran and geological setting of the barite deposits. For achieving to the mentioned information, in addition to collecting geological and exploration data about the different Iranian barite resources by reviewing their geological and exploration documents, the site visits from 33 of the most important Iranian barite deposits have been conducted and necessary fieldwork geologic data have been studied and compared with each other.

2 GEOLOGICAL SETTING & GEOLOGICAL TIME OF BARITE DEPOSITS

From a global tectonic point of view, Iran is part of the Alpine–Himalayan orogenic belt that extends from Atlantic Ocean to Western Pacific. Most European and Asian geologists believe that this belt represents the great Tethys Sea once located between two large continents, Gondwana and Laurasia, during Paleozoic–Mesozoic eras.

Iran has been divided into several geostructural zones (units), each characterized by a relatively unique record of stratigraphy, magmatic activities, metamorphism, orogenic events, tectonics, and overall geological style. The tectonic and structural setting of Iran in the Alpine–Himalayan orogenic belt, and the structural evolution of Iran, has been the focus of many studies. The first study divided Iran into 10 structural zones based on certain geological features. This structural division remained a reference for Iranian geologists for almost three decades. However, the new observations and findings require a revision to this structural scheme. The newer structural schemes are mostly derived and inspired by the very first structural division presented by Stocklin. In recent years, new interpretations and models have been offered regarding the geological setting of Iran by different Iranian geologists. On the basis of these newer structural divisions, Iran subdivided to 11 main geostructural zones including Khouzestan plain, Zagros fold belt, Zagros thrust, Sanandaj-Sirjan zone, Urmieh-Dokhtar zone, Alborz Mountains, Central Iran, Central Iran micro-continent (Lut block), Kopeh Dagh Mountain, Makran zone and Eastern Iran zone [5] & [7] (see figure 1).

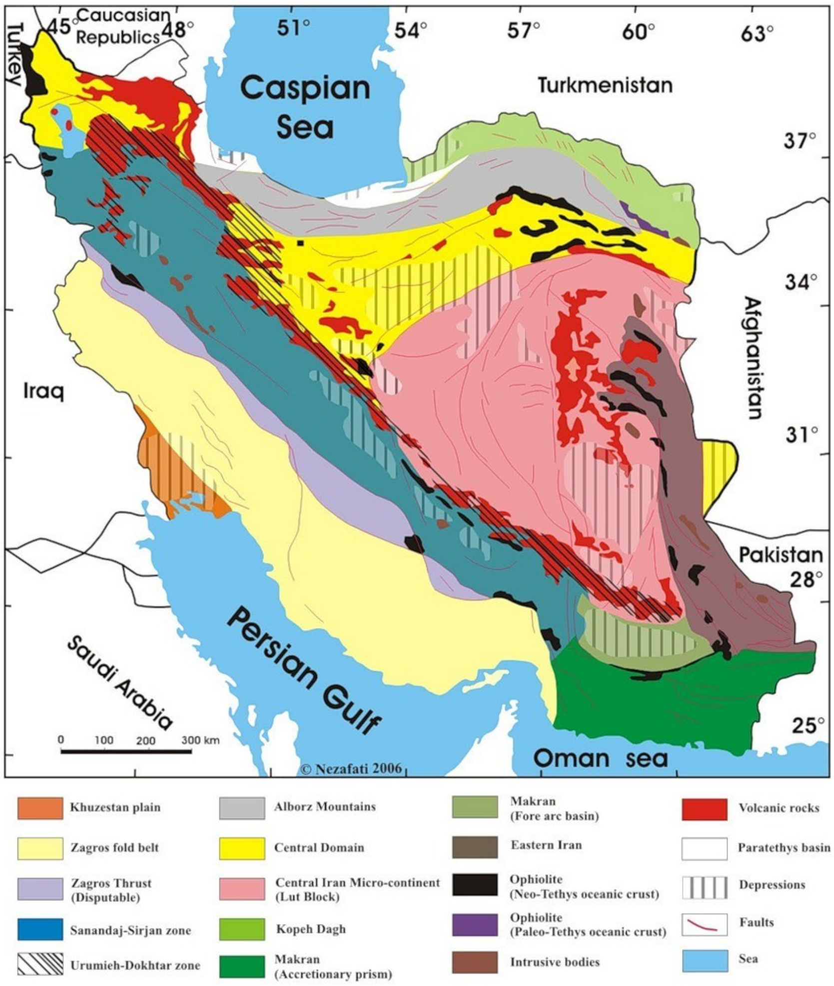

Figure 1: Geostructural zones of Iran

Source: Mineral Resources of Iran; an overview (Nezafati, 2015) [7]

Barite mineralization in Iran can be subdivided in four mineralization phases as followings [5]:

I. Late Precambrian-Early Cambrian barite mineralization phase

II. Permian-Triassic barite mineralization phase

III. Cretaceous barite mineralization phase

IV. Tertiary barite mineralization phase

These barite mineralization phases occurred in different geostructural zones and cause various types of barite deposits are found throughout Iran in a variety of geostructural zones.

In the Late Precambrian-Early Cambrian barite mineralization phase, the barite mineralization is mainly hosted in ancient dolomitic and also volcanic (especially rhyolitic) rocks and occurs in; Alborz Mountains, Northwest of the Sanadaj-Sirjan and Central Iran geostructural zones.

In the Permian-Triassic barite mineralization phase, the barite mineralization is specially hosted in Triassic dolomitic rocks and frequently occurs in; Central Iran, Alborz Mountains and Sanandaj-Sirjan geostructural zones. This barite mineralization phase is mainly associated with fluorite and lead-zinc mineralization. The most famous barite resources of Iran are formed at this phase.

In the Cretaceous barite mineralization phase, the barite mineralization is mainly hosted in the Lower Cretaceous carbonate rocks and occurs in; Central Iran and Sanandaj-Sirjan geostructural zones. This barite mineralization phase is associated with lead and zinc mineralization.

In Tertiary barite mineralization phase, the barite mineralization is related to Eocene and Oligocene volcanic to volcanosedimentary rocks which frequently occur in; Urumieh-Dokhtar volcanic zone, Central Iran and South of Alborz Mountains.

According to the abovementioned evidences, it can be concluded that the major geostructural zones of Iran in which the barite deposits were formed are;

I. Metamorphic & Volcanic Domains of Sanandaj-Sirjan Geostructual Zone

II. Volcano-sedimentary Domain of Alborz Geostructual Zone

III. Sedimentary Domain of Central Iran Geostructual Zone

IV. Volcanic & Sedimentary Domains in the Micro-continent of Central Iran Geostructual Zone

3 BARITE DEPOSIT TYPES

From the viewpoint of Deposit Types, Iranian barite deposits mostly include the following types:

1. Vein-type barite deposits,
2. Epigenetic carbonate-hosted (MVT) barite deposits,
3. Stratiform of sedimentary exhalative (SEDEX) type barite deposits, and
4. Stratiform of volcanogenic massive sulfide (VMS) type barite deposits.

The 33 investigated barite deposits which were formed in various geological times and environments in Iran, are compared with each other and illustrate as the following table 1. The geology, geological environment and tectonic setting and type of these deposits are summarized in the table.

Table 1: Geological characteristics of some of the most important Iranian barite deposits

No	Barite deposits	Charactristics	Geostructural zones	Age & lithology of host rocks	Deposit types	Proved reserves (1000ton)
1	Mehdiabad	Layered and concordant lenticular orebodies, with Cu & Pb mineralization	Central Iran	Lower Cretaceous limestones and dolomite	MVT	113,000
2	Komshecheh	Vein form (strata-bound) and Layered (stratiform) with fluorite	West of Central Iran	Triassic dolomite	MVT	2,500

3	Shahneshin (Ebdal e Samadi)	Layered and concordant lenticular orebodies in contact between shale and andesite	Northwest of Sanandaj-Sirjan	Cretaceous shale & andesitic volcanic rocks	Stratiform, SEDEX type	1,000
4	Poshte Semnan	Stratiform, lenticular to sheet-like ore bodies, with Cu mineralization	South of Alborz	Eocene volcanic sequence includes acidic tuffs and andesite to andesibasalt lavas	Stratiform, VMS type	850
5	Ardakan	Veins along fault zones, with Cu mineralization	Central Iran	Upper Devonian, Lower Carbonifer to Permian limestone, dolomite & dolomitic limestone	Vein type	725
6	Dorreh	Concordant lenticular orebodies, with Cu mineralization	Central Iran	Eocene volcanic sequence	Stratiform, VMS type	680
7	Chenarvardeh	Veins and lenticular ore bodies along fault zones	Northwest margin of Central Iran close to Alborz	Eocene tuffs	Vein type	550
8	Sorkhab	Layered orebodies or beds and cocordant lenses	Northwest of Sanandaj-Sirjan	Late Proterozoic slate and phyllite	Stratiform, SEDEX type	500
9	Haft-har	Cavity infillings, lenses and veins as cocordant orebodies	Central Iran	Permian limestone and sandy limesdtone	MVT	360
10	Ashkhaneh	Veins along fault zones	Kopeh Dagh	Late Cretaceous limestone, sandy limestone and shale	Vein type	300
11	Meraneh	(1) beds and cocordant lenses & (2) cavity infillings and lenses	Northwest of Sanandaj-Sirjan	(1) Late Proterozoic slate and phyllite & (2) Early Cambrian dolomite	(1)Stratiform, SEDEX type & (2) MVT	300
12	Hajiabad	Stratiform as layered and lenticular ore bodies	Central Iran	Lower Cretaceous limestone, argillaceous & sandy limestone	MVT	260
13	Vanakan	Layered in the bedding plane, with Cu mineralization	South of Alborz	Eocene volcanic sequence	Stratiform, VMS type	200
14	Neeq	Veins along fault zones	Central Iran	Late Eocene andesitic-basaltic volcanic rocks	Vein type	200
15	Talgestan	Concordant small lenes, cavity infillings and beds	Central Iran	Lower Cretaceous silicified limestone	MVT	160
16	Eshqabad (Abkhorg)	Cavity infillings, lenses and veins in breccias and fractures, with silicification	Lut block	Middle Triassic dolomite	MVT	140
17	Abdollahabad	Veins along fault zones	Northwest of Sanandaj-Sirjan	Late Proterozoic acidic volcanic rocks	Vein type	100
18	Shakhsefid	Veins along fault zones	Northwest of Sanandaj-Sirjan	Late Proterozoic acidic volcanic rocks	Vein type	90
19	Kohlou	Veins along fault zones	Sanandaj-Sirjan & Urmieh-Dokhtar	Upper Eocene volcanic sequence mostly tuffs	Vein type	70
20	Dizeloo	Lenses and cavity infillings	Central Iran	Middle Triassic dolomite	MVT	60
21	Bardehmish	Veins along fault zones	Northwest of Sanandaj-Sirjan	Late Proterozoic acidic volcanic rocks	Vein type	60
22	Varbon	Veins along fault zones	Alborz	Eocene tuffs and volcanic rocks	Vein type	55

23	Tangedouzan	Veins & pockets along fault zones, with quartz, galena & cerusite	Sanandaj-Sirjan	Cretaceous limestone and Jurassic schists	Vein type	50
24	Cheshmehsorkh e Golzar	Veins along fault zones	Urmieh-Dokhtar	Eocene volcanic rocks	Vein type	50
25	Nooq	Veins along fault zones, with hematitization	Northeast of Central Iran	Oligocene sandstone and conglomerate and Eocene andesite rocks.	Vein type	45
26	Lakehchal	Cavity infillings and lenses, with silicification	Central Iran	Triassic dolomite, close to fault contact with Jurassic shales	MVT	40
27	Soltanabad	Veins along fault zones, with hematitization	Sanandaj-Sirjan & Urmieh-Dokhtar	Eocene tuffs and limestone sequence	Vein type	35
28	Gavankuh	Beds and lenses which are generally oriented parallel to bedding plane	Sanandaj-Sirjan	Early Cretaceous limestones	MVT	25
29	Kahijeh	Veins along fault zones	Northeast of Central Iran	Eocene andesite and andesitic tuffs	Vein type	25
30	Qarehbolaq	(1) Veins along fault zones & (2) cavity infillings	Northwest of Sanandaj-Sirjan	(1) Late Proterozoic acidic volcanic rocks &(2) Infra-Cambrian dolomite	(1) Vein type & (2) MVT	20
31	Lachin	Veins along fault zones	Northwest of Sanandaj-Sirjan	Late Proterozoic acidic volcanic rocks	Vein type	20
32	Bakharz	Veins along fault zones	Northeast of Central Iran	Eocene volcanic rocks, including andesite, andesitic tuff and ignimbrite	Vein type	20
33	Anbaran	Small veins which developed at minor faults and joints in host rocks	Northwest of Alborz	Middle Jurassic limestone and Eocene volcanic rocks	Vein type	15

4 CONCLUSIONS

In Iran, barite mineralization phases can be subdivided in four mineralization phases, including Late Precambrian-Early Cambrian barite mineralization phase, Permian-Triassic barite mineralization phase, Cretaceous barite mineralization phase and Tertiary barite mineralization phase. The barite mineralization phases occur in four main geological zones of Iran, including (1) Metamorphic & volcanic domains of Sanandaj-Sirjan geological zone, (2) Volcano-sedimentary domain of Alborz Geological zone, (3) Sedimentary domain of Central Iran Geological zone, and (4) Volcanic & sedimentary domains in the Micro-continent of Central Iran Geological Zone. From the viewpoint of deposit types, the Iranian barite deposits can be mostly included in these types: (1) Vein-type barite deposits, (2) Stratiform (SEDEX) barite deposits, (3) Epigenetic carbonate-hosted (MVT) barite deposits, and (4) Volcanogenic massive sulfide (VMS) type barite deposits.

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APPLICATION AND USAGE OF THE METHOD OF GEO – ELECTRICAL MAPPING FOR GEOLOGICAL ENVIRONMENT WITH PRESENCE OF VERTICAL FAULT

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ABSTRACT

The usage of the geo – electrical methods is very important for more detailed modelling of geologically investigated environments. The geo – electrical methods are based on registration of the changes on the electrical field, which depends on the conductive characteristics of the geological environments. The determination of the most adequate geo – electrical method mostly depends from the geological structure of the investigated area, the boundary surfaces that separates the different geological structures as well as the geo – mechanical parameters.

Because of the presence of vertical and steeply inclined boundary surfaces in the investigated environment in this paper is elaborated the usage and interpretation of the method of geo – electrical mapping. The method of geo – electrical mapping is performed with Wenner layout of the measuring dispositive which is composed of two current and two potential electrodes. The four electrodes are placed on distance "a" and are equally distanced from each other. With every new measurement the whole measuring array is moved along the measuring area. Therefore for every distance "a" are obtained models that are modelling the investigated area at same depth through multiple points horizontally along the measuring area. This kind of modelling can detect the different geological structures that are separated with vertical *boundary surfaces. When increasing the distance "a" between the current and potential electrodes proportionally is increased the depth of the geo – electrical examinations. The geo – electrical models represent models of apparent electrical resistivity and are made synthetically through the data obtained from the geological and geo – mechanical examinations.*

The last phase in this paper is the process of interpretation of the models obtained for every distance "a" between the electrodes. On the basis of these data, a geo – electrical model is made for the entire investigative area in which are presented the geological structures defined by their accurate specific electrical resistance as well as the vertical and steeply inclined boundary surfaces that are separating them.

KEYWORDS

Electrical mapping, vertical fault, apparent electrical resistance

1. INTRODUCTION

The geo – electrical methods of investigation are based on registration of the changes on known electrical field, witch depending on its nature can be natural or induced. The changes on the electrical field mostly depend on the conductivity properties of the under surface geological complex. According to that the under surface structure is modeled through a process of correlation of the identified changes on the field and the conductive properties of the geological environments.

The investigated area that is modeled in this paper is geologically examined with two exploratory boreholes and has a total length of 80 m. The geological structure of the investigated area is with presence of vertical faults and steeply inclined boundary surfaces. Therefore the modeling of the researched area is performed with the method of geo – electrical mapping.

The method of geo – electrical mapping is performed with Wenner array of the measuring dispositive. The measuring equipment is composed from four electrodes (two current and two potential) that are linearly aligned in a composition where every electrode is placed on equal distance "a". An induced electrical field is generated between the two current electrodes. The electrical field spreads through the under surface geological complex to a particular depth "d" that depends of the distance "a" between the electrodes and its equal to that value d = a [1]. For every distance "a" the investigated area is researched along its whole length while repeatedly moving the measuring dispositive. Thus detecting the different geological structures that are separated with vertical fault. With this method the steeply inclined boundary surfaces depending on the inclination and length are identified through several measuring points along the investigated area.

In this paper the investigated area is examined through different depths: a = 1 m; a = 2 m; a = 4 m; a = 8 m. Every model is interpreted separately whereas the final model of the investigated area is modeled though complex interpretation of the data gained for each investigated depth.

2. GEOLOGICAL INVESTIGATIONS

The investigated area is geologically investigated through two exploratory boreholes with depth of 15 m in one profile line with a total length of 80 m. Through the data obtained from the mapped boreholes is made a geological profile of the investigated area that is presented on figure 1. From the geological profile is concluded the vertical fault and at least one steeply inclined boundary surfaces.

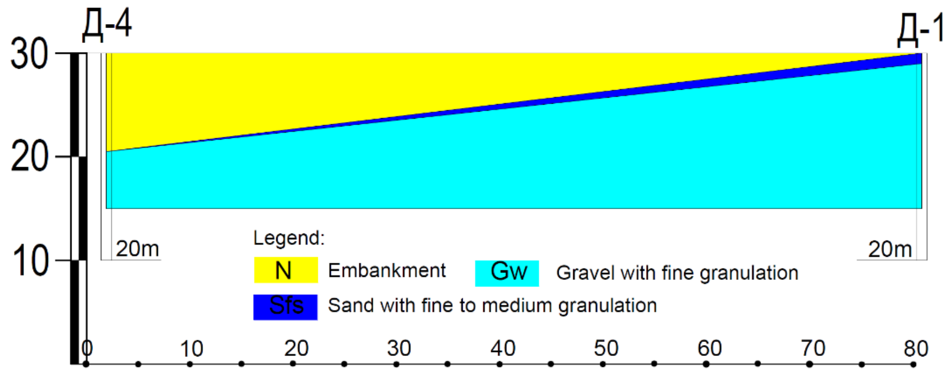

Figure 1. Geological profile of the investigated area

From the figure can be concluded that from the geological data obtained of the boreholes the investigated area remains relatively unknown with few details about the geological structure of the under surface complex.

3. GEO – ELECTRICAL CHARACTERISTICS OF THE INVESTIGATED AREA

For suitable application of the method of geo – electrical mapping in addition of the geological data it's important to be researched the conductivity properties of the geological structures. The conductivity properties are investigated with propagation of induced electrical field through the geological structures and registering their electrical resistance. The real electrical resistance can vary from 10 to $10^7\Omega$m and they mostly depend on the level of underground water as well as the structure and geo – mechanical parameters of the geological structures. In the table 1 are shown the geological structures that are present in the research area and their values for the real electrical resistance.

Table 1. Conductivity properties of the geological environments

Geological formation	Real electrical resistance (Ωm)
Embankment (N)	20
Sand with fine to medium granulation (Sfs)	60
Gravel with fine granulation (Gw)	120

4. METHOD OF GEO – ELECTRICAL MAPPING

The method of geo – electrical mapping is performed with four electrodes (AB – current and MN – potential) in Wenner array that is presented on the figure 2. The electrical field is induced between the current electrodes, whereas in the potential electrodes is registered the interference of the geological structure for particular depth manifested as apparent electrical resistance.

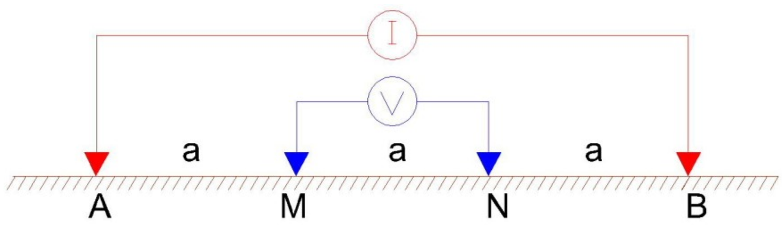

Figure 2. Wenner array of the measuring equipment

The apparent electrical resistance depends from the alignment of the measuring dispositive and the total electrical resistance of the geological complex. The dependence is given with the equation [2]:

$$\rho_a = 2\pi a R \ (\Omega m) \quad (1)$$

Where:

ρ_a – apparent electrical resistance;

π – constant with value 3.14;

a – distance between the electrodes;

R – total electrical resistance;

The investigated area is modeled through four different depths that depend of the total length of the measuring equipment.

The shallowest geo – electrical model covers depth of 1 m, and has a total length of the measuring array of 3 m. For every new measurement the measuring equipment is moved along the investigated area. The geo – electrical model obtained through 27 measuring points for investigated depth of 1 m is shown on the figure 3.

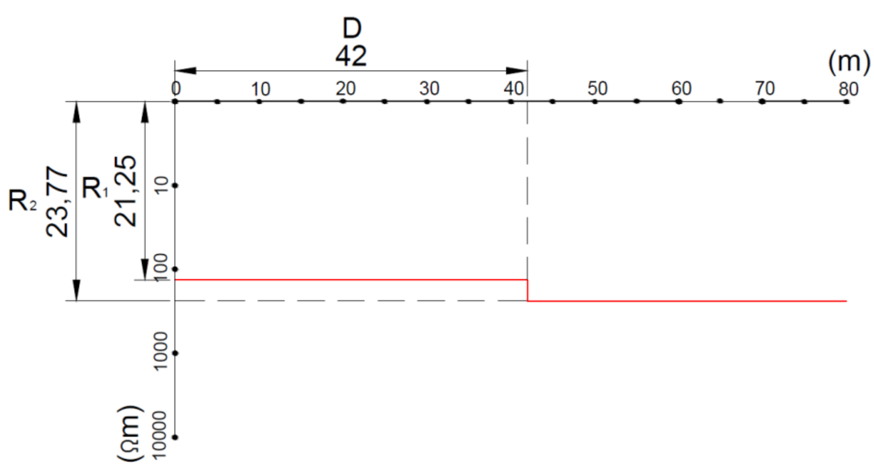

Figure 3. Geo – electrical model for depth of 1m.

On the geo – electrical model on the X axis is registered the total length of the investigated area (m), whereas on the Y axis the registered value for the apparent electrical resistance for depth of 1 m. From the curve of apparent electrical resistance and the two different registered values (R_1 and R_2) is concluded the presence of two different geological structures for the investigated depth. From the value of the distance D is determined the location of the vertical fault or the steeply inclined boundary surface that separates the two different geological structures [3].

The values for the apparent electrical resistance (R_1 and R_2) are obtained directly from the model. The distance "a" between the electrodes is known and is equal to 1 m. According to that through the equation 1 is determined the value for the total electrical resistance for each structure. Because of the shallow depth of investigation, the value of the total electrical resistance is taken as the real electrical resistance for the top layers of the geological complex. The geological environments are identified through the value of real electrical resistance.

The second depth on which the investigated area is modeled is 2 m and it's performed with distance between the electrodes a = 2m, with total length of the measuring dispositive of 6m. On the figure 4 is shown the geo – electrical model of the investigated area performed through 14 measuring points along the measuring line.

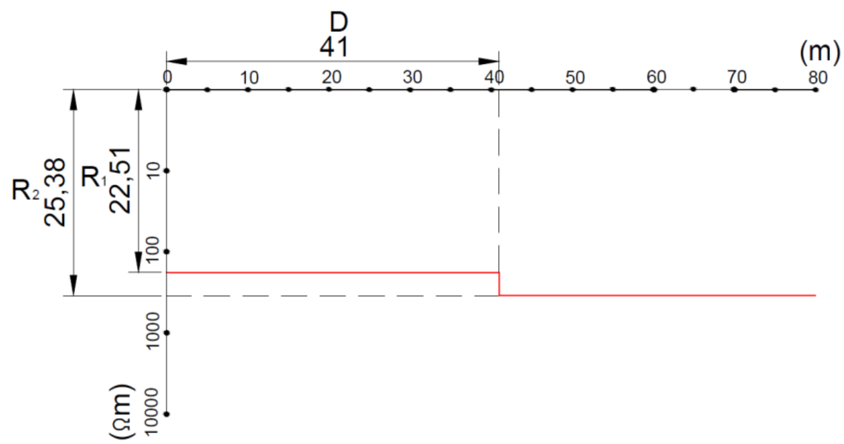

Figure 4. Geo – electrical model for depth of 2m.

From the model is obtained the data for the registered apparent electrical resistances (R_1 and R_2). Through the equation 1 are calculated the values for the total electrical resistance. If there are differences in the values of the total electrical resistance obtained from the previous model is concluded that the new calculated data for the real electrical resistance can't be obtained directly. Because of the spherical way of propagation of the electrical field as well as the horizontally layered structure of certain geological formations the total electrical resistance can be calculated as the total resistance from parallel resistors:

$$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2}+\ldots\frac{1}{R_n} \qquad (2)$$

According to that beginning from the first electrical resistance through the equation 2 progressively is determined the real electrical resistance for each deeper geological structure.

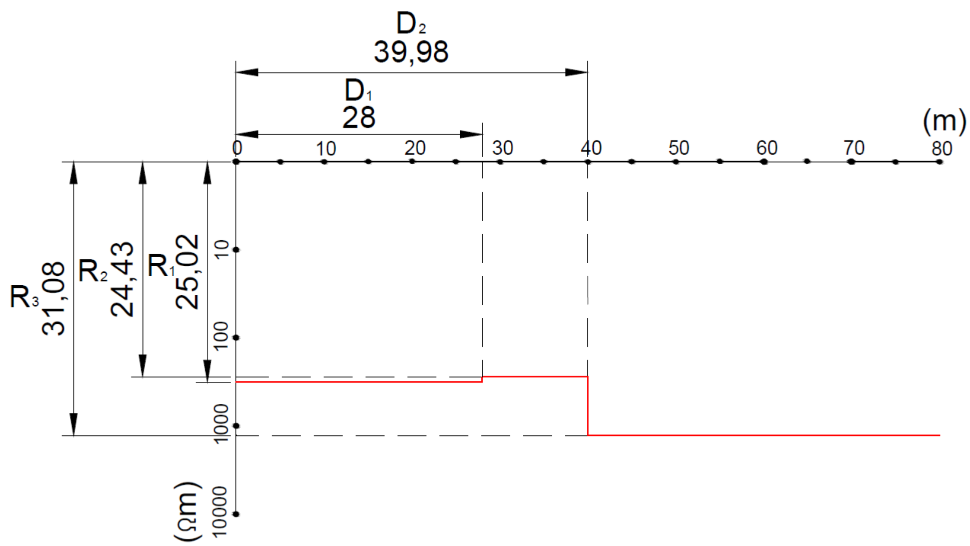

Figure 5. Geo – electrical model for depth of 4m

On figure 5 is shown the geo – electrical model that models the investigated area for depth of 4m through 7 measuring points with a total length of the measuring equipment of 12m.

From the model are obtained the values for the apparent electrical resistance (R_1, R_2 and R_3) and through the equation 1 are determined the values of the registered total electrical resistance. Through the equation 2 are determined the values of the real electrical resistance of the new registered geological structures.

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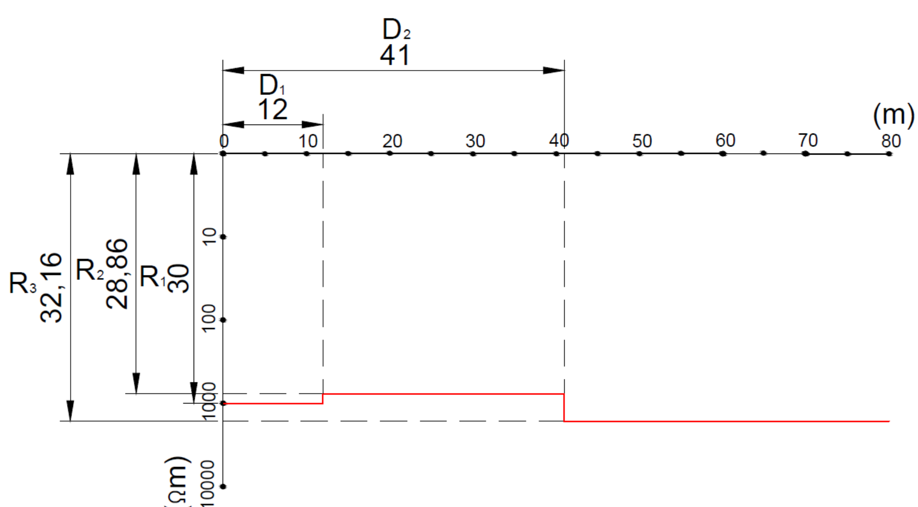

Figure 6. Geo – electrical model for depth of 8m

On figure 6 is presented the last single geo – electrical model that models the investigated are for depth of 8m through 4 measuring points along the research area with a total length of the measuring dispositive of 24m

From the model directly are obtained the values for the apparent electrical resistance and through the equations 1 and 2 the values of the registered total and real electrical resistances.

5. COMPLEX INTERPRETATION OF THE GEO – ELECTRICAL MODELS

On the basis of the data obtained through a process of interpretation of the geo – electrical models are determined the different geological structures as well as the location of their boundary surfaces. The geological formations are identified through correlation of the obtained data and their conductivity properties. The geo – electrical model of the investigated area is constructed with complex interpretation of the data obtained from the geo – electrical models for each depth. The complete geo – electrical model is modeled to a maximal depth of 8 meters through four different horizontal measuring points. On the figure 7 is shown the geo – electrical model for the investigated area processed with the method of geo – electrical mapping.

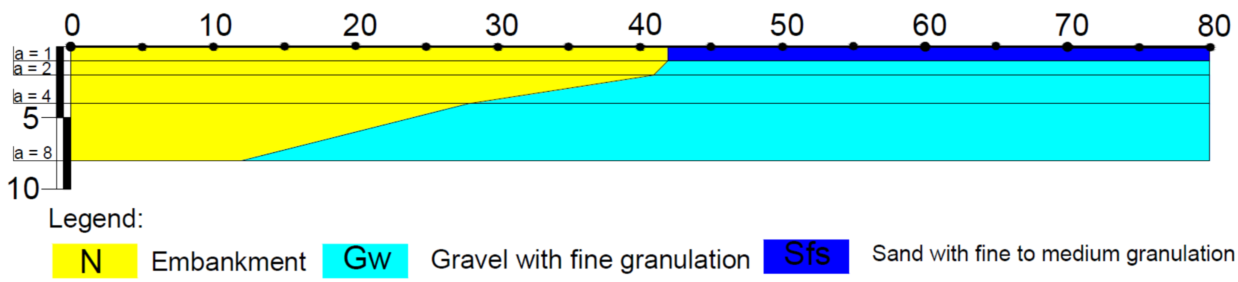

Figure 7. Interpreted geo – electrical model for the investigated area

Through correlation of the interpreted model with the geological profile it's clearly determined the differences, precision and efficiency of the geo – electrical model. In the geological model is determined the presence of different geological structures that are separated with vertical fault or steeply inclined boundary surface but without any indication where the first structure might end and the other begin. In general with geological investigations the vertical faults and steeply inclined boundaries are very difficult to determine and its location usually is interpolated between the known data.

The method of geo – electrical mapping covers many repetitions through the measuring line and depending on its length can be extensive and complex for application. Even though this method is far more cost-effective and more efficient while determining the under surface structure in geologically characteristic environments.

CONCLUSION

On the basis of the presented surveys as well as the impressions gained while comparing the geo – electrical and geological model can be concluded that the method of geo – electrical mapping is effective method for locating the vertical faults and steeply inclined boundary surfaces. The method is based on producing several (as much is needed) models with different depths of investigations. With this approach the vertical faults and different geological structures are identified through different depths vertically as well as several measuring points horizontally along the measuring line. With the interpreted data the boundary surfaces are modeled with more precision. The investigated area that is chosen is geologically investigated to relatively shallow depth and it's important to note that the method of geo – electrical mapping can be applied with acceptable precision for much greater depths.

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CORRELATION OF THE SEISMIC DATA WITH THE GEO – MECHANICAL PARAMETERS OBTAINED THROUGH THE METHOD OF REFRACTION

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Abstract

In this paper is elaborated the usage and application of the seismic methods applied for geologically examined and relatively known environments, in order to determine their precision and efficiency. The seismic methods are used for researching the geological structure under the surface of the examined area, by determining the traveling speeds of the elastic waves through the different geological structures.

Because of the horizontally layered geological structure (without presence of vertical faults) of the examined environment as well as the adequate geo – mechanical characteristics of the geological environments (each deeper layer has higher speed of propagation of the elastic waves than the upper one) in this paper is elaborated the procedure of applying and interpretation of the refractive seismic method. The examined geological environment is presented as one profile line composed from five exploratory boreholes with a total length of 210m. The length of the refractive profiles, their number as well as the way of overlapping on the examined area depends of the geological structure, the depth of examination as well as the geo – mechanical characteristics.

The depth of examination depends on the distance between the source and the receptor of the elastic waves and equals to one half of that length. The investigated area is examined with maximal depth of 30m, therefore the length of the refractive profiles reaches value of 60m. A total of four refractive profiles are made in order to cover the full length of the investigated area. The refractive profiles are overlapping on every 50m on the investigated area. The geo – mechanical characteristics of the geological structures are obtained with laboratory trials and through them for each geological structure is determined the speed of propagation of P and S elastic waves. Due to a lack of field trials the refractive profiles are made synthetically based on the

geological and geo – mechanical data. Through the process of interpretation on the refractive profiles is determined the number of different geological structures, the speed of propagation of the elastic waves, and with the t_0 method the depth to each boundary surface that separates two geologically different environments.

1. Introduction

The basic principles of the seismic investigations are based on generating elastic waves at a known time interval that results with propagation of the seismic waves through the sub surface structure in the investigated area where after a process of refraction and reflection the returning waves are registered on the surface at known distance.

The time difference registered from the generation until the reception of the elastic waves is used for determining the geo – mechanical characteristics of the geological structures. The under surface geological complex of the investigated area is modeled from the data obtained through the seismic investigations and the data of the geo – mechanical characteristics of the geological environments.

In this paper is elaborated the procedure for appliance and usage of the refractive seismic method. The refractive methods are geophysical methods of investigations that are used in correlation with geological and laboratory investigations. It is necessary that the investigated area for acceptable depth is geologically researched through several exploratory mapped boreholes. The different geological environments are determined from the mapped material of the boreholes.

Each mapped geological environments is tested in laboratory conditions in order to obtain data for the appropriate parameters. Because of the nature of the investigations performed in this paper in the laboratory investigations are determined the physical and geo – mechanical characteristics of the geological environments. On the basis of the geological and laboratory data is determined the efficiency of the adequate geophysical method.

The horizontally layered structure of the ore body without the presence of vertical faults and steeply inclined boundary surfaces presents favorable conditions for application of the seismic methods.

Through the data obtained from the laboratory conditions are determined the velocities of propagation of the elastic waves through each geological structure. With correlation of them and the geological data is investigated the condition for application of the refractive seismic method (each deeper geological environment presents greater propagation velocity than the upper one)

The investigated area is modeled in one profile line with a total length of 210m through a total of five double refractions. The seismic modeling of the environment is based on the data obtained from direct analysis of the refractive curves.

2. Geological investigations

The investigated area is geologically investigated through a depth of 25m with a total of five exploratory boreholes. From the mapped boreholes are determined the geological structures and on the basis of that data is concluded that the investigated area is composed from the following geological formations:

- Clayed composition
- Sands and gravel with fine to medium granularity
- Pliocene sands and gravels
- Pliocene marls and conglomerates

The geological structure determined from the geological investigations is shown in the geological profile presented on the figure 1.

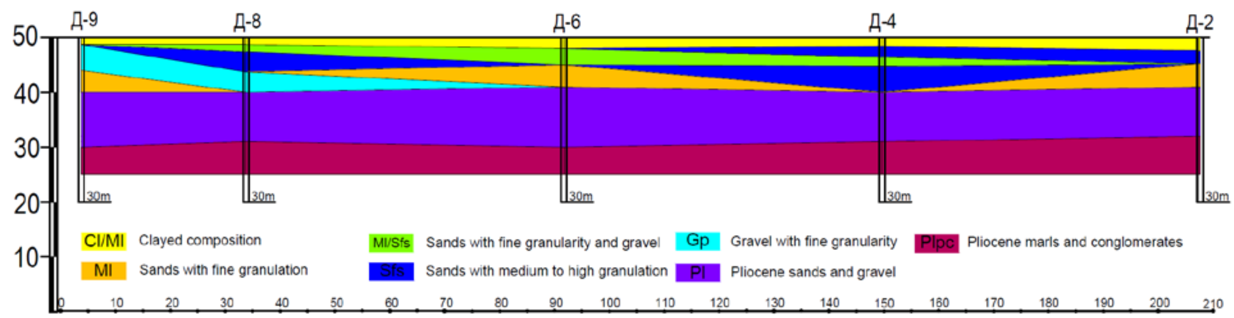

Figure 1. Geological profile composed from five exploratory boreholes, examined to a depth of 25m

3. Laboratory investigations

The laboratory investigations presented in this paper are based on determining the geo – mechanical characteristics of the geological environments. In general the elastic waves (packages of elastic energy) from the seismic source through the geological structure are propagating with speed that is determined by the elastic modules and the density of the environment. There are two basic types of elastic waves:

- P – Waves has the biggest impact of the research seismology are called longitudinal or primary elastic waves. The propagation velocity of the P waves is presented as $V_{p.}$
- S – Waves are called transversal or secondary elastic waves, have smaller propagation velocities than the P wave and their speed is presented as V_s.

The elastic modules that impact the propagation velocities of the longitudinal and transversal elastic waves are: Poisson ratio μ_{din}, Elasticity module E_{din}, Shear module

G_{din} and Volume module K_{din}. The dependencies of the propagation velocities of the P and S waves from the elastic modules are given in the next equations [1].

$$Vp = \sqrt{\frac{K+4G/3}{\rho}} = \sqrt{\frac{(1-\mu)E}{(1+\mu)(1-2\mu)\rho}}$$

$$Vs = \sqrt{\frac{G}{\rho}} = \sqrt{\frac{E}{\rho}\frac{1}{2*(1+\mu)}}$$

The elastic modules for the geological environments are obtained through laboratory investigations and on basis of that data, using the equations 1.1 and 1.2 the propagation velocities for each environments are calculated. In table 1 are shown the physical and geo – mechanical characteristics of the geological environments.

Table 1 Geo – mechanical parameters of the geological environments

Parameter	Clayed composition Proluvial sediments (Q_2prsk)	Clayed sands and gravel Proluvial sediments (Q_2prsk)	Sands and gravel, Proluvial sediments (Q_2prsk)	Pliocene sands and gravels Pliocene sediments (PL)
H (m)	1-3	2-5	8-12	25-60
Vp (m/s)	340-450	400-550	910-1360	1750-2750
Vs (m/s)	125-180	180-250	400-570	650-1100
γ (kN/m^3)	15-16	17-18	19-20	21-23
μ_{din}	0.42-0.40	0.38-0.37	0.38-0.39	0.42-0.40
E_{din} (MPa)	68-148	165-315	855-1840	2570-7950
G_{din} (MPa)	25-55	60-115	375-660	905-2840
K_{din} (MPa)	142-247	230-405	1100-2790	5350-13250

4. Refractive seismic method

The refractive seismic method is based on the basics of the seismic principles and its simplest form is composed from a source and receptor of elastic waves. Through the time delay that occurs from the moment of generation until the moment of registration is determined the propagation velocity of the elastic waves, whereas through the distance between the generator and receiver the depth of propagation in the sub surface geological complex. The refraction of the waves is a process of breaching of the elastic waves when they across environment with smaller propagation velocity in to environment with greater velocity. The angle of refraction depends from the propagation velocities of the two environments and it’s defined through the equation [2]:

$$\sin i_n = \frac{V_n}{V_{n+1}}$$

The refractive models that are processed in this paper are with maximal length of 60m and according to that the maximal investigated depth of the geological complex is 30m. For detailed investigations of the researched are produced a total of 4 refractive models that are overlapping on every 50m. Because of the extensiveness of the investigations in this paper is elaborated the registration and interpretation of one refractive model.

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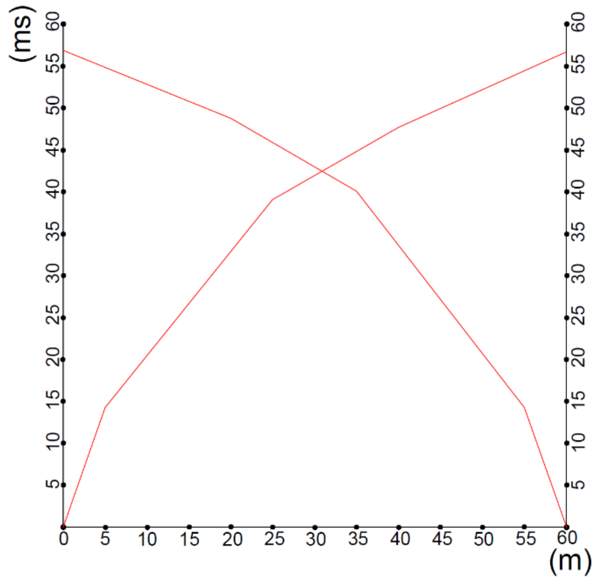

Figure 2. Model of refraction presented through two curves

5. Interpretation of the refractive seismic method

The interpretation of the refractive models contains several phases and the entire process is gradual and separate for the refractive measurement performed forward and backward. The process starts with detecting the breaches and branches of the curve. Each breach indicated boundary surfaces that separates two different geological structures. By determining the length Δx and time Δt differential is calculated the propagation velocity of the elastic waves in the investigated environments according to the equation:

$$Vn = \frac{\Delta x_n}{\Delta t_n}(m/s)$$

The depth to the boundary surfaces is determined through the t_0 (time intercept) method for each branch of the curve. The depth to each surfaces is calculated through the following equation [3]:

$$z_n = \frac{1}{2}\frac{Vn * t_{0n}}{\cos i_n}$$

Where:

z_n – depth to the n boundary surface;

V_n – Propagation velocity from the source on the ground surface to the boundary surface;

t_{0n} – intercept of the time t for n geological environment

$\cos i_n$ – angle of refraction of the elastic wave агол

On figure 3 is presented interpreted seismic model that models the investigated area through the t_0 method for each geological environment. The average propagation velocity of the elastic waves for each environment as well as the values of the length and time differential are obtained through direct analysis of the curve. From the figure can be concluded the time t_0 for each breach is presented with dotted lines. The values illustrated in the image are presented in ms whereas the depths to the boundary surfaces and the length of the model in m. The different geological environments are identified through correlation of the calculated data for the propagation velocities and the elastic modules obtained through the laboratory investigations.

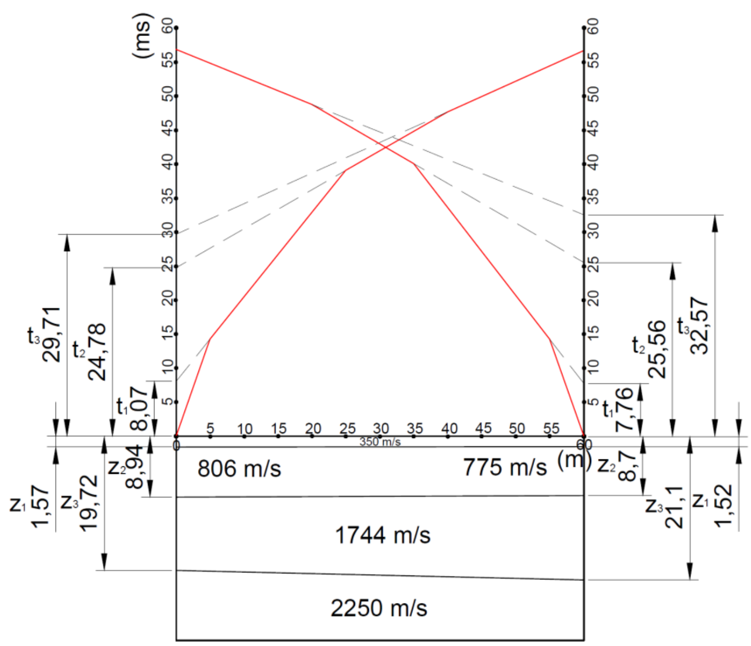

Figure 3. Interpreted refractive model

6. Refractive seismic profile

The refractive seismic profile is modeled with complex interpretation of the data obtained from the refractive models. The different values defined in the interpretation are interpolated and complete the geological structure of the investigated area defined through the seismic investigations. The refractive profile has the same length as the geological profile and with their comparison can be concluded that some geological environments that have similar geo – mechanical characteristics can't be modeled with this type of investigations. This geological structures on the basis of their different physical characteristics can be detected with appliance of different geophysical methods based on different principles (geo – magnetism, geo – electrics, gravimetric etc.)

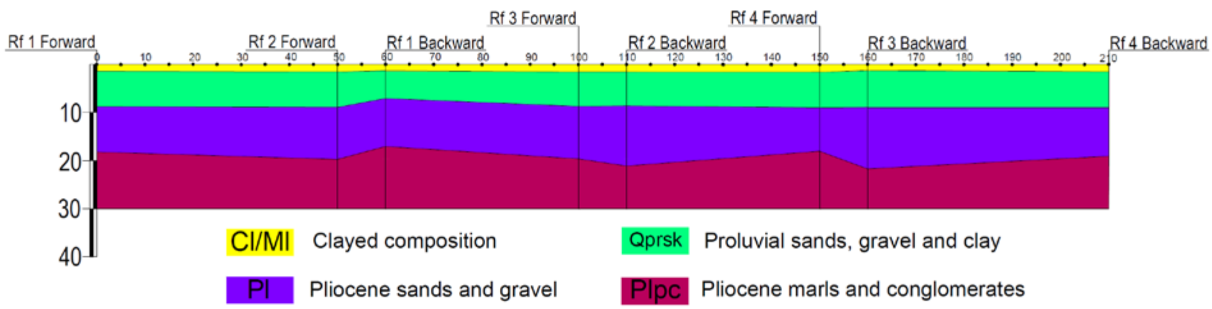

Figure 4. Refractive profile composed from four refractions

Conclusion

From the data and models presented in the paper can be concluded that the seismic methods can be applied for determining the under surface structure with reliable and accurate data while defining the different geological environments. It is important to note that the process of application and interpretation of the seismic methods is not independent and should be used as a complementary process to the geological and geo – mechanical investigations. The network of refractive models is relatively rare because it models around the same data as the exploratory boreholes but it is important to note that the investigations are performed in order to determine the precision and the effectiveness of the seismic methods through correlation with the data obtained from the geological investigations. With preparation of denser network the investigated area can be modeled through more measuring points along the surface of the field. Through that process can be determined the real value of the geophysical investigations, particular the seismic methods. The application of the geophysical investigations can significantly reduce the time and the cost for detailed investigation of the geological structure, producing more detailed geological profiles with much more data than the geological investigations conducted with exploratory boreholes.

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MODEL OF GEO – ELECTRICAL SOUNDING BASED ON GEOLOGICAL INVESTIGATIONS

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Abstract

The geo – electrical investigations are of great importance for more detailed modelling of geologically examined environments. The geo – electrical investigations are based on registration of the changes on the electrical field regardless of its nature (natural or induced) through which are determined the conductive properties of the geological structures that are associated with the geo – mechanical parameters. The determination of the most adequate geo – electrical method mostly depends of the geological structure of the environment, the geo – mechanical characteristics as well as the purpose of the trials.

The investigated area has geologically horizontally layered structure and acceptable data for the actual specific electrical resistance of the geological environments. Because of these features this paper elaborates the procedure of modelling and interpreting of geo – electrical models made with the method of geo – electrical sounding. The sounding is performed with Schlumberger layout of the measuring dispositive which is composed of two current and two potential electrodes in measuring array in which the distance between the current electrodes is much greater than the distance between the potential electrodes. For each new measurement the current electrodes are successively moving away from each other, which increases the modelling depth of the investigated environment. The examined area is composed of five exploratory boreholes with a total length of 240m. The geo – electrical sounding is performed with a maximum depth of 30m, and it’s represented with models of actual electrical resistance and models of apparent electrical resistance. The models of actual electrical resistance are made through the data for the geo – mechanical characteristics of the geological environments, whereas the models of apparent electrical resistance

are made synthetically in conjunction of the data for the geo – mechanical characteristics as well as the data obtained from the geological examinations.

The process of interpretation of the geo – electrical models of apparent electrical resistance through which are determined the different geological structures, their actual electrical resistance as well as the depths to the boundary surfaces that separates two environments with different geological characteristics.

1. Introduction

The geo – electrical methods are based on registering the changes on a known electrical field that depending on its nature can be natural or induced. The changes on the electrical field depends from the conductivity properties of the sub surface complex. According to that the underground geological environment is modeled while correlating the identified changes on the field with the conductivity properties of the geological structures. Depending on the nature of the electrical field the geo – electrical methods are divided in two main categories. The self – potential methods are registering the natural electrical current that is produced in the geological complex where as the resistivity methods register the electrical resistance of the complex manifested on induced electrical field.

The investigations elaborated in this paper are performed with current and potential electrodes that induce and register electrical field. According to that the investigations are categorized as methods of electrical resistance. This investigations contain geo – electrical models of real and apparent electrical resistance. The models of real electrical resistance are performed on the field in the exploratory boreholes or in laboratory conditions investigating the geological samples obtained from the process of geological mapping.

The models of apparent electrical resistance are interpreted by solving the direct task. With the interpretation of the apparent electrical resistance the real electrical resistance is determined for different depths. The different geological environments are identified with correlation of the interpreted data with the models of real electrical resistance. Based on the identification of the geological structures as well as the registered depths the investigated area is geo – electrically modeled. The models of apparent electrical resistance reach maximal length of 60m and according to that the investigated area is modeled to a maximal depth of 30m.

The investigated area that is chosen for geo – electrical investigations is geologically investigated through five exploratory boreholes and in this paper geo – electrically modeled with the method of geo – electrical sounding. The method of geo – electrical sounding is performed with Schlumberger layout of the measuring dispositive composed from two current and two potential electrodes where the distance between the current electrode is much greater than the distance between the potential electrodes. The investigated area is modeled through different depths with successively distancing the current electrodes for every new measurement. The potential electrodes register the apparent electrical resistance of the geological complex for given depth.

2. Geological investigations

The geological structure of the investigated area is geological examined through depth of 25m with five exploratory boreholes with various distances and a total length of 240m. Through the mapped boreholes are determined the geological environments that are representing the investigated area and on basis of this data is concluded that the geological complex is composed from the following geological structures:

- Clayed composition
- Sands and gravel with fine to medium granularity
- Pliocene sands and gravels
- Pliocene marls and conglomerates

On figure 1 is shown the geological profile of the investigated area modeled through the data obtained from the mapped boreholes.

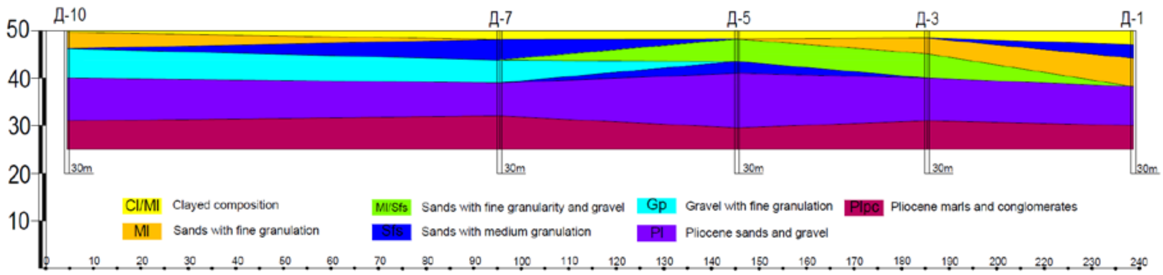

Figure 1. Geological profile of the investigated area

3. Geo – electrical characteristics of the investigated area

Table 1. Conductivity properties of the geological environments

Геолошки формации	Специфичен електричен отпор (Ωm)
Clayed composition (CL/ML)	10
Sands with fine granulation (ML)	60
Sands with fine granulation and gravel (ML/Sfs)	80
Sands with medium granulation (Sfs)	100
Gravel with fine granularity (Gp)	150
Pliocene sands and gravel (Pl)	200
Pliocene marls and conglomerates (Plpc)	300

For successful implementation of the geo – electrical sounding it is important to be determined the conductive properties of the geological environments meaning the values for their real electrical resistance. This parameters are obtained with identification of the electrical resistance registered while conducting a known electrical field through the investigated material. The values of the real electrical resistance may vary from 10 to 10^7 Ωm and are most dependent from the level of underground water, structure as well as the geo – mechanical parameters of the geological environments. In the Table 1 are presented the different geological structures as well as the values for the registered real electrical resistance.

4. Models of apparent electrical resistance

The models of apparent electrical resistance are represented as half logarithmic diagrams that on X axis contains the data for the investigated depth whereas on the Y axis the data for the apparent electrical resistance registered for the according depth. The geo – electrical models presented in this paper are made synthetically through the data of the mapped boreholes and the geo – electrical characteristics of the represented geological structures.

A total of five geo – electrical models are produced for thorough geo – electrical examination of the investigated area. In this paper visually is presented only one model of apparent electrical resistance and it's important to note that the shape of the models is different and depends from the thickness of the geological environment as well as their geo – electrical characteristics. For each measuring point on the researched profile line is made a geo – electrical model that models the environments vertically. The measuring point is located in the middle of the potential electrodes and the investigated depth is equal to one half of the distance between the current electrodes. On figure 2 is shown a geo – electrical model of apparent electrical resistance.

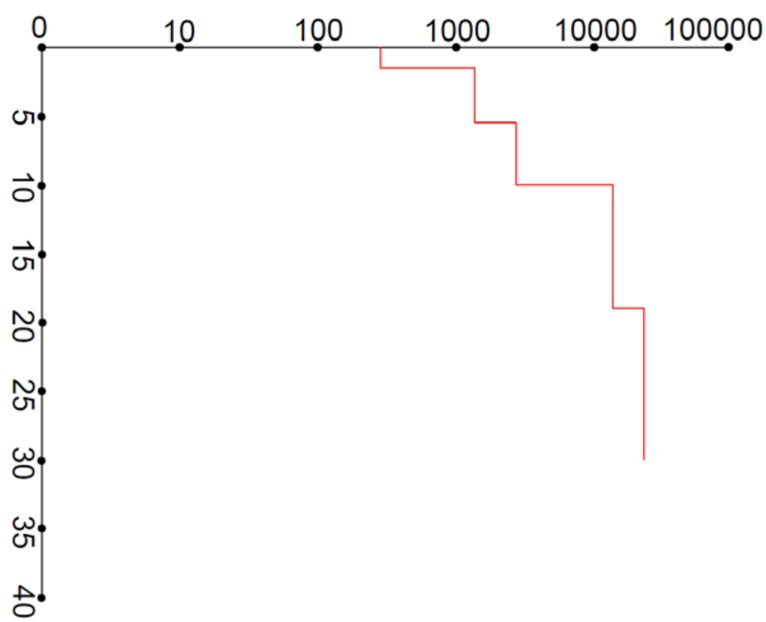

Figure 2. Geo – electrical model of apparent electrical resistivity

5. Interpretation of the model of apparent electrical resistance

The process of interpretation of the models of apparent electrical resistance for each model is similar and starts from the number of breaches (registered different values) of the geo – electrical curve, the registered depth and apparent electrical resistance. Each different value (breach) indicates change in the geological complex (new registered geological environment) [1]. The registered apparent electrical resistance is the total electrical resistance of the geological complex for given depth. Because of this the interpretation of the models is gradual and begins from the first breach of the curve. On figure 3 is presented the dimensioned curve of apparent electrical resistance.

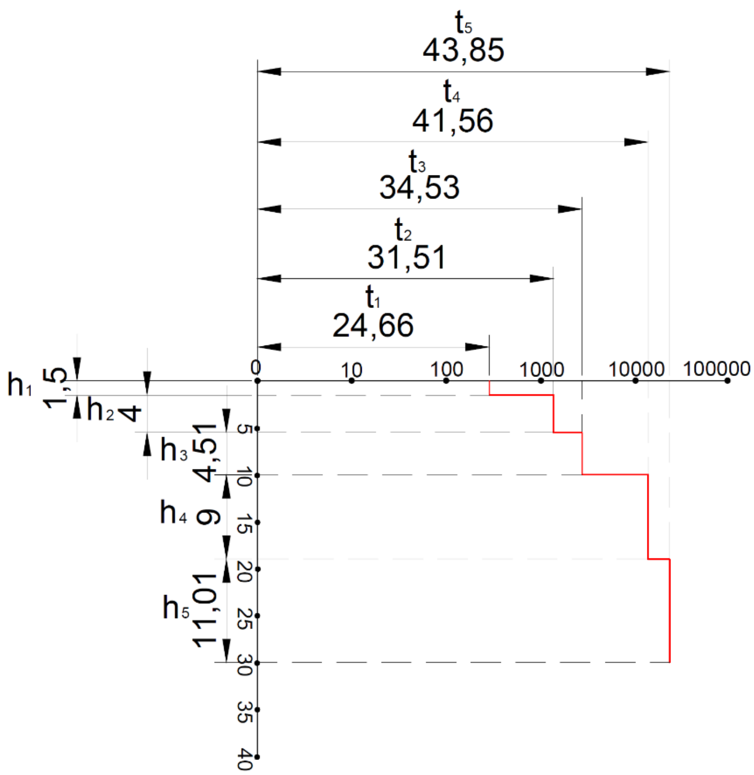

Figure 3. Interpreted curve of apparent electrical resistivity

The process of interpretation continues with dimensioning of each breach towards the X and Y axis respectively. Through this process are obtained the data for the depth (thickness of each geological structure) and the total electrical resistance. The data from the X axis are obtained directly whereas the data from the Y axis after mathematical calculation given that the Y axis represents the data logarithmically. The value of the apparent electrical resistance registered with Schlumberger layout depends from the distance between the current and potential electrodes as well as the electrical resistance of the geological complex. The dependences are shown in the next equation [3]:

$$\rho_a = \frac{\pi a^2}{b}\left[1 - \frac{b^2}{4a^2}\right]R$$

Where:

a – The distance between one current electrode and the center of the measuring dispositive

b – The distance between the two potential electrodes

π – Constant with value 3.14

R – The total electrical resistance of the geological complex.

under condition $a \geq 5b$;

For each breach of the curve the values of the measuring dispositive are known (a and b), as well as the registered apparent resistance ρ_a. With this data through the equation 1.1 is calculated the total electrical resistance of the geological structure. Because of the starting shallow depth of investigation and the geological structure of the investigated area, the total electrical resistance registered with the first breach is equal to the real electrical resistance of the first geological environment. For each successive breach the total electrical resistance is accumulated value from the real electrical resistances of the covered geological environments [2]. Because of the spherical way of propagation of the electrical field as well as the horizontally layered structure of the geological complex the different geological environments can be taken as parallel resistors and according to that the total electrical resistance for geological structure composed from n geological environments is equal to:

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \frac{1}{R_n}$$

From the data obtained with direct analysis of the curve of apparent electrical resistance through the equations 1.1 and 1.2 for each breach is determined the thickness of the geological structure, its real electrical resistance as well as the depth to each boundary surface.

6. Geo – electrical model of the investigated area

The geo – electrical model of the investigated area is made after identifying the geological environments from the data obtained from the interpretation of the curves of apparent electrical resistance. The geo – electrical model of the investigated area is produced with complex interpretation of the data obtained separately for each measuring point. The precision of the geo – electrical model depends from the density of the measuring points along the profile line as well as the integrity of the interpreted data. If the field and geological conditions allow favorable conditions for geo – electrical investigations, their results can be taken with high level of precision.

On figure 4 visually is shown the total geo – electrical model for the investigated area. With direct comparison of the geo – electrical and geological profile is concluded that in the process of geo – electrical modeling very little geological data is lost.

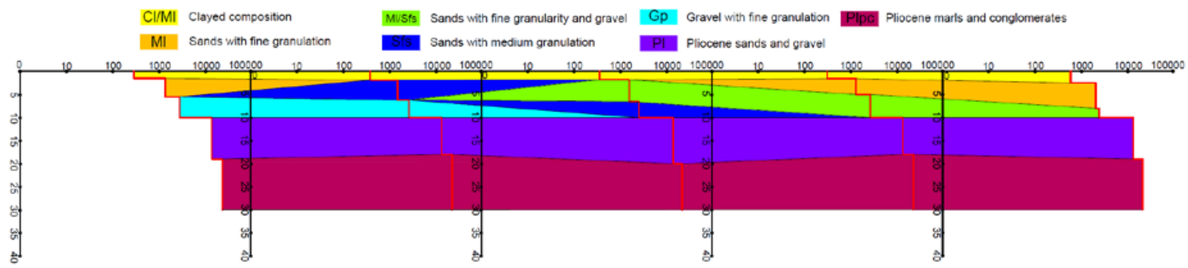

Figure 4. Geo – electrical model of the investigated area

Conclusion

The applicability and efficiency of the geo – electrical sounding depends from the field structure, the layering of the ore body, field conditions and most importantly the conductivity properties (electrical resistance) of the environments. If the necessary conditions allow successful application the method of geo – electrical sounding is very practical while determining geologically partially investigated and relatively extensive areas. This method is exclusively used in combination with exploratory mapped boreholes.

The data obtained through the modeling are added to the data obtained with the mapped boreholes and because of that the geo – electrical investigations can significantly reduce the number of necessary boreholes, therefor drastically decreasing the costs of geologically modeling. Depending on the purpose of the investigation the method of geo – electrical sounding can be applied independently or for greater efficiency in combination with other geophysical methods.

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COMPLEX INTERPRETATION OF DATA OBTAINED FROM SEISMIC REFLECTION AND REFRACTION

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ABSTRACT

The seismic methods of refraction and reflection are both based on registration and determination of the velocity of propagation of the elastic waves through geological known environments with the main difference in the rays that are registering. Namely the reflective method is registering the ray that that is reflected from the boundary surface that is dividing two different geological environments, whereas the refractive method is registering the refractive ray that is breached on a certain boundary surface. Every refraction has a process of reflection, therefore the procedure of registering the refractive and reflective waves is performed simultaneously by setting more geophones along the investigated environment.

The investigated area that is chosen to be modelled through models of refraction and reflection is geologically investigated with five exploratory boreholes and has a total length of 210m. With the method of refraction the investigated area is examined to a maximal depth of 30m, whereas with the seismic method of reflection the investigated area is examined with maximal depth of 15m. Because the depth of examination of the environment depends on the distance between the source and the receiver of the elastic waves and it's equal to one half of that length, the refractive profiles are made with length of 60m, whereas the reflective profiles with length of 30m, with the source of the elastic waves positioned in the middle of the refractive profiles. In *order to examine the whole length of the investigated area through the modelling a total of four refractive and reflective profiles are made. The modelling of the profiles is made synthetically on the basis of the geo – mechanical data for the geological environments as well as the geological data obtained from the exploratory boreholes. The last phase of the modelling in this paper is the process of complex interpretation of the obtained seismic models. Through the process of interpretation are determined the propagation velocity of the elastic waves through the geological structures, the geological characteristics of the investigated environment and with the* t_0 *method the depths to the boundary surfaces that are separating the different geological environments.*

KEYWORDS

Elastic waves, propagation velocity, refraction, reflection

1. INTORDUCTION

The seismic investigations are based on generating elastic waves at a known time interval, that are propagating through the under surface geological structure in the researched area. Along the propagation the elastic waves are reflecting and refracting on the boundary surfaces and the different waves are registered on the surface at known distance and time delay. The elapsed time registered from the generation and the first registration of the elastic waves is used to determine the propagation velocity and the physical and geo – mechanical characteristics of the geological environments. The investigated area is modeled by determining the different geological structures as well as the depths to the boundary surfaces that are separating them.

In the paper is elaborated the procedure of appliance and complex interpretation of the seismic methods of refraction and reflection. The essential difference in the main principles of the two methods is in the type of elastic waves that is registered. When an elastic wave is traveling from one geological structure to another at the boundary surfaces are conducted process of breaching (refraction) and process of reflection. Part of the elastic wave is reflected towards the surface and part of the elastic wave is refracted deeper in the geological complex. Accordingly the seismic method of refraction is based on registering the breached or refracted part of the elastic wave, whereas the seismic method of reflection is registering the reflected part of the elastic wave. The generation and registration of the elastic waves is performed simultaneously while strategically placing several adequate geophones along the investigated area.

The researched area that is investigated and modeled with complex application of seismic methods is geologically investigated with five exploratory boreholes with maximum investigation depth of 25m and a total length of 210m. Through the refractive method the investigated area is researched and modeled with maximal depth of 30m and according to the principles of determining the depth of investigations the total length of the refractive models reaches 60m. With the method of reflection the investigated area is researched to a maximal depth of 15m and accordingly the reflective models have a total length of 30m. The models of reflection are registering the elastic waves that are generated in the middle of the refractive models.

2. GEOLOGICAL INVESTIGATIONS

The investigated area is geologically investigated with a depth of 25m through five mapped exploratory boreholes. From the mapped boreholes are determined the different geological environments and on the basis of that data is concluded that the investigated are is mainly composed from five geological formations:

- Clayed composition
- Sands and gravel with fine to medium granularity
- Pliocene sands and gravel
- Pliocene marls and conglomerates

The geological structure determined from the geological investigations is shown in the geological profile presented on the figure 1.

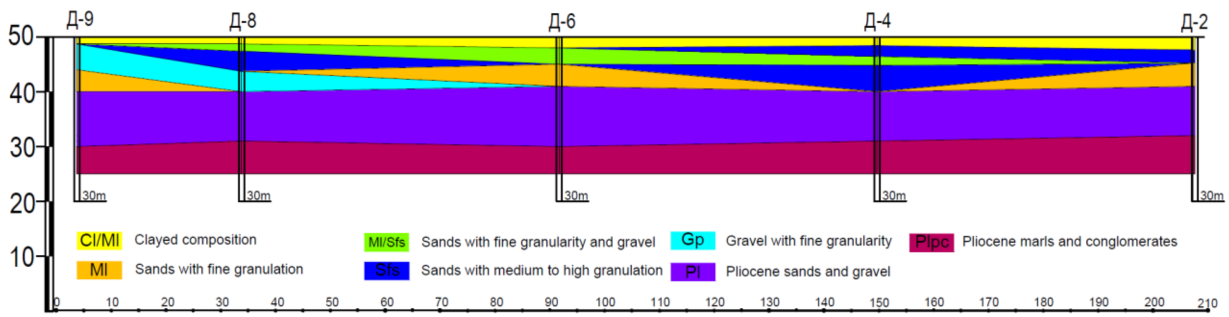

Figure 1. Geological profile composed from five exploratory boreholes, examined to a depth of 25m

2. LABORATORY INVESTIGATIONS

The laboratory investigations presented in this paper are based on determining the geo – mechanical characteristics of the geological environments. In general the elastic waves (packages of elastic energy) from the seismic source through the geological structure are propagating with speed that is determined by the elastic modules and the density of the environment.

The elastic modules that impact the propagation velocities of the longitudinal and transversal elastic waves are: Poisson ratio μ_{din}, Elasticity module E_{din}, Shear module G_{din} and Volume module K_{din}. The dependencies of the propagation velocities of the P and S waves from the elastic modules are given in the next equations [4]:

$$Vp = \sqrt{\frac{K + 4G/3}{\rho}} = \sqrt{\frac{(1-\mu)E}{(1+\mu)(1-2\mu)\rho}} \quad (1)$$

$$Vs = \sqrt{\frac{G}{\rho}} = \sqrt{\frac{E}{\rho}\frac{1}{2*(1+\mu)}} \quad (2)$$

The elastic modules for the geological environments are obtained through laboratory investigations and on basis of that data, using the equations 1.1 and 1.2 the propagation velocities for each environments are calculated. In table 1 are shown the physical and geo – mechanical characteristics of the geological environments as well as the calculated propagation velocities.

Table 1 Geo – mechanical parameters of the geological environments

Parameter	Clayed composition Proluvial sediments (Q_2prsk)	Clayed sands and gravel Proluvial sediments (Q_2prsk)	Sands and gravel, Proluvial sediments (Q_2prsk)	Pliocene sands and gravels Pliocene sediments (PL)
H (m)	1-3	2-5	8-12	25-60
Vp (m/s)	340-450	400-550	910-1360	1750-2750
Vs (m/s)	125-180	180-250	400-570	650-1100
γ (kN/m^3)	15-16	17-18	19-20	21-23
μ_{din}	0.42-0.40	0.38-0.37	0.38-0.39	0.42-0.40
E_{din} (MPa)	68-148	165-315	855-1840	2570-7950
G_{din} (MPa)	25-55	60-115	375-660	905-2840
K_{din} (MPa)	142-247	230-405	1100-2790	5350-13250

3. SEISMIC MODELS OF REFRACTION AND REFLECTION

The seismic models of refraction and reflection are composed from curves obtained complementary through the refractive and reflective investigations. The curves are presented as two – dimensional diagrams that for a known distance are showing the registered time of propagation of the elastic waves.

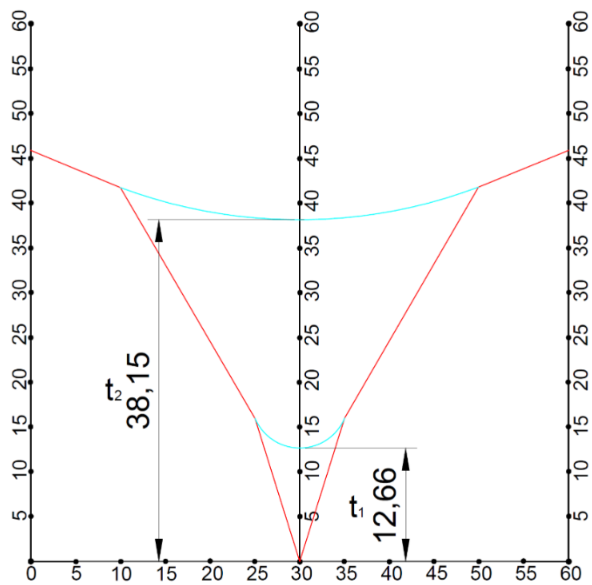

Figure 2. Seismic model from curves of refraction and reflection

The registered time of the elastic waves depends from the propagation velocities of the elastic waves through the geological complex, the depth of propagation as well as the angle of breaching or reflecting depending on the type of investigations. On the figure 3 is shown seismic model with two curves of refraction (from the beginning and the end of measuring line) and one curve of reflection in the middle of the measuring line.

4. INTERPRETATION OF THE SEISMIC MODEL OF REFRACTION AND REFLECTION

The interpretation of the seismic models of refraction and reflection is performed under different concepts independently from one another. For both type of investigations the shape of the curve represented the same physical principles and point to the same parameters. The procedure of interpretation begins with the determination of the breaching points of the curve where each branch represent different geological structures. For each branch is determined the length (Δx) and time (Δt) differential and through that data is determined the propagation velocity of the elastic wave through the investigated environment. The velocity is calculated through the following equation [1]:

$$Vn = \frac{\Delta x_n}{\Delta t_n} (m/s) \tag{3}$$

The depths to the boundary surfaces for the two models are interpreted through the t_0 method. Because of the different physical principles used in the process of registration of the elastic waves the depths are calculated through different equations and dependencies. According to that when interpreting the data obtained from the models of refraction the depths to each boundary surfaces is calculated through the following equation [3]:

$$z_n = \frac{1}{2} \frac{Vn * t_{0n}}{\cos i_n} \tag{4}$$

Whereas with the interpretation of the data obtained from the models of reflection the depths to the boundary surfaces is calculated through the equation:

$$z_n = \frac{Vn * t_{0n}}{2} \tag{5}$$

Where:

z_n – depth to the n boundary surface;

V_n–Propagation velocity from the source on the ground surface to the boundary surface;

t_{0n} – intercept of the time t for n geological environment

i_n – angle of refraction of the elastic wave

The data for the propagation velocities of the elastic waves as well as the time intercept are obtained through direct analysis of the refractive and reflective curves (as it’s shown on the figure 2). The angle of refraction between two geological environments depends from the propagation velocities of the elastic waves in the structures and its calculated through the following equation [2]:

$$\sin i_n = \frac{V_n}{V_{n+1}} \qquad (6)$$

On figure 2 is shown the interpreted seismic model of refraction and reflection.

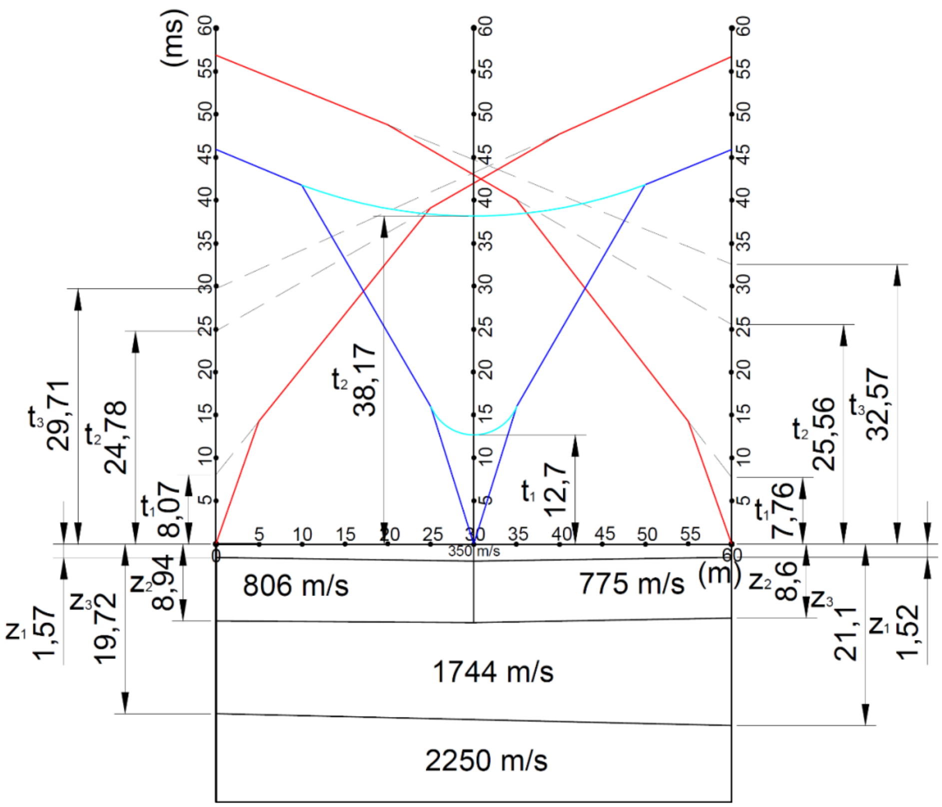

Figure 3. Interpreted seismic model of refraction and reflection

5. COMPLEX INTERPRETATION OF SEISMIC INVESTIGATIONS

The seismic profile is modeled with the data obtained from the refractive and reflective models. The differences in the data of the investigations are modeled in the process of interpolation between the known depths. The seismic profile has the same length as the geological profile where the modeling of the under surface structure is obtained through a lot more measuring points along the measuring line, thus increasing the data used in the modeling.

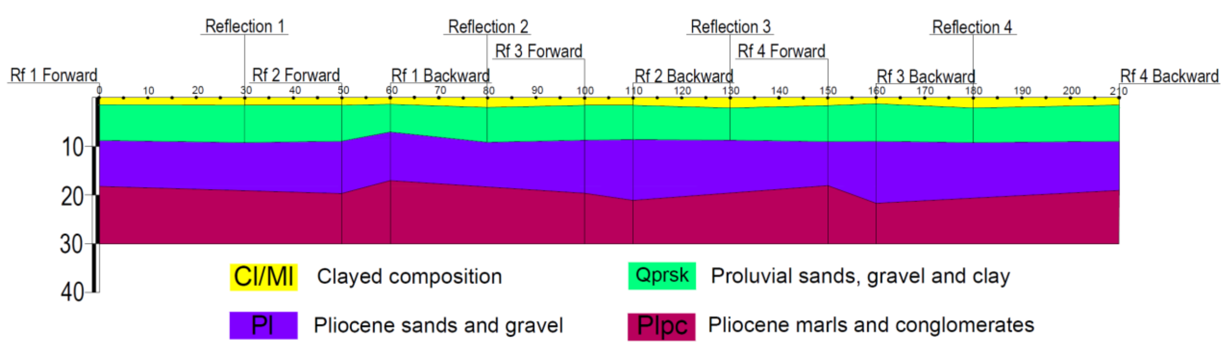

Figure 4. Seismic profile of the investigated area

On figure 4 is shown the seismic profile obtained through complex interpretation of the data obtained from the refractive and reflective investigations.

CONCLUSION

With complex interpretation of the data obtained from the different seismic investigations can be detected the differences in terms of efficiency and accuracy of the two methods. When comparing the obtained data with the geological investigations can be concluded that the depths to the boundary surfaces are more accurately determined with the method of seismic reflection. The interpreted data are very important when determining the optimal network of seismic models (refractive and reflective), for precise and optimal modeling of the investigated area.

The seismic network that is used for geophysical investigations is relatively rare, because the purpose of the investigations are to determine the benefits and losses of each method. For detailed seismic investigations it's important to implement a lot more reflective models (on every 5 – 10m) along the investigated area. With increasing the number of reflective models, the investigated area will be modeled through more measuring points along the profile line, which will result with seismic model that will contain a lot more data. According to that the refractive models would be used to determine the different geological structures and their elastic characteristics whereas the reflective models would be used for precise and denselydeterminations of the depths to the boundary surfaces. The depths of investigations of the reflective models depends from the purpose, and does not always investigated the same depth as the refractive seismic models.

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CORRELATION OF THE MODELS OBTAINED WITH THE METHOD OF REFRACTION AND GEO – ELECTRICAL SOUNDING

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ABSTRACT

In order to obtain more concrete and more accurate results when the modelling of the under surface structure of the investigated area is made with the usage of geophysical examinations, if the field conditions allow it is necessary to be applied more than one geophysical method. In this paper is elaborated the procedure of complex interpretation of a seismic and geo – electrical model. The seismic model is modelling the geological structure by determining the speeds of propagation of the elastic waves which depends from the geo – mechanical characteristics of the geological environments. The geo – electrical model is modelling the investigated area by registering the changes on the electrical field which depends from the conductivity of the geological environments.

The parameters of the investigated area (the layers of different geological environments, their electrical conductivity and geo – mechanical characteristics as well as the depth of examination) that is elaborated in this paper provide acceptable conditions for applying the refractive seismic method and the method of geo – electrical sounding. The investigated area is geologically researched with five exploratory boreholes and has a total length of 240m in one profile line. The refractive models as well as the models of geo – electrical sounding are made synthetically *while using the data obtained from geological and geo – mechanical examinations. The refractive models are composed from five refractions and the geo – electrical model is made from five geo – electrical soundings all of them with length of 60m. With the interpretation of the refractive models are determined the different geological environments (by the different speeds of propagation of the elastic waves) as well as the boundary surfaces that separates them, whereas with the interpretation of the models of apparent electrical resistivity the different geological structures and the boundary surfaces between them are defined by their actual specific electrical resistance.*

As a final phase of the modelling in the paper is made correlation between the two models (seismic refraction and geo – electrical sounding) as well as comparison and interpolation between the interpreted results in order to obtain more concrete and more precise vision for the under surface structure of the investigated area.

KEYWORDS

Elastic waves, electrical resistance, refraction, sounding

1. INTRODUCTION

The geophysical investigations are based on registering the physical characteristics of the under surface structure (rock masses, sediments, water etc.) and generally can be divided in two fundamentally different types:

- Passive methods that register the variations of the natural earth fields (gravitational and magnetic)
- In contrast of this methods are the active geophysical methods that are based on artificially generating signals that are transmitted through the under surface complex. In their propagation the artificial field is modified as result of the physical characteristics of the materials. The changes in the field are registered on the surface with adequate receptors. The subsurface structure is identified with the interpretation of the changes on the field.

If the research conditions allow the geophysical methods will be with greater value if are applied with several different geophysical methods. The investigated area researched in this paper is modeled through seismic and geo – electric investigations. Both geophysical methods until the complex interpretation are applied independently. The interpretation of the data obtained from the both investigations is made correlatively, whereas the interpreted geophysical model with process of interpolation of the obtained data. For accurate determination of the adequate geophysical methods it's important detailed review of the available geological and geo – mechanical data of the investigated area.

2. GEOLOGICAL AND GEO – MECHANICAL INVESTIGATIONS OF THE RESEARCH AREA

The investigated area is geologically investigated with a depth of 25m through five exploratory boreholes with different distance between them with a total length of 240m. The different geological structures are determined through the data obtained from the mapped boreholes.

Based on that data is concluded that the investigated area is mainly composed from the following geological structures.

- Clayed composition
- Sands and gravel with fine to medium granularity
- Pliocene sands and gravel
- Pliocene marls and conglomerates

On figure one is shown the geological profile for the investigated area constructed from the data of the boreholes.

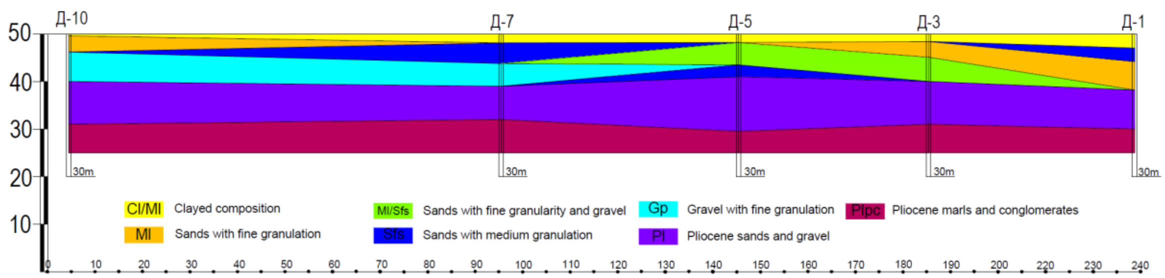

Figure 1. Geological profile of the investigated area

From the geological profile is concluded that the ore body in the investigated area is horizontally layered.

The geo – mechanical investigations of the geological environments are applied in laboratory conditions using the material samples from the mapped boreholes. Through this investigations are determined the elastic modules, density as well as the conductivity properties of the different geological structures. From the obtained data is calculated the propagation velocity of the elastic waves as well as the real electrical resistance for each geological environment.

The applicability as well as the efficiency of the seismic and geo – electrical investigations is determined on the basis of the results obtained from the geological and geo – mechanical investigations. The horizontally layered structure of the geological complex indicates favorable conditions for usage of the refractive seismic method as well as the method of geo – electrical sounding. The propagation velocities of the elastic waves fulfill the necessary condition (each deeper geological environment provides greater speed of propagation than the upper one) for application of the refractive method.

The usage of the method of geo – electrical sounding is justified with the data of real electrical resistance that manifest sufficient differences for accurately dividing the different geological structures.

3. SEISMIC INVESTIGATIONS

The seismic investigations in this paper performed with the method of refraction. This kind of seismic investigations are registering the refracted elastic waves that are propagated though the geological complex. The investigated area is seismically researched through five double refractive models. On figure 3 is shown one refractive model.

The refractive model is composed from two seismic curves as well their time intercepts t_0 for each breach of the curve. The number of breaches of the curve determinates the number of different geological environments that are composing the investigated geological complex. By determining the difference in the length Δx as well as the time Δt is calculated th (1) pagation velocity of the elastic waves for each geological structure. The dependences are given with the equation [1]:

$$Vn = \frac{\Delta x_n}{\Delta t_n}(m/s)$$

Through the calculated velocities of the elastic waves are identified the geological environments, and their thickest is determined by calculating the depths to the boundary surfaces that are separating them. The depths of the boundary surfaces depends of the average propagation velocity of the elastic waves from their source to the boundary surface Vn, the time intercept t_0, as well as the angle of refraction of the seismic wave. The connection of the parameters is given in the equation [2]:

$$z_n = \frac{1}{2}\frac{Vn * t_{0n}}{\cos i_n} \qquad (2)$$

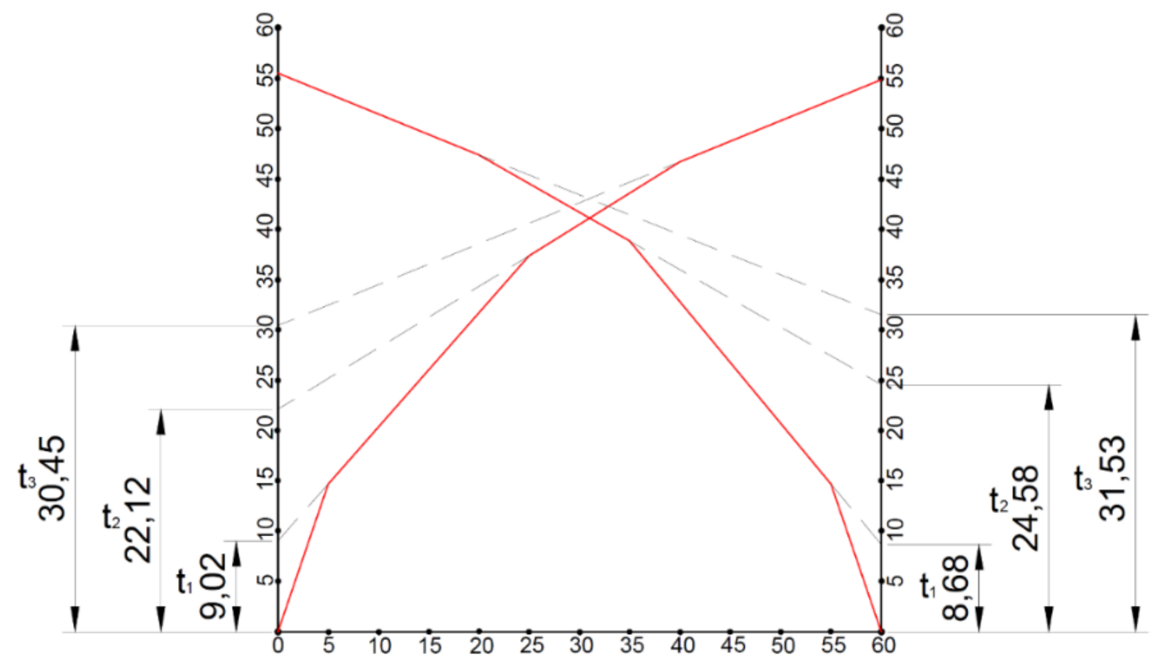

Figure 2.Refractive model

Using the same principle each refractive model is interpreted for both directions and based on that data is modeled the sub surface structure of the investigated area. The seismic model of the investigated area is produced with process of interpolation of the data obtained through the interpretation of the refractive models. On figure 3 is shown the seismic model for the investigated area with the identified geological environments as well as their boundary surfaces.

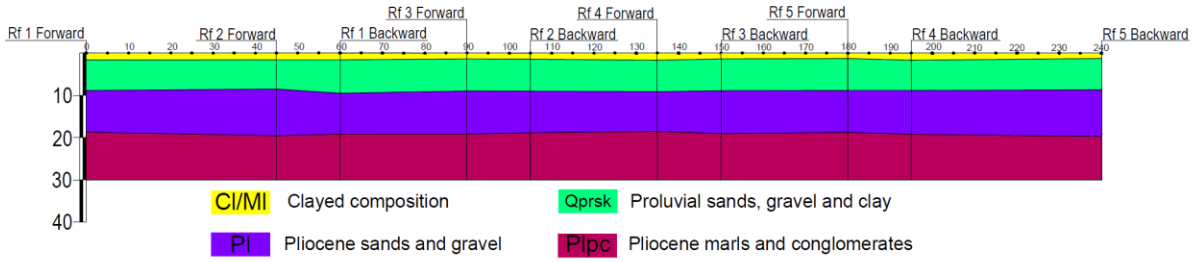

Figure 3.Seismic model of the investigated area

4. GEO – ELECTRICAL INVESTIGATIONS

The geo – electrical investigations are performed with the method of geo – electrical sounding. The method is based on induced electrical field (between two current electrodes), as well as registering of the changes on the field in the two potential electrodes. The investigations are made with Schlumberger array of the measuring equipment where the distance between the current electrodes is much greater than the distance between the potential electrodes. The depths of investigations depends from the distance between the current electrodes. For each new measurement the electrodes are successively receding away and according to that for each new measurement is registered resistance for greater and known depth.

The registered resistance in the potential electrodes is apparent electrical resistance that is manifested from the geological complex. The apparent electrical resistance depends of the different geological environments presented in the complex as well as their conductivity properties. On figure 4 is shown the geo – electrical model of apparent electrical resistance.

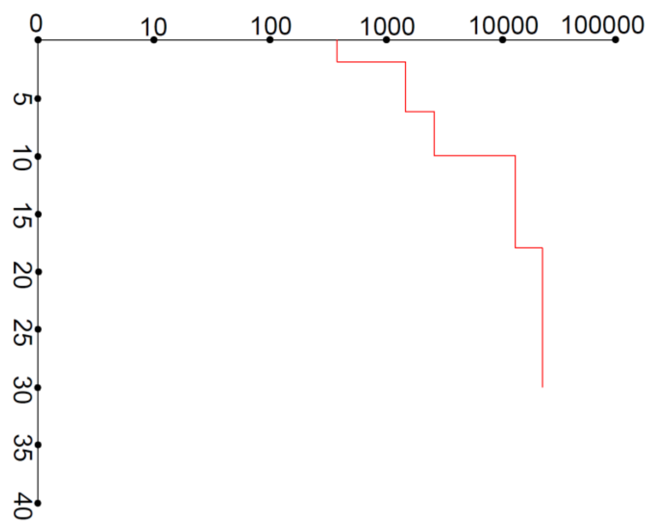

Figure 4. Geo – electrical model of apparent electrical resistance

From the geo – electrical model are determined the breaching points of the curve that indicates different geological environments. The depth to each boundary surfaces is obtained directly from the model whereas the value for the apparent electrical resistance is appropriately calculated from the X axis.

The registered apparent electrical resistance depends from the "a" – distance from one current electrode to measuring point, b – distance between the two potential electrodes and the R - the total electrical resistance of the investigated geological complex. The dependencies of the apparent electrical resistance and the above mentioned parameters is given with the equation [4]:

$$\rho_a = \frac{\pi a^2}{b}\left[1 - \frac{b^2}{4a^2}\right]R \qquad (3)$$

The distances "a" and "b" are known from the alignment of the measuring dispositive during the investigations, and the total electrical resistance R is calculated as accumulated resistance from the geological environments. Because of the spherical way of propagation of the electrical field and the horizontally layered structure of the ore body the total electrical resistance of part of the geological complex can be calculated as a summation of parallel resistors according to the equation [3]:

$$\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \ldots \frac{1}{R_n} \qquad (4)$$

In the process of interpretation the different geological structures are identified by the values of the real electrical resistance R_1, R_2,…R_n, in correlation with the data for the conductivity properties of the tested geological formations. The process of interpretation is proceed for each geo – electrical model.

With complex interpretation of the obtained data from the geo – electrical models is produced a geo – electrical profile for the investigated area modeled through the real electrical resistance of the geological environments. On figure 5 is shown the geo – electrical profile for the researched area.

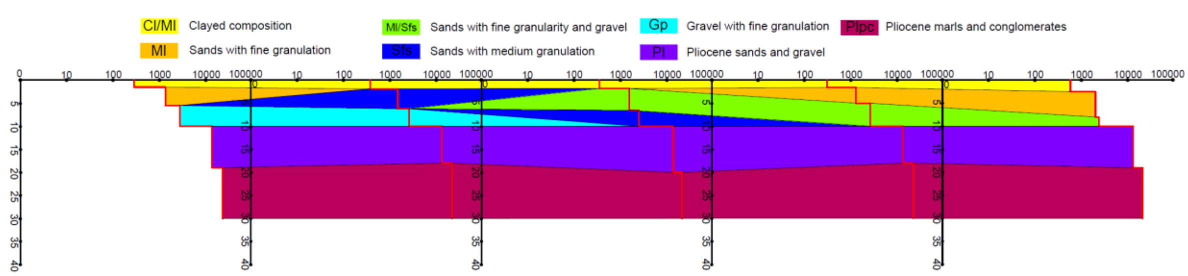

Figure 5.Geo – electrical profile of the investigated area

5. CORRELATION BETWEEN THE GEOPHYSICAL AND GEOLOGICAL INVESTIGATIONS

On figure 6 are shown the geological, seismic and geo – electrical profile. While correlating the seismic profile with the geological is concluded that certain geological environments with similar geo – mechanical parameters are not detected with the investigations and are lost in the process of modeling. The geological environments are presented as one whole structure. In the seismic modeling the geological environments that are lost are presented as pliocene sands and gravels as a second geological environments.

While correlating the geo – electrical profile with the geological and seismic is concluded that the geological environments that are lost in the seismic modeling are identified and determined. When comparing the geophysical profiles with the geological for this investigated area is concluded that the geo – electrical investigations are more suitable and provide precise data for the geological environments as well as the depths to the boundary surfaces. It is important to note that the conclusions about the effectiveness and precisions of the geo – electrical over the seismic investigations are for the investigated area modeled in this paper.

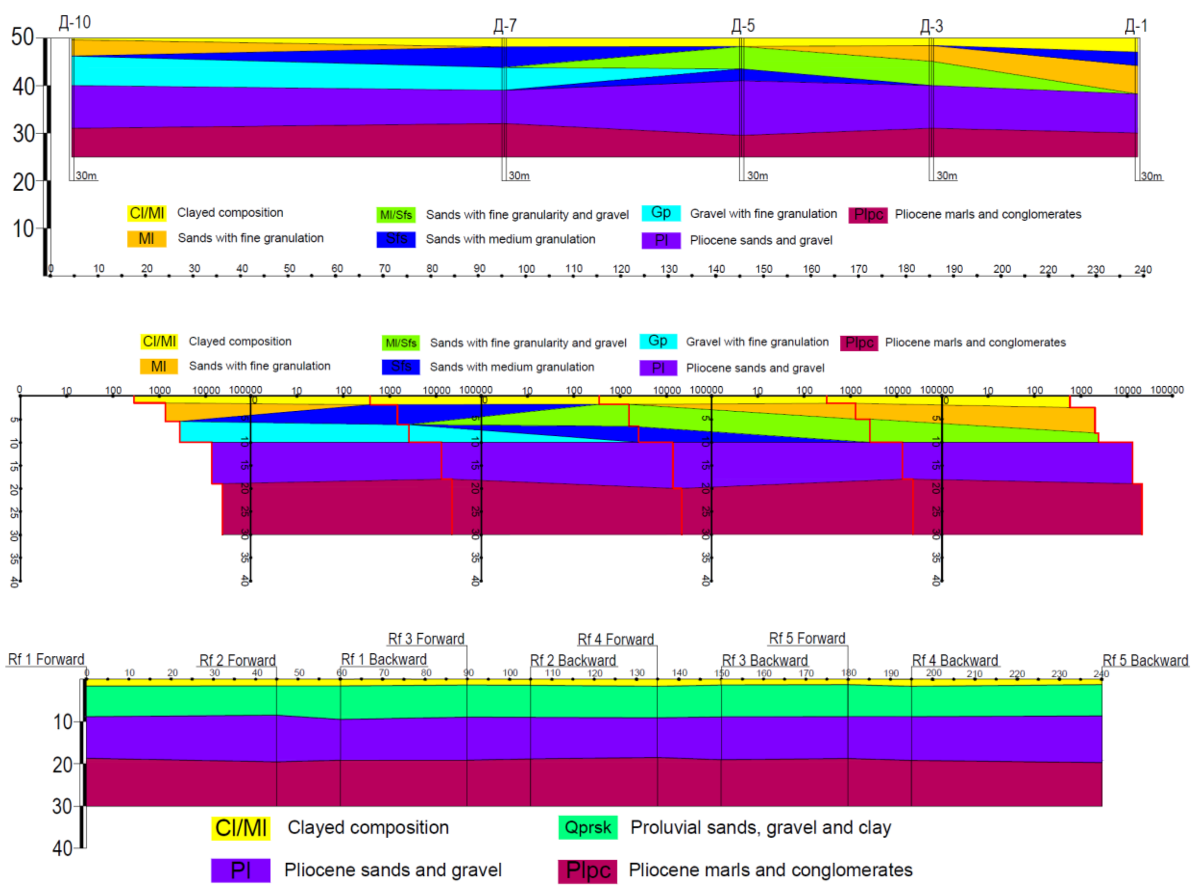

Figure 6. Geological, geo – electrical and seismic profile

CONCLUSION

When investigating a research area with appliance of more than one geophysical method is concluded that the geological structures depending of their characteristics with some investigations are detected whereas with others cannot be identified and are modeled as a whole geological environment. That is because the different geophysical methods are based on different physical principles. Particularly in the seismic investigations the part of the geological complex was modeled as one whole because of the same or similar geo – mechanical parameters of the geological structures. According to the seismic principles those geological environments are characterized as one. Because of the different conductive properties of the complex, when applying the geo – electrical investigations can be modeled as a complex composed from different geological environments with similar elastic characteristics.

With application of more than one geophysical methods is increased the data by which the investigated area is modeled, in the same time the scope of parameters by which are identified the geological structures. Because of this reasons for obtaining detailed and reliable model of the under surface structure of the investigated area it's desirable to be used several different geophysical investigations.

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WHY THE ASSAREL OPEN PIT MINE HAS TO BE MINED IN STAGES

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Abstract

The paper presents the development of Asarel mine in stages where the advantages and disadvantages of the development stages are pointed out. The possibilities for three stage opencast development of the Asarel deposit are described. A flowchart of the development stages of Asarel mine during its expansion is presented.

Introduction

The copper deposits in Bulgaria are steeply dipping layers at a depth of 700 – 1,000 m and deeper. At the same time, they are preferentially mined using an opencast method down to a depth of 400 – 600 m which is the case of the Elatzite and Assarel mines. Their more profound deepening increases the volume of waste, the areas around the surface outlines of the pit and also the hazard of large failures to appear. This leads to an irregular duty of operation and calendar planning of mining works as well as dumping large volumes of waste at external dumps.

So far, the Assarel open pit mine has been working along the approved B-medium contour down to level 555 which covers about 270 million tonnes of ore. According to the Terms of Reference prepared by Assarel-Medet JSC, other technical and economic contours are also possible going deeper to levels 450, 400, 300, etc. These contours cover ore reserves which are from 3 to 10 times bigger than the contained in B-medium contour of cut-off grade of 0.11 ÷ 0.15% Cu and they allow the life of the mine to be increased with 30 to 50 years.

AMEC, Australia, are currently preparing a new conceptual design of the Assarel open pit mine. Ten (10) options have been developed based on which the optimal pit contour will be determined and its throughput will be preserved or increased at the same time. Due to the long dipping height of the deposit, its significant reserves and long mining term, it is currently impossible to select the exact efficient pit contour. This is related to the inaccuracy of geological and geomechanical data concerning the rocks, errors in the technical and economic calculations and world metal price fluctuations.

The former operation of the pit is characterized with relatively low quality indices and complex mining and geological conditions (availability of failures, cracks, etc.), which requires significant operation costs. These costs are particularly high when the deposit is mined along its entire surface contour when deformations occur in the massif and additional volumes of waste are removed. In order to preserve or increase the efficiency of the deposit mining method, it needs to be mined at stages by shaping temporary non-working edges, reducing the width of the mining areas, providing water drainage and ensuring the slope stability. The stages shall be for a period of 10 ÷ 12 years. However, the accuracy of determining the contours will be different. The first stage will be determined at the highest accuracy and the next ones will contain a bigger error. This will continue until the open pit mining becomes inefficient.

Peculiarities of Staged Mining

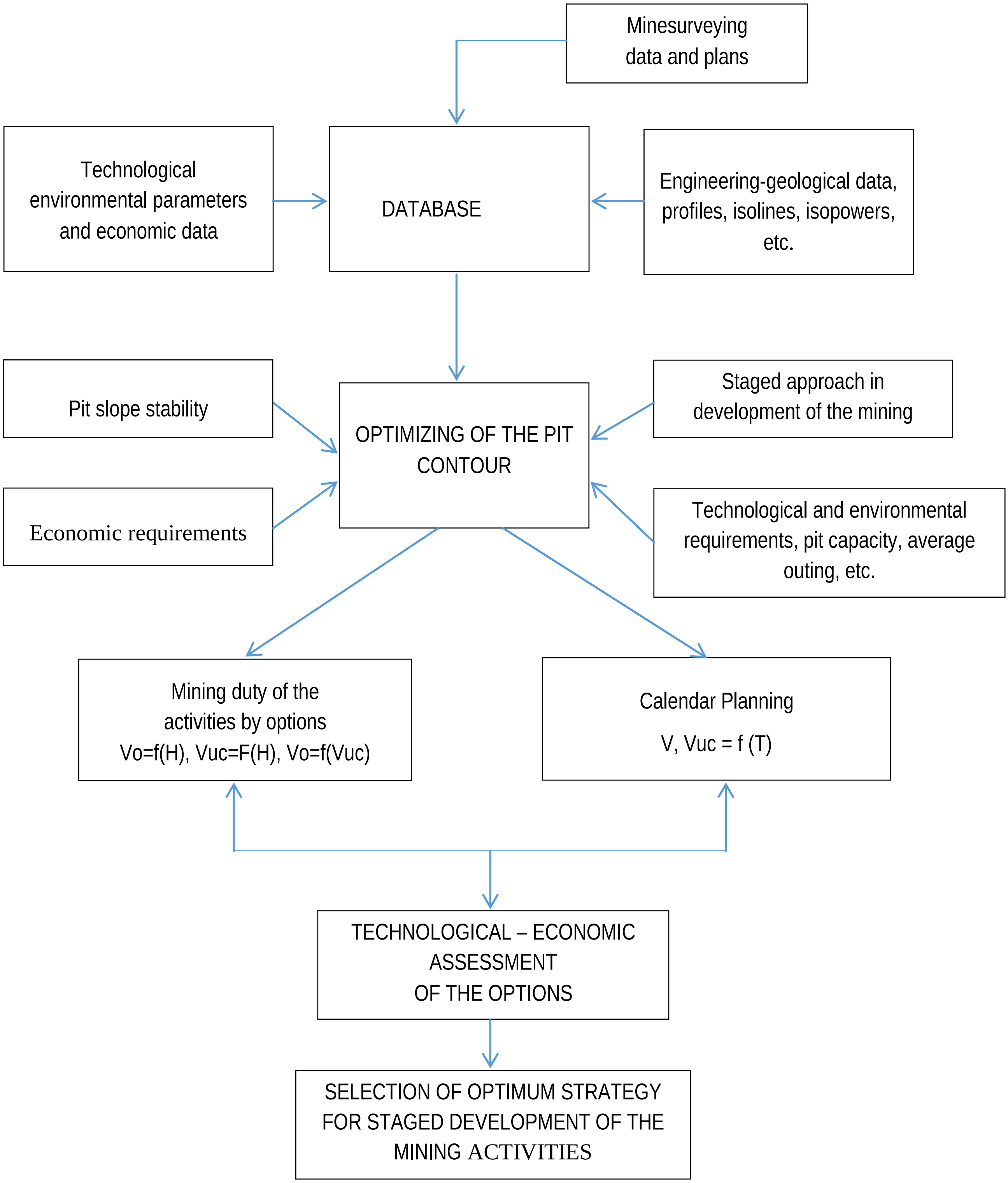


Fig. 1. A flowchart of the staged development of the Assarel open pit mine

The dimensions of the Assarel deposit and the necessity for its efficient mining are the main prerequisites which predetermine that a strategy for a staged mining and leaving temporary non-working edges be applied (Fig. 1).

A staged mining of steeply dipping deposits (like Assarel) leads to a significant capital costs reduction. Undoubtedly, the application of staged mining for the deposit will require new technical and economic solutions which will allow a maximal quantity of ore of the best indices to be mined.

The advantages of the staged mining of the Assarel open pit mine are the following: reducing the reconstruction period; increasing the mining intensity; increasing its capacity; selecting the best technology and equipment; bigger potential to manage the slope stability; working with a dynamic contour at which the massif will be updated; providing planned development of the company and the maintenance and repair schedules. Thanks to the separation of the pit by stages, the duty of mining works and the waste calendar schedule will be improved. Its efficient mining will be enhanced.

The main disadvantages of the open pit staged mining are the following: the complexity of the mining activities will be increased; a necessity of special equipment and funds for development of the mine in the temporary non-working edges will occur.

Considering this separation of the deposit into three (3) stages, a more thorough mining of the reserves could be achieved as well as the safety of the mining activities and the operation period can be extended.

When preparing the working plans for the individual mining stages, their technical and technological solutions shall be interrelated and shall be accepted as a complex taking into consideration the time factor and accuracy in their performance.

Each intermediate contour will be determined based on economic criteria in which the time factor will be considered (for example the current stripping ratio K_t shall be equal to the border stripping ratio K_{bor}) so that the criterion that medium (contour) stripping ratio shall be equal to the border stripping ratio, i.e. $K_{med} = K_{bor}$ for the next stages. This will be reiterated until the depth and the edge location are found to be inefficient for open pit mining.

The application of the staged mining of the deposit will allow a reliable determination of the optimal boundaries of the Assarel open pit mine and mining of a maximal quantity of ore reserves.

Admittedly, after the expiration of each 10-12-year operation period, the stage sizes will be specified again based on the actual technical and economic indices of the open pit mining and the world metal prices which are applicable for the specific time moment.

We consider that such an approach will result into a more efficient usage of the available natural resources. Additionally, the duty of the mining activities and the calendar schedule with their technical and economic evaluation will be developed for each stage.

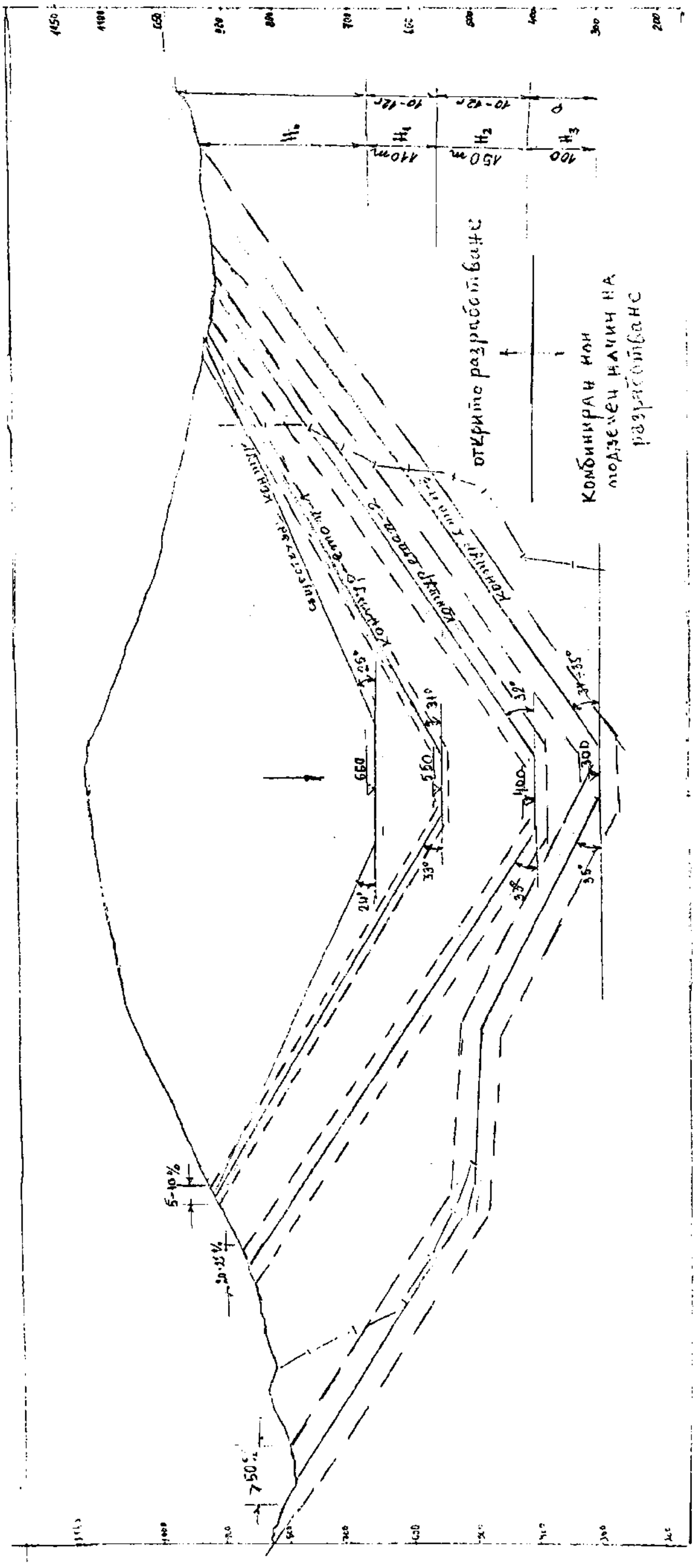
During the stage period, the monument benchmarks placed in the mine will be constantly observed which will be beneficial for enabling a prompt response and balancing of the active and passive powers in the prism volume of a possible failure. This will be done by accelerating or retarding the mining activities. Certain efficient strengthening initiatives are also possible in some weak areas in the pit.

The facilities constructed on the surface will be gradually removed during the staged mining of the deposit which will result into a more uniform distribution of capital costs. Operation costs will be also reduced since the removal of failure material will be of a smaller volume and the normal operation of the mine will be restored faster.

The staged mining of deep open pits has proven its advantages in practice.

Staged development of the mining activities in the Assarel open pit mine

Currently, the mining activities in the deposit are being developed in compliance with the approved technical project for B-medium contour of the Assarel open pit of a bottom level 555. The development of the mining activities reached down to level 660 by the end of 2014 (Fig. 2).



Фиг. 2. Етапи за разработване на рудник “Асарел”

Fig. 2. Mining stages for the Assarel open pit

Our studies and observations so far show that at maximal slope face angles of 33° ÷ 35°, the pit perspective contour is possible to reach a depth for open pit mining down to bottom level 400 [1] (Fig.3). In this case, we suggest that three (3) stages of mining activities development be implemented. The first stage shall be down to level 550 for about 10-12 years of pit operation. The second stage shall also be for a period of 10-12 years down to level 400. The third stage shall be developed from level 400 to level 300 after performing a serious analysis of the operational data – via combined or underground method.

During the design of the first stage, there will be sufficient information about the reserves available as well as the constructive and economic parameters of the pit. It is natural that the first stage be characterized also with an advanced mining of the high grade areas and the low grade areas shall be left for a later mining stage. During this stage the accuracy for determining the contour is very high. The error is like 5 – 10%. The second stage which will be developed after 20 – 25 years will be designed with an error of 20 – 25% and the error during the design of the third stage after 30 – 35 years will be more than 50% (Fig. 2).

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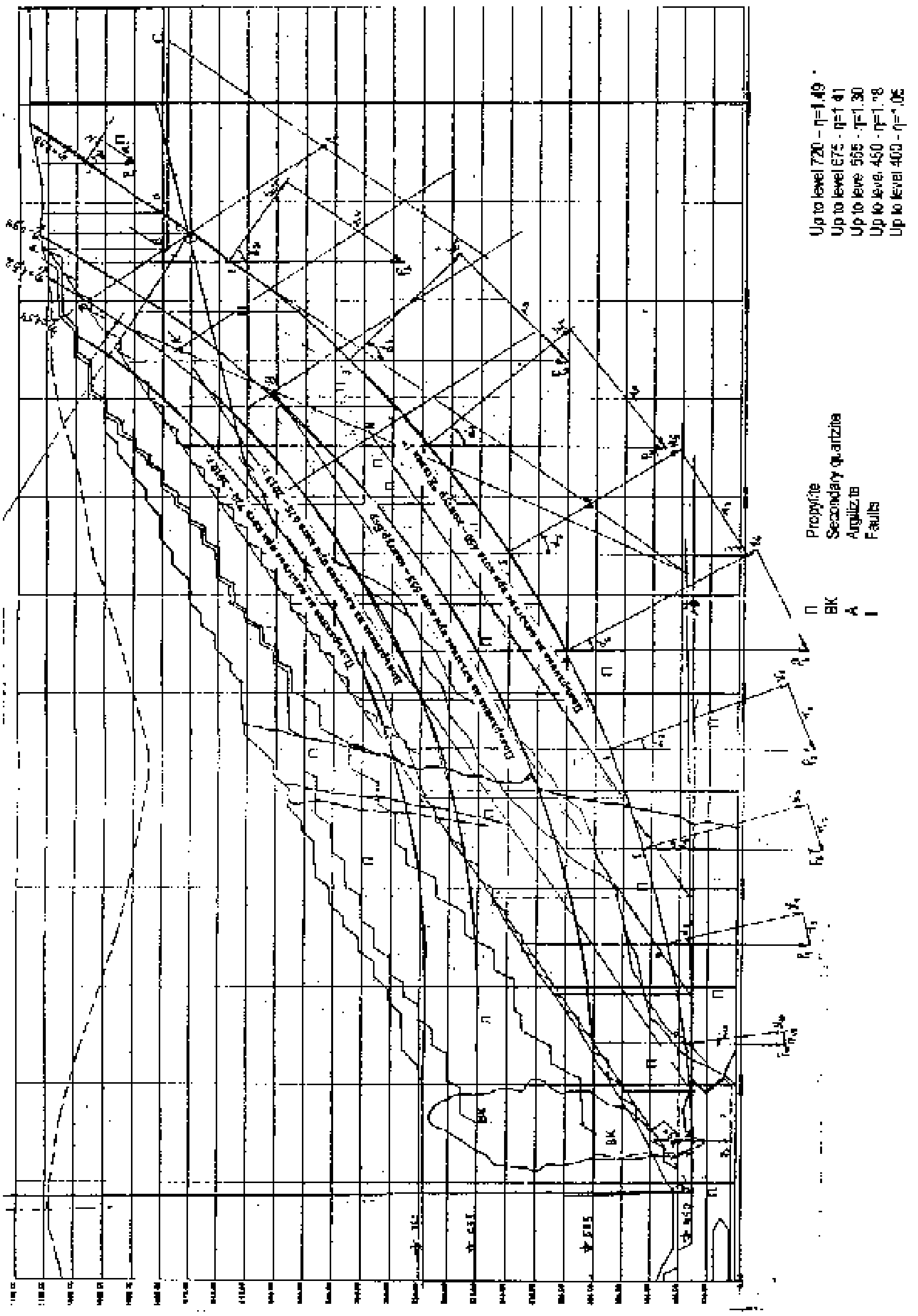

Fig.3 Calculation of the slope's stability for Profile 1 at different stages of development of the mining works in Assarel open pit mine

LADDER PROGRAM FOR A BLENDING PROCESS

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ABSTRACT

Two liquid substances (liquid A and liquid B) are mingled together in a tank by an agitator. The resulted substance is drained from the mixer through a drain valve. The process is divided into functional areas and individual tasks. The area for ingredients A and B is followed by the mixing tank area and the drain area. Programming the FBs (function blocks) for the motors and valves from any areas and the interconnecting of these is our ladder program.

KEYWORDS

logic blocks, symbolic addresses, feed pump, sensor, valve, function block, network, input, output.

1. THE PROCESS AREAS AND LOGIC BLOCKS

Dividing in tasks and areas, safety requirements and describing them. From the four distinct areas, the areas for the A and B ingredients employ the similar equipments. 1) A: Feed pump , Inlet valve, Feed valve, Flow sensor; 2) B: similar 3) Mixing tank : Agitator motor and a switch for tank level measurement. 4) Drain: Drain valve.

The different devices are of electrical or mechanical types and for implementing digital inputs and digital outputs for each task, for achieving of different interlocks and dependencies between the individual tasks.

The pumps, motors, and valves used in this industrial blending process are described below. The feed pump motors : flow rate: 300 l/min, rating: 80 kW at 1200 rpm. The pumps are started and stopped by a human operator situated nearby the mixing tank.

The pumps must operate comply with conditions : the mixing tank is not full, the drain valve of the mixing tank is closed, the emergency is off. To switch off the pumps, there must be the conditions:- after the pump motor is turned on, the flow sensor has signaled no flow 8 seconds ;- the flow sensor signals that the flow has ceased. The draining uses the gravitation and its valve contains a solenoid with a spring return.

The activation means open, in the next conditions: the agitator motor not moving, no "Tank empty" signaled by the level sensor, no "Emergency off". All are controlled by a human person. The pumps are turn off if the "Tank empty" signal is received from the tank level sensor. The level switches in the tank, interlock the feed motors and the agitator motors. The activation means open, in the next conditions: the agitator motor not moving, no "Tank empty" signaled by the level sensor, no "Emergency off".

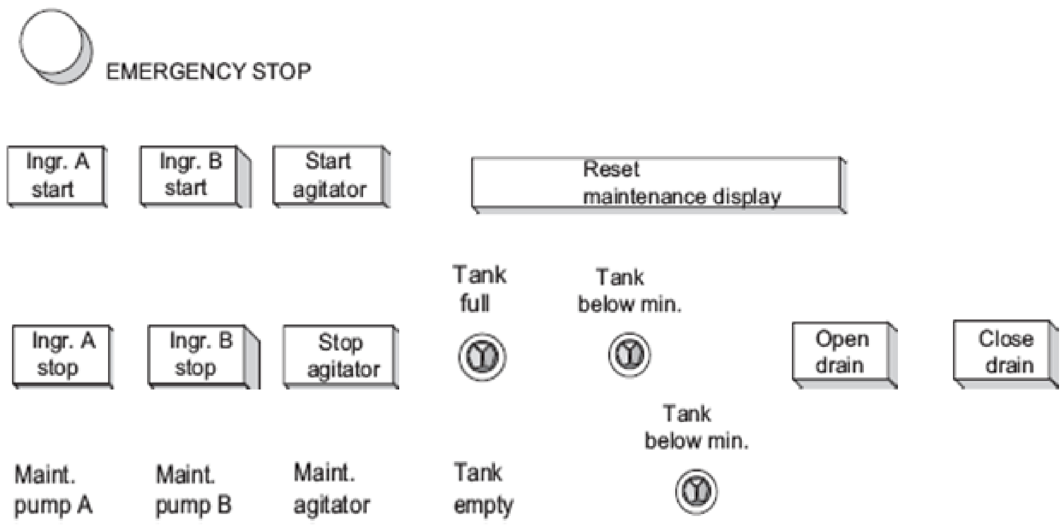


Figure 1: Displays and Controls

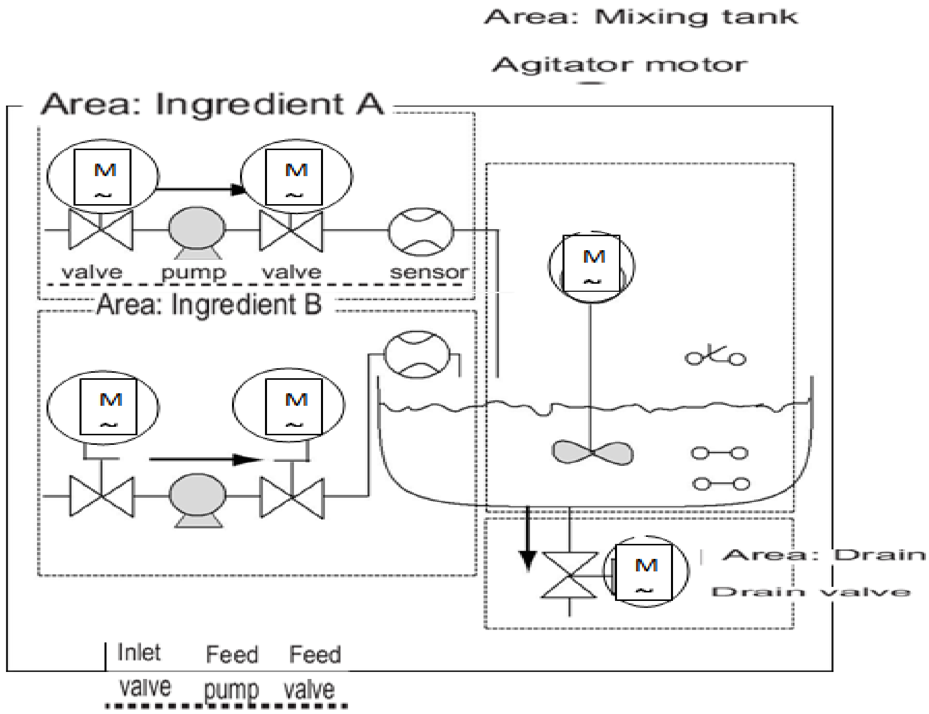


Figure 2: The process areas

Configuration Diagram. Input / Output diagram for our motors. (see figure 3).

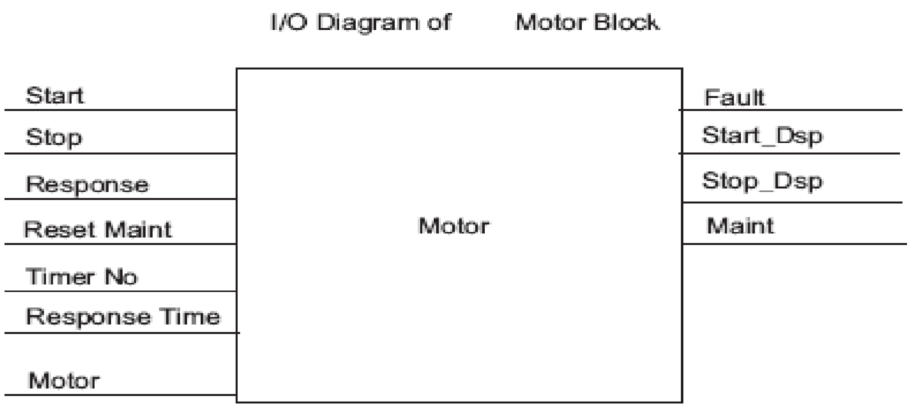


Figure 3: I/O diagram for motors

Three motors, for the feed pumps and agitator, are used in process. Any motor is driven by a motor converter block, the same for each one. This block has six inputs: motor start or motor stop, a reset of the maintenance display, a response from motor (running / not running), one

for the time in which the response has to be received and one for the number of the counters, employed to measure the time. The diagram also requires 4 outputs: 2, to show the starting or the turning off the motor, 1,to signal faults, and 1, to warn that the motor must be sent to maintenance. An in/out is to control the motor: "Motor", for activating it, but at the same time, it is also used in the program, for the "motor block" converter.
Each valve is controlled by its own "valve block" that is the same for all valves used. The logic block has two inputs: one to open the valve and one to close the valve. It also has two outputs: one to indicate that the valve is open and the other to indicate that it is closed. The block has an in/out to activate the valve. It is used to control the valve but at the same time is also edited and modified in the program for the "valve block."

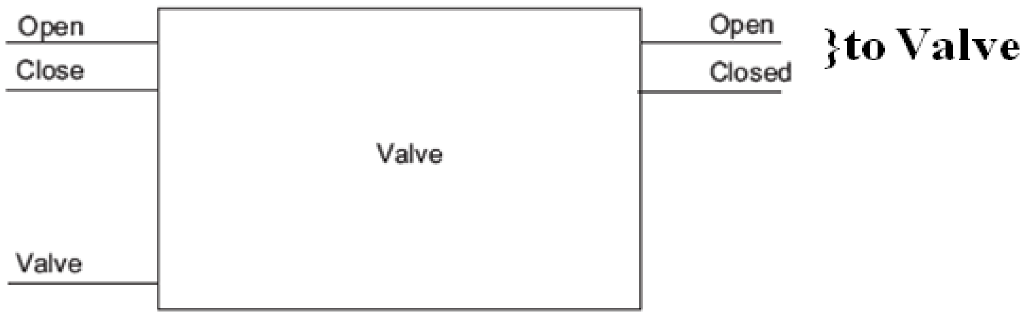


Figure 4: The valve block

Those circuits act independently of the logical controller (but in coordination with its main program, using an I/O interface). There is a matrix for each actuator, configured for connecting it to its own "emergency off range". The matrix is used in building the diagrams of the safety circuits. The designing contains necessary interlocks between the all automation tasks, circuits for the process apparatus, allowing them to be operated by human in an emergency, other further safety requirements. The safety logic circuit contains a switch off , which disconnects the next devices, without the accord of the PLC: feed pump for liquid A, feed pump for liquid B, the stirrer motor, valves. The switch is situated on the operator station. The emergency state is signaled to the PLC.
CPU and Interfaces. The diagram of configuration contains: type of Central Processor Unit, modules of Input /Output , their configuring.

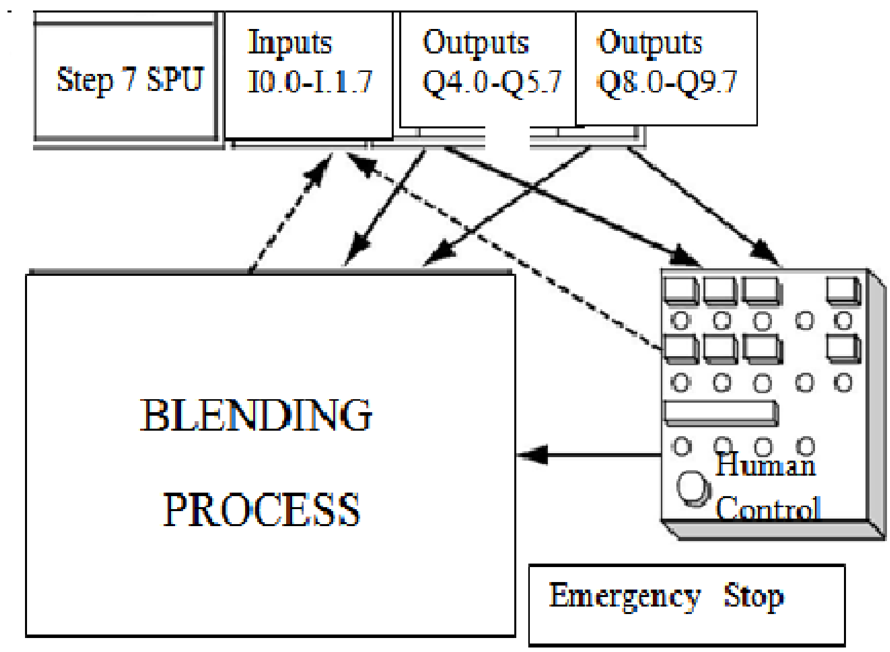


Figure 5: Blending Control

Conditions for supplying with the ingredients A and B (see Figure 2). The inlet and feed pipes contain flow sensors. When the tank level sensor indicates that it is full, the both feed pumps must be stopped. Also when the drain valve is open. The inlet and feed valves have to be opened in maximum 2 sec after the feed pump is started. These valves have to be closed immediately after receiving the signal from the flow sensor indicating that the feed pumps are turned off, for to prevent a leakage from the pump.
Mixing area: The agitator motor must be turned off when the level sensor returns the signal "level below minimum" or the drain valve is open. The agitator motor signals after reaching its rated speed. If no signal appears within 10 seconds after starting, the motor must be stopped.
Drain area:- A solenoid valve prevents drainage of the tank. This solenoid valve is handled by the operator' hand, but must be closed by the "tank empty" signal. –The solenoid valve opening is interlocked when the agitator motor is running or the tank is empty.
Operator Station. It is equipped with the following: switches for stages of the process.
Blocks in the User Program. (see Figure 6). OB1 has the main program, from OB1 are called FB1 and FC1 and are transferred to them the control parameters. FB1 controls all two pumps and the agitator motor the requirements being identical. DBs 1, 2, 3 are associated with FB1. FC1: The feed valves with only the function "open and close" are programmed.

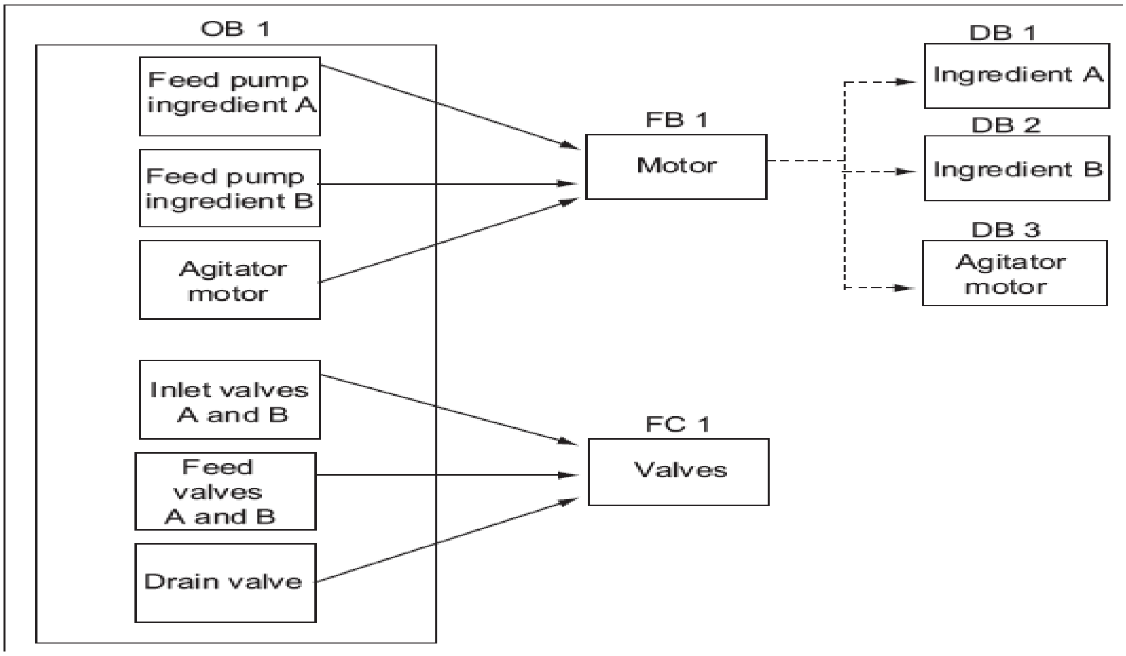


Figure 6: Logic blocks and hierarchy of their Calls

2. VARIABLES OF THE FUNCTION CONTROL BLOCS FB1

The symbol table(see Figure 5). contains the symbolic names and the absolute addresses of elements.

Designing of the FB as FB1 for the Motor. It contains the logical functions:

- start and a stop input,

-interlocks ("Motor_enable," "Valve_enable") which status is saved in the temporary local data (L stack) of OB, and is logically combined with the start and stop inputs when the FB1 for the motor is processed.

-Feedback from the devices. Otherwise, an error or fault would occur. The FB1 function then stops the motor.

-The moment and the length of the response or error/fault cycle has to be specified

-With the start button pressed and the motor validated, the motor switches itself on and runs until the command of stop button

-When the motor is switched on, a timer counter starts. If the feed back signal from the process is not arrived in duration, settled in timer, the motor stops.

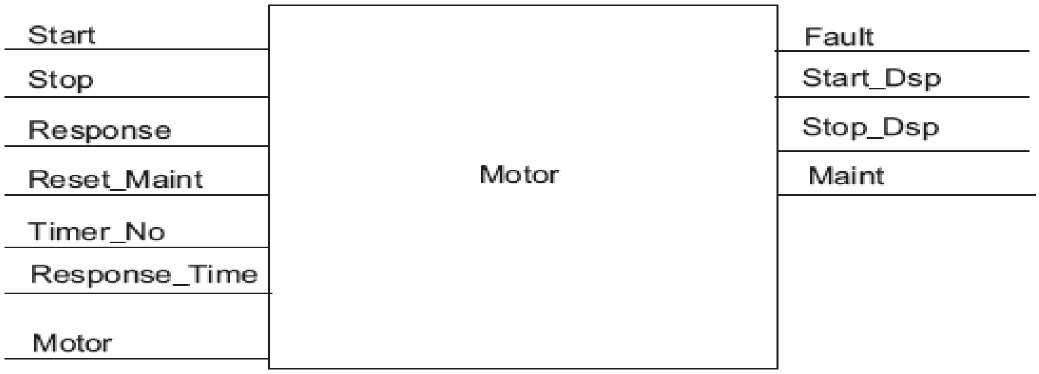
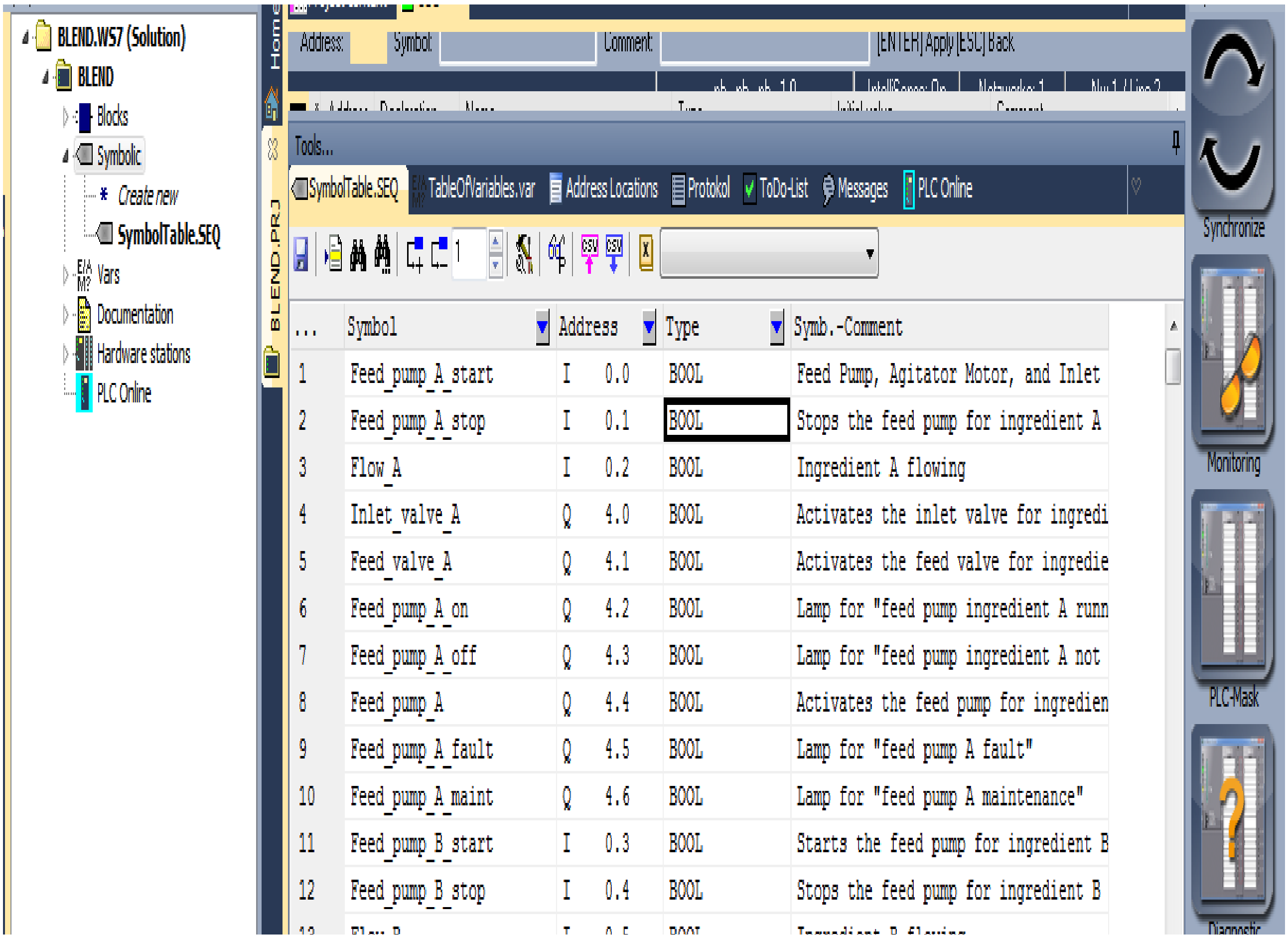
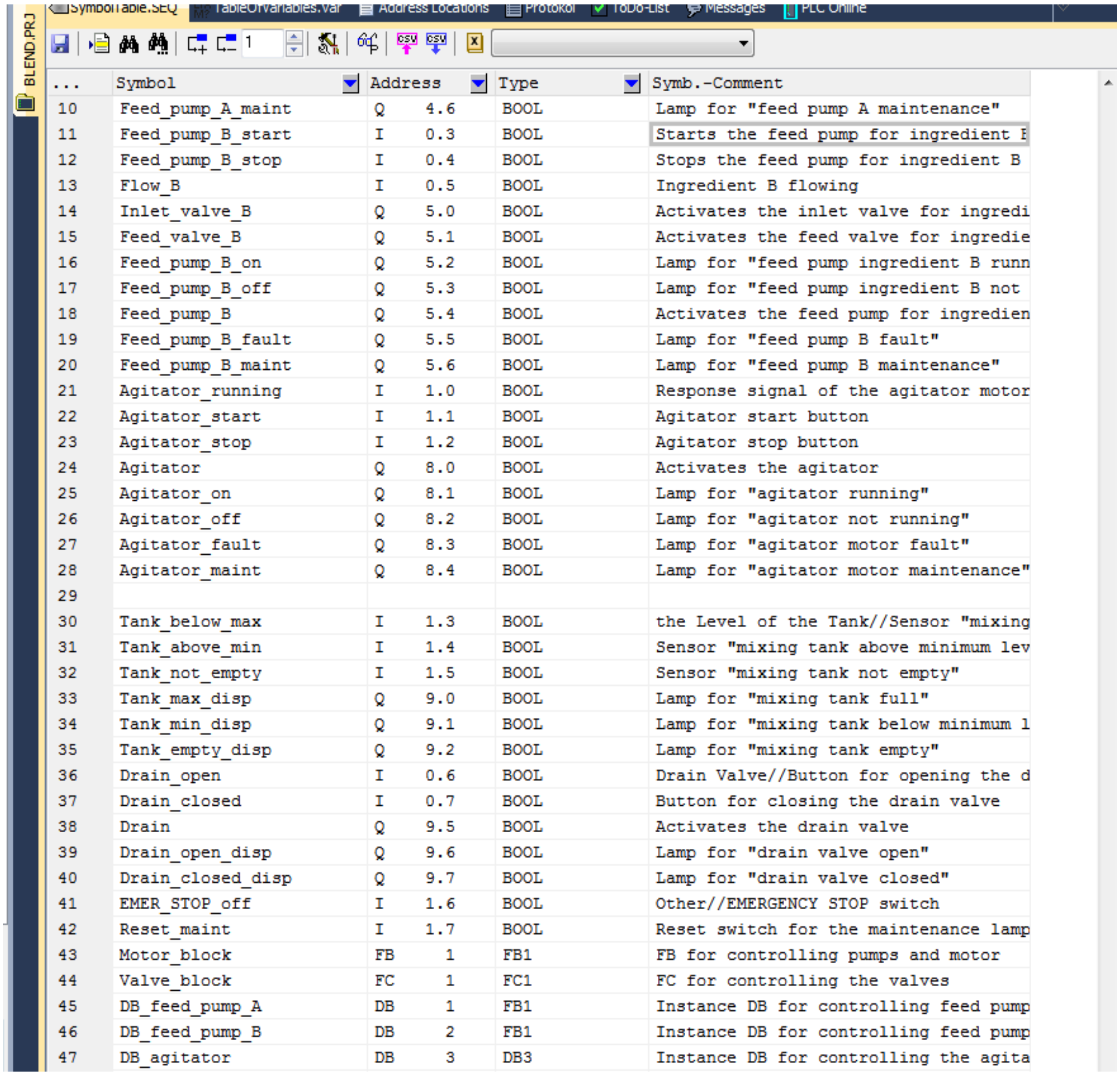


Figure 7: The inputs and outputs of the FB1

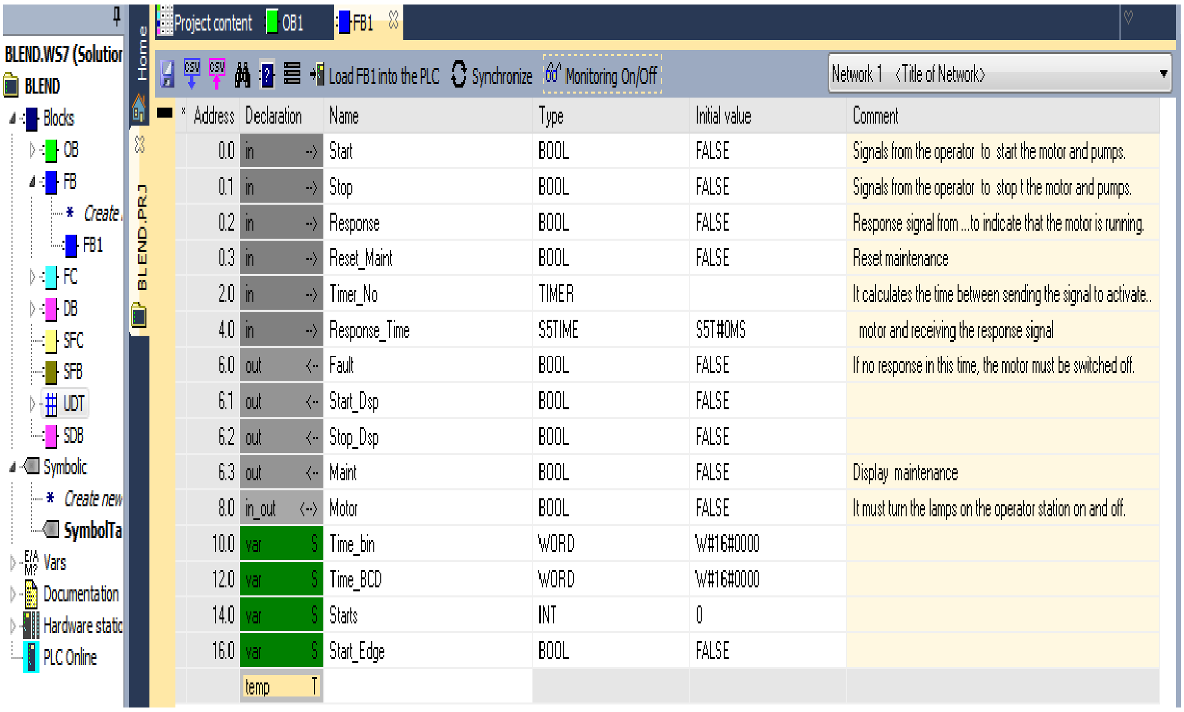




...	Symbol	Address	Type	Symb.-Comment
10	Feed_pump_A_maint	Q 4.6	BOOL	Lamp for "feed pump A maintenance"
11	Feed_pump_B_start	I 0.3	BOOL	Starts the feed pump for ingredient B
12	Feed_pump_B_stop	I 0.4	BOOL	Stops the feed pump for ingredient B
13	Flow_B	I 0.5	BOOL	Ingredient B flowing
14	Inlet_valve_B	Q 5.0	BOOL	Activates the inlet valve for ingredi
15	Feed_valve_B	Q 5.1	BOOL	Activates the feed valve for ingredie
16	Feed_pump_B_on	Q 5.2	BOOL	Lamp for "feed pump ingredient B runn
17	Feed_pump_B_off	Q 5.3	BOOL	Lamp for "feed pump ingredient B not
18	Feed_pump_B	Q 5.4	BOOL	Activates the feed pump for ingredien
19	Feed_pump_B_fault	Q 5.5	BOOL	Lamp for "feed pump B fault"
20	Feed_pump_B_maint	Q 5.6	BOOL	Lamp for "feed pump B maintenance"
21	Agitator_running	I 1.0	BOOL	Response signal of the agitator motor
22	Agitator_start	I 1.1	BOOL	Agitator start button
23	Agitator_stop	I 1.2	BOOL	Agitator stop button
24	Agitator	Q 8.0	BOOL	Activates the agitator
25	Agitator_on	Q 8.1	BOOL	Lamp for "agitator running"
26	Agitator_off	Q 8.2	BOOL	Lamp for "agitator not running"
27	Agitator_fault	Q 8.3	BOOL	Lamp for "agitator motor fault"
28	Agitator_maint	Q 8.4	BOOL	Lamp for "agitator motor maintenance"
29				
30	Tank_below_max	I 1.3	BOOL	the Level of the Tank//Sensor "mixing
31	Tank_above_min	I 1.4	BOOL	Sensor "mixing tank above minimum lev
32	Tank_not_empty	I 1.5	BOOL	Sensor "mixing tank not empty"
33	Tank_max_disp	Q 9.0	BOOL	Lamp for "mixing tank full"
34	Tank_min_disp	Q 9.1	BOOL	Lamp for "mixing tank below minimum l
35	Tank_empty_disp	Q 9.2	BOOL	Lamp for "mixing tank empty"
36	Drain_open	I 0.6	BOOL	Drain Valve//Button for opening the d
37	Drain_closed	I 0.7	BOOL	Button for closing the drain valve
38	Drain	Q 9.5	BOOL	Activates the drain valve
39	Drain_open_disp	Q 9.6	BOOL	Lamp for "drain valve open"
40	Drain_closed_disp	Q 9.7	BOOL	Lamp for "drain valve closed"
41	EMER_STOP_off	I 1.6	BOOL	Other//EMERGENCY STOP switch
42	Reset_maint	I 1.7	BOOL	Reset switch for the maintenance lamp
43	Motor_block	FB 1	FB1	FB for controlling pumps and motor
44	Valve_block	FC 1	FC1	FC for controlling the valves
45	DB_feed_pump_A	DB 1	FB1	Instance DB for controlling feed pump
46	DB_feed_pump_B	DB 2	FB1	Instance DB for controlling feed pump
47	DB_agitator	DB 3	DB3	Instance DB for controlling the agita

Figure 8: Symbol address table for FB1

The general parameter names for the inputs and outputs have to be used, because there is a multiple instance FB1 for the motor (both pumps and motor). The Declaring Variables Table of the FB1 follows. (see Figure 9)



Address	Declaration	Name	Type	Initial value	Comment
0.0	in ->	Start	BOOL	FALSE	Signals from the operator to start the motor and pumps.
0.1	in ->	Stop	BOOL	FALSE	Signals from the operator to stop t the motor and pumps.
0.2	in ->	Response	BOOL	FALSE	Response signal from ...to indicate that the motor is running.
0.3	in ->	Reset_Maint	BOOL	FALSE	Reset maintenance
2.0	in ->	Timer_No	TIMER		It calculates the time between sending the signal to activate..
4.0	in ->	Response_Time	S5TIME	S5T#0MS	motor and receiving the response signal
6.0	out <-	Fault	BOOL	FALSE	If no response in this time, the motor must be switched off.
6.1	out <-	Start_Dsp	BOOL	FALSE	
6.2	out <-	Stop_Dsp	BOOL	FALSE	
6.3	out <-	Maint	BOOL	FALSE	Display maintenance
8.0	in_out <->	Motor	BOOL	FALSE	It must turn the lamps on the operator station on and off.
10.0	var S	Time_bin	WORD	W#16#0000	
12.0	var S	Time_BCD	WORD	W#16#0000	
14.0	var S	Starts	INT	0	
16.0	var S	Start_Edge	BOOL	FALSE	
	temp T				

Figure 9: Variables Table of FB1

3. THE PROCESS AREAS AND LOGIC BLOCKS

FB1 is written in STL, LAD and FBD languages. (see Figure 10).

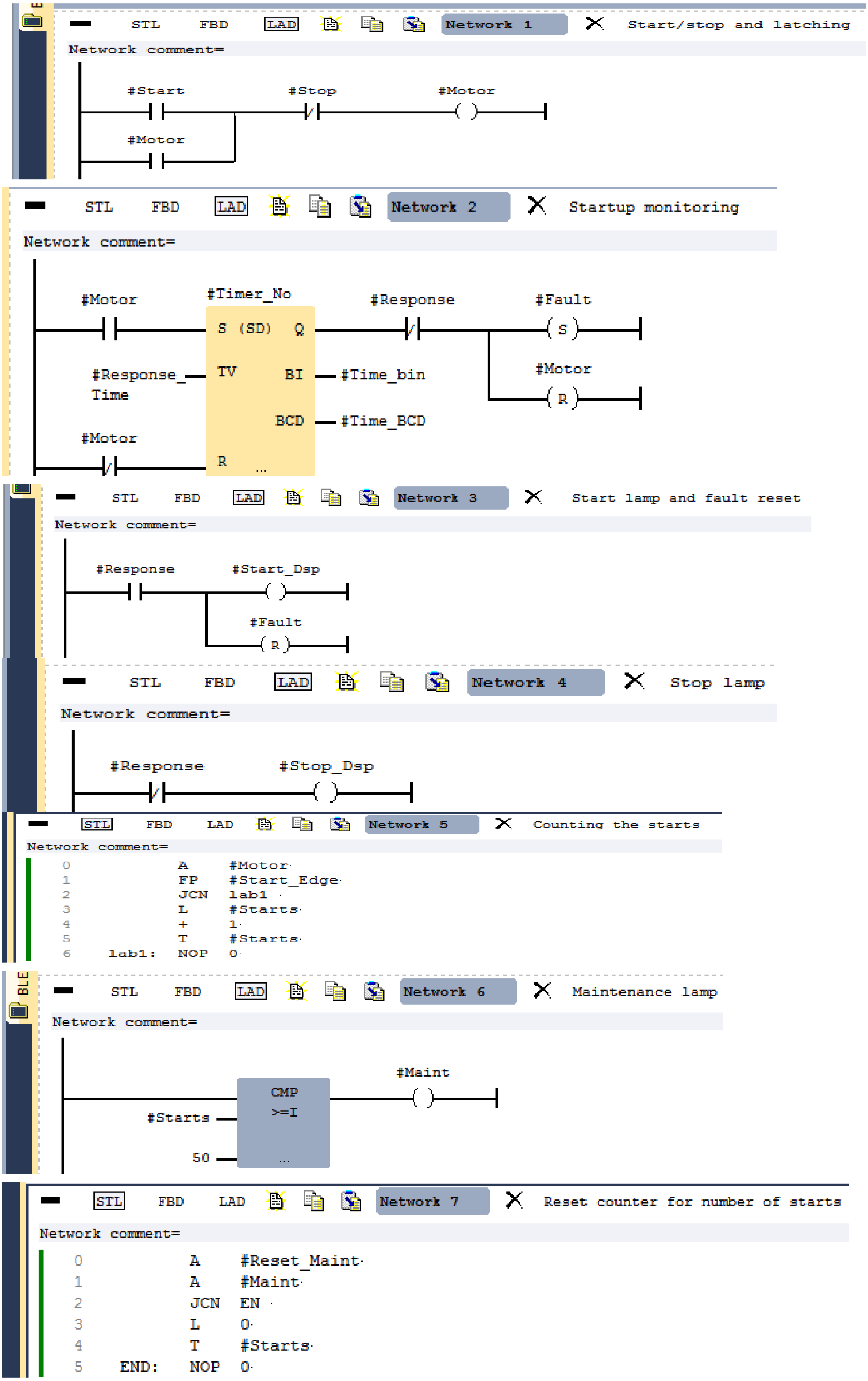


Figure 10: Program of the FB1

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POSSIBLE APPLICATION OF INTERNET OF THINGS IN THE MINING INDUSTRY

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ABSTRACT

In recent years in the field of information technology enters the use of so-called Internet of things (IoT), which offers advanced capabilities in the use of modern computer applications such as intelligent networks.

The focus in this dynamically developing area of IT (Information Technology) is placed on the analysis and evaluation of data received from intelligent networks, leading to the generation of practical benefits such as accelerating the process of making managerial decisions in order to optimize processes, introduction of innovative technologies, competitiveness, etc.

As two of the five main directions in this new area (IoT) are „Smart Enterprise" and „Smart Environment" and these two areas are inextricably linked at work in the mining industry the authors considered appropriate to be explored the possibilities for application of intelligent systems for analysis and evaluation of data and consequently increase the level of reliability of process management in the mining industry.

Some of the companies in the mining industry implement complex specialized solutions covering a whole process, starting from embedded sensors for monitoring by the applications for its management. Advantage of these solutions is that they are created for a specific purpose and can provide an ideal solution for a specific process. The disadvantage however is that they are expensive, inflexible and are deprived of the possibility to easily integrate and exchange data with other information systems used for monitoring and management.

Modern trends in the field of IoT are directed not to develop separate modules, and the construction of complete platforms through which to carry out integration with other available information systems and intelligent networks. This article is focused on exploring the possibilities for implementation of such applications in the mining industry.

KEYWORDS

Analysis, Evaluation, Reliability, Application, Intelligent Networks, Mining Industry

1. INTRODUCTION

Internet of things is a modern computer conception that describes a network of physical objects (or "things") embedded with electronics, sensors, software and connectivity with each other. Each of the devices ("things") is uniquely identified through its embedded computing system), but they are able to interact (i.e., to communicate with each other) in the framework of the existing Internet structure, using existing Web standards. For this reason, this type of devices and their connectivity are also called "intelligent" systems.

The overall objective pursued with the application and use of the Internet of Things is the achievement of greater value and more efficient processes to achieve automation in almost all areas of industry and human life.

2 EXISTING AREAS OF APPLICATION OF INTERNET OF THINGS

The concept Internet of Things has been promoted and developed since 1999, making it one of the newest and most perspective information technologies. Currently, it is used in many areas of industry and human life, which we will discuss shortly.

One of the first applications is the use of smart devices in transport management. Internet of Things helps the integration of communications, monitoring and informatization processes in different transport systems. Its application is extended to all aspects of these systems, including automobiles, transport infrastructure and even the drivers themselves.

The dynamic relationship between these components provided by Internet of Things, allows both for internal communication between them, and for communication with smart devices out of them. Real working applications in this area are the smart traffic control, smart parking, electronic systems for logistics and management of vehicles, logistics, control and safety systems, smart travel and emergency assistance.

The management of large datasets is another area of application of Internet of Things. Big companies accumulate huge datasets, which need to be analyzed to determine the preferences and trends for a product or process. The technologies using Internet of Things help in rapid analysis of this data almost in real time, which provides not only a higher degree of awareness, but also a competitive advantage in today's dynamic market.

Another major area of application of Internet of Things, which is undergoing continuous development, is the monitoring and protection of the environment. The use of smart sensors assists not only in monitoring the quality of water and air, but also in the monitoring of weather and soil conditions, as well as in the distribution of flora and fauna in a given geographical area.

The latest generation of smart sensors in this area helps in early warning of various natural disasters (particularly floods, tsunamis and earthquakes). Characteristic of this type of smart devices is that they are mobile and are in the process of continuous development and improvement.

Waste management is directly linked to the monitoring of the environment; this area is the latest area where Internet of Things is used.

Internet of Things is successfully applied in monitoring and control of infrastructure, both in and outside urban areas, helping in the planning and carrying out the necessary infrastructure works.

Internet of Things finds application in the field of medical and health care, being used mainly for remote diagnosis and monitoring of patients.

Internet of Things is increasingly used in the processes in industry. According to the forecasts of the experts precisely the industry is expected to become the center of the Internet of Things in the coming years. The concept Internet of Things in the production process is based on the idea of a fully automated environment via analog and digital sensors and intelligent control systems that communicate with each other via the IP protocols, and optimize the work and effectiveness of connected devices and equipment. [2], [6]

Another area of application of Internet of Things is the energy management. This term includes not just the management of large energy networks systems, but also the optimization of energy consumption as a whole. Energy management can be realized both for a separate house and for the whole enterprise. [3]

No matter what area you apply to Internet of Things the emphasis is on the analysis and evaluation of intelligent data received from the network, which leads to the generation of practical benefits such as speeding up the process for making managerial decisions, optimization of production processes, introduction of innovative technologies, competitiveness, etc. [4]

3 EXISTING APPLICATIONS OF THE INTERNET OF THINGS IN THE MINING INDUSTRY

Although the Internet of Things, also called Industry 4.0 (The Fourth Industrial Revolution), covers more and more processes in the field of industrial production, its implementation in the field of mining industry is still in its beginning.

The authors found a few applications and ideas for application of Internet of Things in the mining industry, as they cover individual processes in a particular mining enterprise.

Application of Internet of Things in monitoring the groundwater is in the process of implementation in the coal mines in the China. The level and drains of water are monitored and data are collected and processed through a system of sensors in order to prevent flooding of the work horizons.

Another application of Internet of Things is in the extraction of oil, but this application as described is still in the conceptual design phase and is yet to come.

One of the most successful applications of elements of the Internet of Things is presented in the management of mining works in the Chelopech mine, which is part of the Dundee Precious Metals Inc. group. On the basis of systems for integration of information streams coming from different sources, information is automatically collected and processed in a single distribution center, allowing monitoring of mining works, equipment and personnel in real time and taking timely management decisions. [1]

4 OPPORTUNITIES FOR APPLICATION OF INTERNET OF THINGS IN THE MINING INDUSTRY

Based on the research and analysis made by the authors, the following main directions for the most effective applications of Internet of Things in the field of mining industry can be recommended:

4.1 Application of Internet of Things in the automation of manufacturing processes

Many companies in the mining industry implement complex specialized solutions covering the overall specific production process, starting from embedded sensors for monitoring to applications for its management. The advantage of these solutions is that they are created for a specific purpose and can provide an ideal solution for a specific process. The disadvantage however is that they are expensive, not flexible and are deprived of the possibility to easily integrate and exchange data with other information systems (or processes), also used for monitoring and management.

Information systems in the industry gradually evolved. The beginnings of IT systems are those for Enterprises Resource Planning (ERP), Material Requirements Planning (MRP), moving on to the next stage in the systems for Manufacturing Resource Planning (MRPII) systems and Manufacturing Execution Management (MES).

The application of Internet of Things suggests the transition of these systems into an integrated platform that spans business tools, asset management, supply and availability, production schedules, and optimization solutions, operating in real time. The final aim is to have synergy between the smart information technology and staff in order to achieve the desired efficiency of production.
The vision for the integration of Internet of Things functionality is based on the connectivity of the various sensor, control and information systems with solutions for integrating, processing and analysis of data, which could significantly optimize the processes and to increase their effectiveness. The adaptation of the Internet applications of Things is a logical step for increased productivity and better integration of various production and business systems.
To achieve the maximum effect of the application of Internet of Things in the mining enterprise, it is necessary to constantly exchange data between various departments, providing for the production process. It is necessary always to have a fairly high degree of exploration of the deposits of minerals, which allows precision in planning mining works and efficient operation of the equipment and staff.
The process of implementation of the Internet of Things can turn out to be long and expensive, so it's good to assess in advance the benefits and possible difficulties and shortcomings.

4.2 Application of Internet of Things in ventilation management processes

The ventilation of an underground mine, regardless of what minerals are extracted is essential for the operation of the mining equipment and staff. The amount of air fed and numerous parameters related to its quality are monitored to ensure the optimum conditions for work as.

Many of the proposed modern ventilation systems for underground mines (and other underground facilities, such as tunnels, subway, etc.) have built-in sensors that transmit real-time information about the performance of the air. The data from these sensors are usually sent to the operator, who can remotely manage the submission of air jets.

The application of Internet of Things will allow the data from these sensors to be processed automatically and submitted as appropriate and to undertake measures such as dewing, filtering, and others with the aim of improving air quality. For this purpose it is necessary to build an information platform that can bring together the data and manage the processes.

4.3 Application of Internet of Things in environmental monitoring

The extraction of raw materials and the monitoring and recovery of the environment are two inextricably linked processes in the mining industry. The possible applications of the Internet of Things here cover a wide range of activities, which can be categorized in a summary in the following way:

- Monitoring and management of groundwater;
- Monitoring and control of tailings (wastes);
- Management of waste from the production;
- Minimizing the risk of harmful effects for the population, flora and fauna in the particular geographic area.

The possibilities for application of intelligent information systems in this field are many. Depending on the specific type of minefield smart irrigation system of the tailings pond to reduce dust, system separation and recycling of waste from the extraction and much more can be applied.

4.4 Application of Internet of Things in the management of traffic flows

This is actually one of the first applications of the Internet of Things in general, which is fully applicable and in the mining industry.

It is possible to use technique fully equipped with sensors and managed remotely from a safe distance for work in dangerous or insecure areas.

It is possible to optimize the routes and their compliance with specific weather conditions through the use of sensors and information systems, which would optimizire the fuel consumption and increase safety during the disposal of the ore out of the pits.

In the case of rail transport it is possible to implement completely automated management after deployment of the devices for automation and information system.

Contemporary conditions require each machine and facility to be equipment with sensors for positioning in real time in order to enhance safety and minimize the risk of accidents when working on large mining sites, which are usually open cast mines.

4.5 Application of Internet of Things in managing large datasets of data

The present information systems and technologies in the mining industry generate huge datasets of data only for a particular process, which greatly hampers the processing and analysis. As a typical example in this respect, we can point the generated data from sensors and the express analyzers in the enrichment of the ore.

When you attempt to merge the data from all processes observed in a mining enterprise the scale of generated data increases enormously, which practically makes almost impossible the monitoring and management of all processes.

To realize these opportunities, it is necessary industrial automation that is used at present to become gradually a comprehensive digital communication sphere which supports all systems related to the various applications used in the industry.

Mobile technology and cloud services are leading to increased opportunities for processing and analyzing huge volumes of data and making them operational information resource. According to the research, their use is entirely possible in the mining industry, and for this purpose it is necessary to build an appropriate information and communication infrastructure.

5 CONCLUSION

In order to implement intelligent technologies and the mining industry to make the most of their advantages, it is necessary all devices, equipment and personnel to be able to communicate with each other. The same is true for the business enterprise level devices, such as using a unified IP network infrastructure.

This is necessary because only the features of the Internet Protocol can provide scalability and harmonious coexistence of the services in the Internet of Things and create the conditions for progressive innovations in the platform that will allow full communication of the various devices between them.

The number of devices used in industrial automation, which are connected to the Internet of Things has been rising steadily in recent years. Only for the period 2012-2015 there is a combined growth rate of 36,3%. There is also continuous growth of the number of all devices connected to the Internet of Things, for the same period the increase was over 100% (Figure 1.) [7]

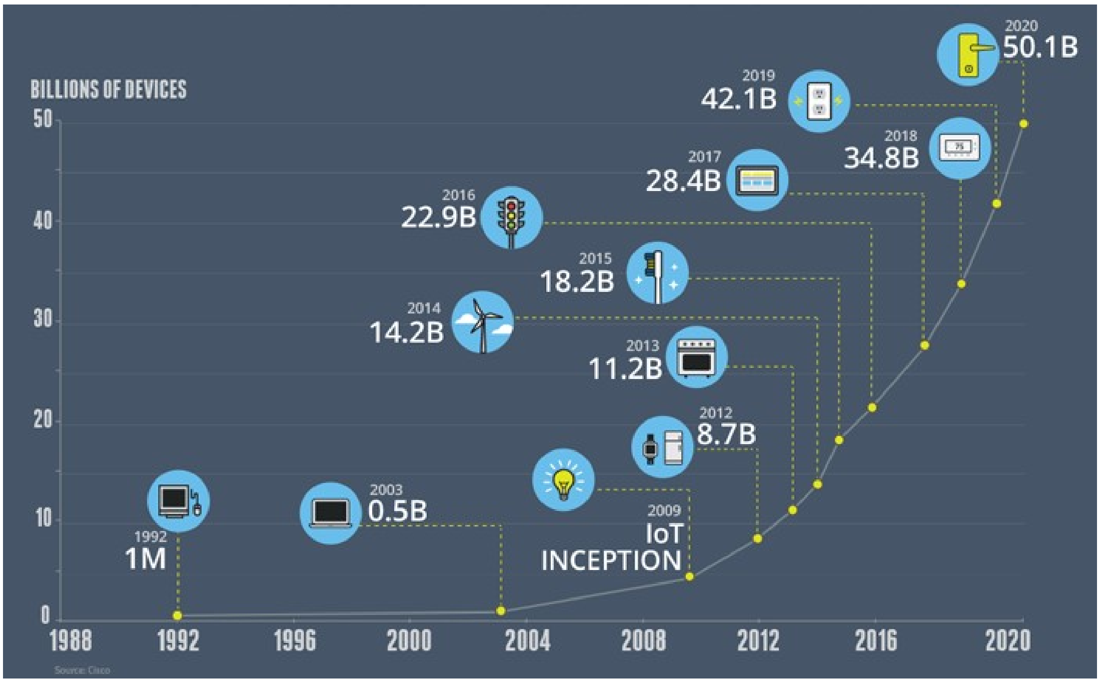

Figure 1: Number of devices connected to the Internet of Things

Source: https://www.ncta.com

Specifically in connection with the development of the Internet of Things in the field of industrial automation leading world companies in the field of information technologies join forces to resolve the challenges that arise in the implementation of the so-called intelligent systems. [5]

In the field of the industry as a whole and in particular in the mining one there are already applications that are able to process and visualize the planned activities. Such examples are the possibilities of integration of CAD systems and planning, control and monitoring of mining activities and processes.

The current trends in the field of Internet of Things are not targeted at developing separate modules, but at building complete platforms through which to carry out the integration with the existing information systems and smart grids.

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PERTURBATIONS IN THE METHANE ACCUMULATION SYSTEM FROM THE MINE WORKINGS AFTER THE OCCURRENCE OF AN EXPLOSION - CASE STUDY, COAL BED 13, LIVEZENI MINING UNIT, PETROSANI-ROMANIA -

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ABSTRACT

In coal mines, the share of mining faults with disastrous consequences upon mining workers and upon the deposit is represented by methane explosions and burnings.

Although the geological and technical factors were known when opening and exploiting coal from coal bed no. 13, Livezeni mining unit, located in the centre of Jiu Valley coal field, there occurred an explosion generated by methane releases over the maximum admitted limits.

After the occurrence of the explosion (year 2003) in current mine workings, from panel 2, coal bed no. 13, bl. IX, horizon 100, the coal reserve had been flooded for several years, after which, in 2013, it was re-opened for exploitation.

In re-opened mine workings, there haven't been registered methane concentrations at the known and measured level before the mining fault.

The paperwork proposes a technical analysis on the gaseous-dynamic regime of methane from coal bed no. 13, in order to increase the safety level of the coal deposit and of the underground workers, when re-opening the exploitation workings, taking into account the quartering places, the methane gas migration paths and the causes which have led to this phenomenon.

KEYWORDS

methane, explosion, migration, pressure, mine workings, flooding

1 INTRODUCTION

In Romania, hard coal mining is performed only in Jiu Valley basin, the largest hard coal deposit in the area, with an industrial reserve of over 300 million tons, this activity having a dominant chare in the area's economy.

Livezeni mine unit is located in the eastern part of the basin and has an annual production capacity of 340,000 tons of coal.

Methane releases recorded at mine level are determined by the absolute flow q_a=15.7 m^3 CH_4/min and relative flow q_r=14.0 m^3 CH_4/ton.

Mining process is performed over two coal beds, coal bed no. 3 and no. 13, on different horizons, the current paper work focusing on coal bed no. 13, horizon 100.

Mining this coal bed generated difficulties related to methane releases and accumulations, being recorded two spontaneous combustion phenomena, and because of this occurred a methane ignition in the mechanized coalface panel 2, coal bed 13, block IX, followed by an explosion after approximately 7 hours, hazardous events which led to the temporary work incapacity of 7 workers.

Following these events, in order to liquidate the fault, there has been decided to insulate the entire horizon by total flooding, the coal deposit remaining immobilized for several years.

2 GEO-MINING STRUCTURE OF JIU VALLEY AND OF LIVEZENI MINING PERIMETER

As a whole, Petrosani tectonic depression is an asymmetric synclinal oriented ENE-WSW. The sediment complex of Petrosani is formed of deposits from the Upper Cretaceous, Paleogene, Neogene and Quaternary. It has a width of approx. 150 – 300 m and comprises compact clays, sandstone, marl, brown marls and has a number of 21 coal beds. The coal beds have variable extent and width, of centimetres up to tens of meters, with variations within the same bed, both on the direction and on the inclination. The northern part has variable inclinations ranging between 25^0 and 40^0, and the southern part ranges in inclination between 10^0 and 35^0. The disjunctive elements are represented by a system of cross-section and directional rifts with various extents and amplitudes.

Livezeni mining field frames into the eastern part of Petrosani tectonic depression, being located in the area in which the basin has the largest width, and neighbouring with Petrila mining perimeter in the North, Salatruc in the South and Dalja in the West. The mining field is characterised by an anticlinal fold with the area of maximum deposits lifting in the north-eastern part. Fault lines which split the deposit have the general direction NW-SE or SW-NE. From East to West, there is noticed the descending of formations, with inclinations ranging between 10^0 - 15^0 towards the south-west.

Exploration workings performed within Livezeni mining perimeter intercepted 10 coal beds. The coal beds from the perimeter have various extents and widths, but we are going to focus only on the exploitable ones 3, 5 and 13, which fulfil the technical economic conditions for being subject to mining. In the order of their sedimentation, coal beds are the following:

Coal bed 3 is the main bed from the perimeter. The coal bed has the shape of a complex of coal benches with clay intercalations. The thickness of the bed is in average 28 – 32 m in the central and northern area, and in the south the width decreases. It is located at a 10 – 20 m distance from coal bed no. 2. The roof consists of alternations of sandstone and clay, and the roof of hard chalky sandstones or clays with fossil plants remains.

Coal bed 5 is the second important coalbed of the perimeter, of 2-6 m in thickness. It is located approximately at 40 – 60 m from coal bed 3. It is formed of two coal benches separated by thin clay intercalations. The roof is formed of an alternation of clays, grey marls with fauna and the floor is made of sandstones and clays with siderite concretions.

Coal bed 13 has a uniform extent in the perimeter. It is formed of 1 – 2 coal benches. The roof consists of clays and marls with limestone concretions and remains of fauna, and the floor is made of sandstones and clays with siderite concretions.

When the event occurred, the object of the mining was represented by the coal reserve from coal bed 13, block IX, opened at horizon 100. The horizontal thickness of coal bed 13 records values comprised between 3.8 and 4.2 m, and the average inclination of the coal bed in the area of block IX is 4^0- 6^0.

3 MINING VENTILATION AND WORK TECHNOLOGY

3.1. Ventilation

Fresh air enters underground on the Main Shaft and Auxiliary Shaft and reaches horizon 300, one part entering on the collection plane horizon 300-100, and another one of Blind shaft no. 6. The two pathways unite at the level of horizon 100 and the air continues its way over the collection gallery of panel 3, the connection gallery of panel 2 and through the main gallery reaches the coal face. Return air is exhausted on the head gallery of the coal faces, on the ventilation rising of coal bed 13, on the ventilation plane from coal bed 13 and from here on the connection gallery to the main ventilation station from the ventilation Shaft East (Fig. 1).

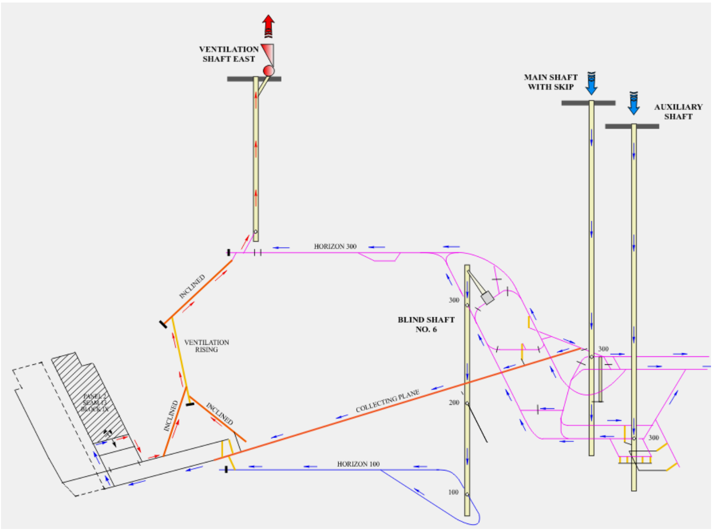

Figure 1: Spatial ventilation diagram of mine workings from horizon 100

3.2 Work technology

Coal face panel 2, coal bed 13, block IX had 120 m in length, a maximum height of 3.5 m, being equipped only with a mechanized support type SMA-2, a coal shearer type KS-3M and a conveyor type TR-7 (Fig. 2). The work technology from the coal faces consists of the following operations: cutting coal in the work face, exhausting coal from the face and the slipping of conveyor TR-7, supporting the coal face and intersections, circulating the mining pressure and digging the niches from the end of the coal face.

Figure 2: Mechanized mining in coal face panel 2, coalbed 13, block IX

4 METHANE RELEASES, ACCUMULATIONS AND MINING FAULT

For the methane releases in the mechanized coal face are considered the following influencing factors: achieved production (1100 t/day), advancing speed (v_m=24 m/month) and the manner for directing the roof's pressure (with mechanized supports, by caving rocks from the bed's roof). Scheduled measurements for controlling methane concentrations recorded values from 0.4 % vol. on the main gallery, in the coal face 0.7 % vol. and 1.2 % vol. on the head gallery.

In the area of the longwall, methane releases have in general a regulated characteristic, and they can be managed by proper ventilation. Although, there are situations in which methane concentrations sharply increase to values higher than the average ones, generating disorders in the underground technological process as a consequence.

In case of the studied coalface, panel 2, methane measurements recorded before the occurrence of the event, registered during a year approximately 31 accumulations over the admitted limits, of which 15 accumulations when directing the mining pressure, 5 while removing coal from the roof of the coal face following the cutting with the shearer and 8 accumulation due to other causes (changes in the ventilation system, open doors).

In addition, besides these accumulations recorded by automatic alarming installations which uncouple power when exceeding the limit threshold, from the reports concluded the fact that on the alignment of the coalface, during the cutting or stepping operations, there occurred methane accumulations of over 2% vol., which due to the high air flow circulated in the coal face (Q=1256 m^3/min) were diluted and the detection sensors sensed methane concentrations with values under the pre-established limit of 1.7 % vol.

The risk exposure of methane accumulations increased because in the mined coalbed has occurred spontaneous combustion phenomena. Overlapped in time and space with methane-air mixture, there have been fulfilled the elements required for the occurrence of a mining fault type methane ignition and explosions, fact which imposed the measure to insulate the exploitable reserve, for the health and safety of workers and of the deposit.

5 GAS-DYNAMIC REGIME FOR THE HORIZON'S REOPENING

The removing of the mining fault from horizon 100 has been achieved by permanent insulation of the inclined planes for transportation, ventilation and ventilation risings which connect with horizon 300. For a higher efficiency of technical measures, horizon 100 was flooded, the water level reaching elevation +175 in Blind Shaft no. 6.

The immobilization of the reserve lasted for years, nowadays the works for mining coal bed 13 from block IX have been resumed, at a new panel, adjacent to panel 2.

For re-opening purposes, the area flooded with approx. 242000 m^3 industrial water has been dewatered, mine workings have been restricted step-by-step with dams, on which there have been performed periodical monitoring of gas concentrations, sampled air and analysed using gas-chromatography, in order to assess the safety state of the deposit and the safety of the worker's entrance in the area.

The analysis of gas concentrations measurements O_2, CO_2, CO and CH_4 performed directly and indirectly through gas-chromatographic processing, in mining works from horizon 100, highlighted a normal situation, with inert atmospheres of areas sealed with insulation dams and gas concentrations framing in the limits allowed by the OHS regulation, on the entire pathway of the opened mine workings.

But what is of interest for the technical analysis is the current methane emission regime, because compared to the level from 13-15 years ago it is much lower, in opening and preparation works, the frequency of methane accumulations over the allowed limit decreased. Therefore, the average value of methane concentrations from the profile of mine workings performed in coal do not exceed

0.2 – 0.5 % vol. according to on-site measurements or the ones recorded by the detection installation. From the exploitation history of coal bed no 13, both at Livezeni mine unit and at other Jiu Valley mines (Petrila mine unit) it is known the fact that this is a coal bed with high methane content, therefore it is raised the issue of its migration, of its storage areas and migration pathways.

6 METHANE MIGRATION

From the specialized literature, there is known that for a cubic meter of coal has formed up to 250 m^3 methane and 200 m^3 carbon dioxide. The methane's genesis is related to the biochemical transformation of vegetation, during the carbonisation process. During geologic eras, part of these gases were lost into the atmosphere, and another part migrated into the pores, fissures and cracks of sterile surrounding rocks. In this manner may be explained the presence of mine gas in surrounding rocks.

The analysis of methane migration phenomena in mine workings related to block IX, horizon 100 from Livezeni mine unit involves several discussions on more hypotheses.

Firstly, there has to be taken into account the fact that horizon 100 has been flooded between elevations +80÷+175 m (minimum elevation of mine workings and the maximum flooding elevation from the shaft) and as a consequence there is a hydrostatic pressure of approx. 9.5 bar exerted by the water column on the coal massif.

Secondarily, there have to be taken into account the factors influencing the gas storage capacity: gas pressure in the coalbed, temperature gas type, coal ranking (content of volatile matters), humidity, ash content, rock pressure and coal porosity. We will take into account the methane solvability in water and the permeability of coal and surrounding rocks.

Thirdly, there shall be taken into account the tectonics of coalbed no 13 and the presence of block rifts.

Having these input data, there may be drawn up several hypotheses of the methane's "natural degasification" from the deposit:

1. Methane migration from mine workings in coal bed 13, horizon 100 occurred due to hydrostatic pressure generated by the water column. The phenomenon is possible if the gas pressure in coal and surrounding rocks is lower than the water column's pressure. Possible migration pathways may be: goafs, rifts from block IX, pores of coal and surrounding rocks and surrounding seams located in the strata-graphic column.

2. Methane migration through immersion into the water column and from here into mine workings from the water's free surface, in case the gas pressure in the deposit is higher than the hydrostatic column pressure.

3. Methane migration from the massif into the water column and its solubilisation, taking into account the solubility in water (55.6 l/m^3). The horizon was flooded several years with 242,000 m^3 of water and humidity is a factor which decreases the gas storage capacity.

4. Methane migration in gaps from the coal bed's surrounding rocks, because the geological age (cretaceous, quaternary) and the mineral framework (sandstone, marl, limestone) indicates a profile having a large gaps index.

5. Methane explosion in panel 2, coal bed 13, bloc IX occurred due to gas accumulation, having as ignition source a spontaneous combustion phenomena, could have created a depression which to degas the coal bed to some extent.

All gas migration hypotheses are supported by the physical-mechanical properties of coal and surrounding rocks, the geological profile of the deposit and the convincing proofs obtained from research and measurements conducted during the insulation period as well as after the re-opening of the deposit.

Until the completion of this work, coal mining in coal bed 13, horizon 100 has not been resumed, only preparation and opening works for a new production facility in a coalface adjacent to panel 2, panel 4, with the same geometric parameters and exploitation technology. It represents a new phase for continuing the research on this phenomenon.

7 CONCLUSIONS

This paper analysed a case study at a coal mine from Jiu Valley, Petrosani – Romania, on perturbations in the system for methane accumulation in mine workings, following the occurrence of a methane explosion.

Research took into account the geology of the coal deposit from Livezeni mining perimeter, the ventilation system and the applied working technology, as well as the methane balance in panel 2, coal bed 13, block IX, horizon 100, based on measurements and analyses of gas concentrations before the event, after the insulation of damaged mine workings by flooding and when re-opening the works on the horizon, several years after the event.

There have been identified five hypotheses of gas migration from coal bed 13, based on the physical-mechanical properties of coal and surrounding rocks, on the tectonic' s influence, effects generated by an explosion as well as on the impact of a technical measure for insulating a coal reserve through water flooding.

Research upon the dynamics of methane from coal bed no. 13, horizon 100, rom Livezeni mine unit will continue on the new production capacities from the exploitation schedule, from occupational safety reasons (establishing fresh air flows required for diluting methane from the deposit under the maximum admitted limits enforced by the legislation) as well as for establishing the level of available gas resources in order to implement methane recovery and capitalization applications.

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NATIONAL REGULATIONS REGARDING INTERVENTION AND RESCUE ACTIVITIES IN TOXIC / EXPLOSIVE / FLAMMABLE ENVIRONMENTS

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ABSTRACT

After Romania's adherence to European Union on 1 May 2007 and harmonization of Romanian legislation with European law, the Technical Prescriptions of the "Specific Directions for Labor Protection in Coal, Schist and Bituminous sand Mines", were replaced with the "Norms regarding the organization of intervention and rescue activities at industrial units with potential emissions of toxic and / or explosive gases".

Unlike previous regulations, which included a number of 111 articles and 6 annexes, the current legislation is more concise and well structured, setting the bare minimum regarding the organization of rescue activities at underground or surface activity economic agents, within 22 articles and 5 annexes.

Within INCD INSEMEX Petrosani the Rescue Authorization Group acts as certification service of compliance with the "Norms regarding the organization of intervention and rescue activities at industrial units with potential emissions of toxic and / or explosive gases", which primarily aims to establish general provisions for organizing intervention and rescue activities at industrial units with potential emissions of toxic / explosive/ inflammable gases, thus supporting economic agents on its application.

KEYWORDS

intervention and rescue staff, mining industry, training facility, protective breathing equipment.

1. Intro

Given the legal vacuum created after the repeal of the Technical Prescriptions of the "Specific Directions for Labor Protection in Coal, Schist and Bituminous sand Mines", both mining industry's economic agents and inspection authorities acutely felt the need for a new regulatory framework for this field.

In this context, INCD INSEMEX Petrosani in cooperation with state authorities started a process of drafting a legally and statutory regulatory document regarding the organization of rescue activities within Romanian economy. Thus, on 19th June 2007 the joint Order of the Minister of

Economy and Finance and the Minister of Labor, Family and Equal Opportunities was published, regarding the approval of "Norms regarding the organization of intervention and rescue activities at industrial units with potential emissions of toxic and / or explosive gases".

2. National legislative provisions

The regulatory document aims to establish general requirements for the organization of intervention and rescue activities at industrial units with potential emissions of toxic/ explosive/ flammable gases.

The Regulation sets out the following provisions:

1) The Regulations apply to all economic operators whose activity is likely to generate events, work accidents or dangerous incidents as a result of accidental releases of toxic/ explosive/ flammable gases.

2) In the event that during the production process arises the danger of gas, vapor and toxic, asphyxiating flammable or explosive dusts emissions, the economic operator must establish a station for intervention and rescue in toxic/ explosive/ flammable environments within the unit.

3) Only the activity of the rescue stations authorized and supervised by the National Research Institute for Mining Security and Explosion Protection - INSEMEX Petrosani is permitted.

4) In order to acquire the functioning approval, economic operators will have to submit to INCD INSEMEX a technical documentation for setting up a rescue station, which will include:

- Brief description of the current activity;
- Table containing all toxic / flammable / explosive substances used in the production process or resulting from it;
- Situation plans and emplacement plans;
- Specifying the total number of employees (including contractors) and their distribution during shifts and departments;
- Details regarding the space assigned for the rescue station;
- Structure of rescue station's personnel;
- List of necessary equipment for optimal performance of activities conducted by the rescue station;
- Intervention regulation;
- Appropriate procedures regarding:
    - Proceeding to action and work in confined spaces;
    - The best way to quickly alert rescuers;
    - First aid;
    - Conducting (within the rescue station) periodic theoretical training (listing of theoretical themes) and practical training in conjunction with specific work consumption.

5) The rescue stations will be serviced by operational rescuers, control and coordination staff and rescue station mechanics.

6) Personnel working in the rescue stations will be trained and authorized by INSEMEX (Fig. 1).

Fig. 1 – Intervention and rescue personnel

7) Spaces assigned for the rescue station should provide:

a) Appropriate conditions for rescue station personnel's theoretical training;

b) Keeping insulating devices, control equipment, resuscitation equipment;

c) Storage for rescues materials and spare parts;

d) Storage for transportable pressure containers used in respiratory protection equipment, observing applicable ISCIR technical requirements.

8) Spaces assigned for the rescue station should be located in an easily accessible place for both rescuers and vehicles and be connected through a telephone line with the economic operator.

a) Access for persons without duties;

b) Carrying out activities that are not rescue station related.

9) Minimum rescue station equipment consists of:

a) One properly functioning isolating apparatus for each rescuer and one backup isolating apparatus for every 5 isolating apparatuses;

b) One universal control apparatus for every 10 isolating apparatuses, but not less than two;

c) One resuscitation apparatus for every 10 isolating apparatuses, but not more than two;

d) For each isolating apparatus, two loaded cylinders of compressed oxygen (air), as backup;

e) One health kit bag for each team;

f) One safety rope belt equipped with and carbines and hooks for each five isolating apparatuses;

g) One stretcher for every 5 isolating apparatuses.

10) Requirements for the employment of rescue stations personnel are:

a) Age between 20-50 years for operational staff and up to 55 years for control and coordination staff;

b) Training and authorization by INCD INSEMEX Petrosani (fig. 2, 3);

c) Candidate must be declared medically and psychologically fit to perform intervention and rescue activities in toxic/ explosive/ flammable environments.

Fig. 2 – Training of intervention and rescue personnel

Fig. 3 – Authorization of intervention and rescue personnel

11) Control and coordination of rescue activities during interventions is carried out by personnel with technical qualification.

12) The rescue team's intervention program to the affected area will include:

a) Demarcation of the affected area and threatened areas;

b) Access and evacuation of routes for rescuers;

c) Security point;

d) Method for personnel evacuation from affected area and endangered areas;

e) Works carried out in the affected area in order to reduce the effect of the event, accident or dangerous incident and liquidation thereof;

f) Safety precautions to be taken while working in the affected area;

g) List of people who may give instructions during interventions in the affected area.

13) Upon completion of intervention shift, the team/ group leader makes out a detailed report which will include:

a) Number of rescuers who worked during the intervention;

b) Work performed;

c) Difficulties encountered and gas concentrations in the affected area;

d) Rescuers behavior;

e) If work was performed with the isolating apparatus in operation;

f) Observations, failures, proposals.

The intervention program and report on the intervention conduct will be recorded in the register.

14) Only persons named in the intervention program have access to the affected area;

15) In order to receive an operating license a rescue station must meet all the following conditions:

- To have a sufficient number of authorized rescuers personnel (minimum 2% from the overall unit personnel - including subcontracting companies staff carrying out activities in the operator's area, but at least 10 rescuers) in order to be able to intervene in case of damage occurring.

- Industrial units organized as subunits will have a minimum number of rescuers of 2% of the overall unit personnel (including subcontracting companies' staff carrying out activities in the operator's area).

- Industrial units with more than 200 employees will organize the intervention and rescue activity on their own or through other economic operators that have authorized rescue stations.

- Industrial units that have multiple locations can organize their intervention and rescue activities by establishing a central station at their headquarters and rescue intervention points for each location.

- Industrial units with an effective range of 100 ÷ 200 employees may choose, with the approval of INCD INSEMEX, to conclude a service contract with the nearest economic agent who disposes of a rescue station. In this situation the industrial unit will have a team of at least 6 rescuers of its own personnel, trained, certified and equipped according to the specifications of this procedure.

- Industrial units with an effective range of 50 ÷ 100 employees may choose, with the approval of INCD INSEMEX, to conclude a service contract with the nearest economic agent who disposes of a rescue station. In this situation the industrial unit will have a team of at least 3 rescuers of its own personnel, trained, certified and equipped according to the specifications of this procedure.

- Industrial units having less than 50 employees may choose, with the approval of INCD INSEMEX, to conclude a service contract with the nearest economic agent who disposes of a rescue station, without the obligation of having their own rescue team.

3. Rescue Authorization Group – GAS

Within INCD INSEMEX Petrosani the Rescue Authorization Group acts as certification service of compliance with the "Norms regarding the organization of intervention and rescue activities at industrial units with potential emissions of toxic and / or explosive gases".

Specific activities of the Rescue Authorization Group:

- Training and licensing intervention and rescue personnel;
- Training and licensing control coordination personnel;
- Training and licensing maintenance and repair mechanics for rescue equipment;
- Licensing rescuers to work in conditions of high humidity and temperature;
- Initial authorization and annual monitoring of rescue stations.

The training for intervention and rescue personnel/ control and coordination staff consists of two components:

1. The theoretical component held in a classroom equipped with the latest equipment, approaching the following issues:

- Relevant legislation;
- Principles of intervention and rescue activity in toxic/ explosive/ flammable environments;
- Thorough knowledge of respiratory protective equipment;
- Procedures of alarm, intervention and first aid in case of injury;
- Knowledge of injured resuscitation devices;
- Specifics of work in confined spaces.

These issues are addressed using both theoretical and practical demonstrations, followed by their actual assimilation by organizing restricted workshops for different categories of equipment.

2. Practical component - consisting in training exercises conducted in the training facility, which is unique at national level.

In these trainings staff gets familiar with operative intervention wearing isolating apparatus in conditions of difficult movement, working in confined spaces, reduced visibility, smoke and gas, high temperature and humidity and sustained effort.

Supervision of trainees during training is conducted both by video monitoring and direct assistance of qualified trainers and medical staff.

Also, the trainees are undergoing heavy training wearing isolating apparatus, within an exercise room equipped with fitness equipment, assisted by medical staff, in order to monitor changes in physiological parameters during interventions.

The testing and training facility (fig. 4, 5, 6, 7) used by intervention and rescue personnel in toxic/ explosive/ flammable environments is unique at national level, being similar to those found in countries with a long tradition in this filed and includes training spaces for rescuer's practical exercises and installations, equipment and operations used during training are designed to be close to the actual conditions encountered in situations when different types of failures occur.

Fig. 4 – Training facility

The rescuer’s testing and training facility disposes of the following spaces:

- Room with treadmill and fixed ladders;
- Room for endurance testing using ergo meters in environments with smoke and low visibility;
- Room that simulates movement through narrow spaces (on three levels) and running through a maze route;
- Two sections vertical construction equipped with metal ladder and wooden stairs.

Fig. 5 – Training facility

Also within this training facility are performed tests, under strict medical monitoring, for personnel intervening in toxic/ explosive/ flammable environments working in conditions of high temperature and humidity, while wearing isolating apparatuses.

Fig. 6 – Training facility

The training facility is equipped with a video monitoring system that has fixed cameras and a central monitor.

Fig. 7 – Training facility

In the application of the regulatory document's provisions, INCD INSEMEX has developed two specific procedures:

- Specific procedure for the authorization and supervision of rescue stations at industrial units with potential emissions of gases, vapors or toxic/ explosive/ flammable dusts.
- Specific training-authorization procedure (training and authorization renewal) for intervention and rescue personnel in toxic / explosive / flammable environments.

4. Romanian intervention and rescue stations, specialized for underground

Because at national level, since 1990, many mines were closed, this has automatically led to the closing of corresponding intervention and rescue stations.

Currently in Romania there are four mining areas, divided as follows:

1.Jiu Valley - coal extraction.

In this area 2 companies carry out activities, them having 5 respectively 3 intervention and rescue stations, as follows:

- Hunedoara Energetic Complex has 4 intervention and rescue stations, at its 4 sub-units and one central mining rescue station that serve all 4 units composing the complex.
- Jiu Valley Mine Closing National Association has 3 rescue stations at its three sub-units. This company manages the three mines that are being closed by 2018.

2. National Salt Company - extraction and processing of salt. It has two subordinate interventions and rescue stations located at the largest and most important salt mines in the country. One of the two rescue stations has 5 intervention points at saline found nearby.
3. National Uranium Company - extraction and processing of uranium ore. It is in charge of one intervention and rescue station from a mining unit.
4. Oltenia Energetic Complex - coal extraction. It is in charge of one intervention and rescue station from a mining unit.

Conclusions:

1. Development of this regulatory document led to the possibility of implementing intervention and rescue activities in all economic agents, where there is potential for emissions of toxic/ flammable/ explosive gases.
2. For each economic agent, intervention and rescue activities (organizing personnel, provision of rescue equipment, work procedures and intervention procedures in case of events) are customized according to the types of failures specific to work performed by them.
3. Rescue Authorization Group - GAS within INCD INSEMEX Petrosani implements the provisions of this regulatory document and along with other institutions of Romania authorizes the operation of rescue stations at economic agents.
4. Each year specialists from GAS – INCD INSEMEX supervise authorized rescue stations, allowing continuous compliance with the initial conditions from when the rescue station was authorized.
5. Application of this regulatory document, both for underground and surface industries, leads to reducing negative effects on workers health and safety in the event of fire or explosion due to the

ignition of inflammable substances or harmful physical effects arising from chemically unstable substances or mixtures of substances.

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METHODOLOGY FOR ESTABLISHING THE UNDERGROUND MINING WORK ENVIRONMENT AFTER THE OCCURRENCE OF AN EXPLOSION

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ABSTRACT

The explosion type phenomenon is an extremely complex physico-chemical process leading both to the physical change of objects and objectives encountered over the propagation path as well as to the chemical change of the underground atmosphere in the area of influence. During the development of the explosion-type phenomenon, due to the energy of the dynamic wave are generated significant mechanical effects at the level of affected mining works and at the level of ventilation constructions. In addition, due to severe burning reactions at high temperatures are generated major effects related to the compositions and concentration of the underground atmosphere in the area of influence.

Simulations performed on the ventilation network have been conducted using the Australian software Ventsim Visual Advanced. The methodology for establishing the work environment after an event comprises the purpose, objectives and means required for achieving the objective, developing the hypotheses, establishing work steps and obtaining the results.

KEYWORDS

explosion, methodology, modelling, simulation, ventilation

1 INTRODUCTION

In normal conditions of hard coal exploitation, in the underground work environment occur a variety of gases of various concentrations. The most representative and at the same time the most hazardous ones for working staff are methane, carbon monoxide and carbon dioxide. Highest gas quantities are usually released from active coal faces during technological processes and during the coal's spontaneous combustion processes.

In order to establish gas concentrations at the level of a coal face, there shall be performed specific measurements during a one week time period. The maximum concentration is recorded during actual exploitation works, and the minimum values are recorded during the resting periods from the end of the week.

After the occurrence of an explosion type phenomenon, the level of concentrations in air is very close or even identical to the one recorded in the resting days.

Significant for establishing the work environment after the occurrence of an explosion are the information related to the changes of gas concentrations (CO_2, CH_4, CO) and of air flow [4, 6, 11].

2 ESTABLISHING THE STRUCTURE OF THE VENTILATION NETWORK AFFECTED BY AN EXPLOSION

In this regard, for establishing environmental conditions after the occurrence of an explosion, several steps are required to be performed:

- Simulation of explosive and or toxic gas dispersion, in normal exploitation conditions;
- Establishing the structure of the ventilation network after the occurrence of an explosion;
- Simulation of explosive or toxic gas dispersion after the occurrence of an explosion.

For performing gas dispersion simulations at ventilation network level, the ventilation network has to be solved first. In this regard has been chosen the ventilation network of Vulcan mining unit.

2.1 Establishing the ventilation network's structure after the occurrence of an explosion

In order to establish the structure of the ventilation network after the occurrence of an explosion /1; 2; 3;8;9;12/, the following steps shall be performed:

- Establishing the influence of the explosion type phenomenon upon the ventilation network;
- Solving the ventilation network by taking into account the changes generated by the explosion.

The explosion of a gaseous mixture is an extremely complex physic-chemical process depending on various factors: explosive mixture volume; type of explosive gas; structure of the accumulation area; gaseous mixture flow regime; existence or non-existence of support over the propagation path; type of ignition source etc. Any change of one of the factors of influence leads to a high variation of explosivity parameters [5, 10, 13].

or establishing the average gradient of pressure loss dP/dx there were taken into account two experiments performed in underground conditions. The first experiment was conducted in Romania by Bana F. in the 100 m in length experimental tunnel from INSEMEX Petrosani [1, 2, 9]. Within this experiment was ignited a 50 m^3 explosive mixture with 5% vol. methane concentration.

The second experiment was performed in China by Z. Zheng and J. Li in the 896 m long tunnel from Chongqing Research Institute belonging to Coal Scientific Research Institute /14/. In this experiment was ignited an explosive mixture of 200 m^3 having a 9.5% vol. methane concentration. Taking into account experiments have been performed in tunnels with relatively reduced lengths of 100 m, respectively 896 m compared to the length of the mining works from within an underground mine which may add up to tens of km, with a high complexity degree from the structural point of view, there is considered the maximum pressure loss gradient of dP/dx = 0.35 bar / 100 m to be covering [15].

3 SIMULATION OF EXPLOSIVE OR TOXIC GAS DISPERSION AFTER THE OCCURRENCE OF AN EXPLOSION

For conducting the simulation in order to establish the dispersion of explosive and or toxic gases after the occurrence of an explosion type phenomenon [15], the following steps shall be performed: Simulation of CH_4 dispersion at the level of the ventilation network; Simulation of CO_2 dispersion at the level of the ventilation network; Simulation of CO dispersion at the level of the ventilation network.

Changes of the ventilation network's structure bring along the change of airflows at branch level and there occur major changes of gas concentrations in areas of influence.

3.1. Simulation of CH4 dispersion at ventilation network level

Figure 1 provides the simulation of methane dispersion at the level of the ventilation network of Vulcan mine unit, representing the area of the active coal face no. 1/3/VIII.

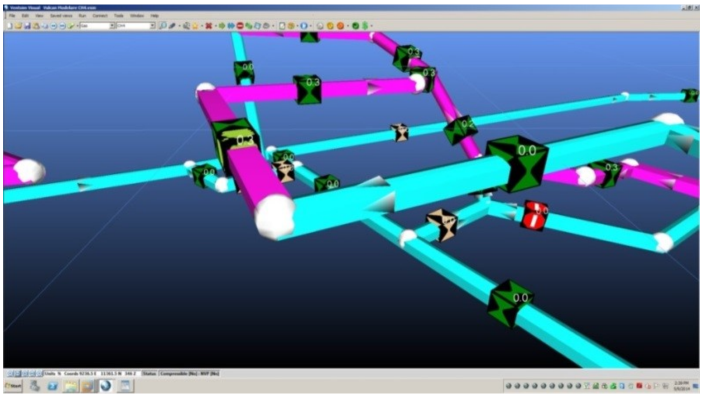

Figure 1: CH_4 dispersion in the undermined coal bed no. 1, layer no. 3, block VIII

3.2 Simulation of CO2 dispersion at ventilation network level

Figure 2 provides the simulation of carbon dioxide dispersion at the level of the ventilation network of Vulcan mine unit, representing the area of the active coal face no. 1/3/VII.

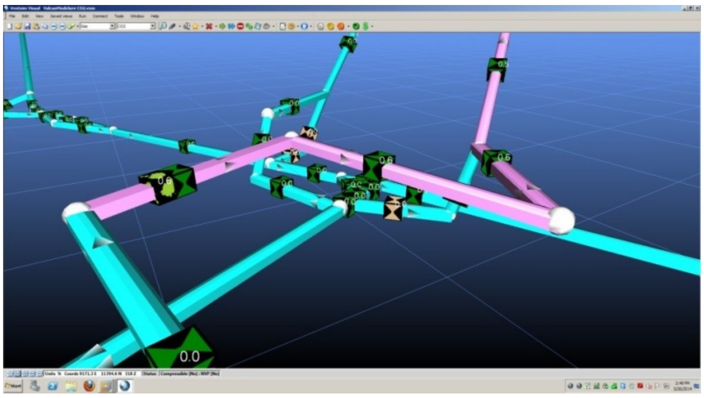

Figure 2: CO_2 dispersion in the undermined coal bed no. 1, layer no. 3, block VII

3.3 Simulation of CO dispersion at ventilation network level

Figure 3 presents a detail of the carbon oxide dispersion the level of Vulcan mine unit ventilation network, representing the area of the active coal face no. 1/3/VII.

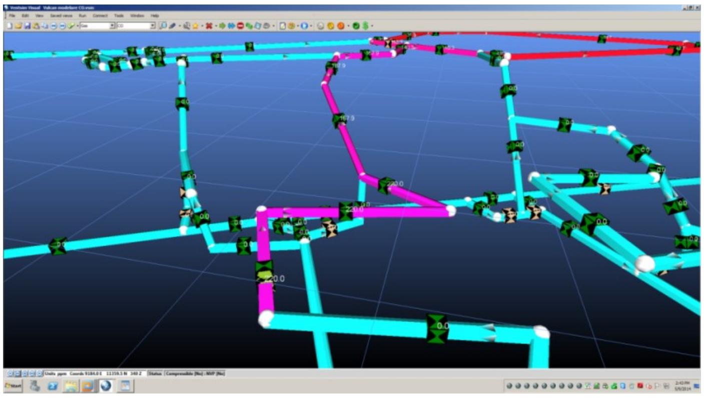

Figure 3: CO dispersion in the undermined coal bed no. 1, layer no. 3, block VII

4 METHODOLOGY FOR ESTABLISHING CHANGES OF THE WORK ENVIRONMENT AFTER THE OCCURRENCE OF AN EXPLOSION

4.1 Purpose of the methodology

The main purpose of the methodology for establishing changes of the work environment after the occurrence of an explosion in relation with its intensity is the prior identification of underground atmosphere in affected coal faces and mine workings in order to decrease human losses, to establish precisely the retreat pathways, respectively to forecast the risk of an explosion to repeat.

4.2 Objectives of the methodology

For establishing changes of the underground work environment after the occurrence of an explosion in relation with its intensity, the following objectives have to be reached:

- Detailed knowledge of the analysed mine ventilation network, regarding the complexity of ventilation circuits and sub-circuits;
- Identification of underground work environment parameters in normal exploitation conditions;
- Analysis of the ventilation network using specialized tools which allow its modelling, simulation and solving;
- Establishing changes which occur at ventilation network level, after the occurrence of an explosion in relation with its intensity;
- Knowledge of underground work environment changes after the occurrence of an explosion in relation with its intensity.

4.3 Tools required to achieve the objectives

For achieving the objectives are applied modern IT tools, usage of specialized software for modelling, solving and simulating ventilation networks, such as CANVENT 3D, VENSIM, VENT-GRAF, VENPRI, Mine Ventilation Services, Venet PC, Duct SIM, Clim SIM, MIVENA, VUMA, ICAMPS Mine Vent etc.

4.4 Hypotheses development

For establishing changes of the work environment at mine level after the occurrence of an explosion in relation with its intensity is required the approach of some hypotheses which keep in mind the actual underground conditions:

- Ventilation network has a simple or complex structure from the point of view of the number and position of ventilation circuits;
- Ventilation network has an average or high aerodynamic resistance, at the level of the entire network;
- At mine level are registered low, average or high methane releases;
- At mine level exist coal faces which are ventilated under the general depression of the mine;
- At mine level exist coal faces which are ventilated using partial ventilation installations;
- The explosive air-methane mixture is accumulated on the entire volume of the coal face;
- The initiation of the explosive mixture is generated by a spontaneous combustion phenomenon;
- The support structure of mine workings is relatively affected to small extent by the explosion type phenomenon;
- The explosion equally affects ventilation doors and insulation dams.

4.5 Work phases establishment

For obtaining the changes of the work environment after the occurrence of a low intensity explosion is required to perform the following steps:

- Choosing the mine unit;
- Conducting a campaign of complex measurements;
- Solving the ventilation network;
- Simulating gas dispersion on the modelled and solve ventilation network;
- Establishing the ventilation constructions affected by the explosion;
- Solving the ventilation network in relation with the new conditions generated by the explosion;
- Simulating gas dispersion at ventilation network level in relation with the new conditions generated by the explosion;

4.6 Results obtainment

Following the steps performed for obtaining changes of the work environment at mine level after the occurrence of an explosion in relation with its intensity, results a series of data such as:

- Air flows at branch level Q, în m^3/s;
- Aerodynamic resistance R, în Ns^2/m^8;
- Depression developed by the fan H, în Pa;
- Pressure developed by the explosion P, în bar;
- Pressure loss gradient $P/\Delta x$ în bar/m;
- Ventilation network configuration obtained using VENTSIM VISUAL ADVANCED;
- Configuration of gas dispersion pathways in relation with the release source obtained using VENTSIM VISUAL ADVANCED;
- Methane concentrations % vol;
- Carbon dioxide concentrations % vol;
- Carbon monoxide concentrations ppm.

5 CONCLUSIONS

- Identifying environmental conditions after the occurrence of an explosion consists of the following phases:
  - Simulation of explosive or toxic gases dispersion in normal exploitation conditions

- Establishing the structure of the ventilation network after the occurrence of an explosion
    - Simulation of explosive or toxic gas dispersion after the occurrence of an explosion.
- The establishment of explosive or toxic gas dispersion in normal exploitation conditions and after the occurrence of an explosion claims the simulation of gas dispersions at the level of the mine's ventilation network;
- The methodology for establishing changes of the work environment after the occurrence of an explosion comprises the following elements: purpose of the methodology, ovjectives of the methodology, tools required for achieving the objectives, hypotheses development, work phases establishment, results obtainment.

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TECHNICAL ASPECTS REGARDING SPONTANEOUS COMBUSTIONS MONITORING

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ABSTRACT

One of the most important hazard that might occur in coal mines is represented by spontaneous combustions. This phenomenon endangers safety of the working staff, of equipment and of the deposits. For monitoring the evolution of this extremely dangerous process, a large range of fire indices are employed and among them, Graham index (R_1) and Breathing index (R_2) may be cited. The use of these fire indices is sometimes limited especially when the differences among the oxygen concentrations are very small. As a result, the interpretation of the fire indices in this range is difficult. The paper deals with these aspects and aims to settle certain limitations with the purpose of an increased accuracy when interpreting the two fire indices, Graham and Breathing. There is also presented a non-invasive method for detecting areas with self-heating phenomena.

KEYWORDS

fire indices, monitoring, spontaneous combustion

1 INTRODUCTION

Underground coal mining involves the perforation of coal seams during preparation workings and cutting and extracting the useful mineral substance through specific mining works. During these works, oxygen from the air required to ventilate workface directly enters into contact with uncovered coal surfaces, leading to the well-known oxidation reaction with exothermal effect. In certain conditions, this reaction may lead to spontaneous combustion and finally to endogenous fires. These phenomena are one of the major risks in coal mines.

For controlling these phenomena, experts from countries having well-developed mining industry tried to identify connections between percentage increases or decreases in concentration of gases which are released during the oxidation process and its' development stage. In this regard, new fire indices emerged, with the help of which practitioners can estimate the evolution stage of the spontaneous combustion phenomena, in order to establish the optimal moment for intervening with special tools for stopping this process.

2 SHORT HISTORY

Since the early twentieth century [1] special attention has been granted to fire indices, T.Rhead and R.Wheeler in 1910 being the first ones to study them in detail. They said that the CO_2/CO ratio decreases once with the temperature increase. T.Winmill and J.Graham in 1913 – 1916 noticed the following:

- CO/O_2 ratio increases once with the temperature increase;
- CO_2/CO ratio increases in time;
- CO_2/CO ratio decreases once with the increase in temperature.

In Romania, Tomus I. granted special attention to this problematics since the '50s [2, 3, 4]. He studied and applied several fire indices, of which only two are currently applied: Graham index and Breathing index.

3 FIRE INDICES USED IN ROMANIAN MINING

Currently, several fire indices are known, but the most used ones are the following:

- Graham index – R_1 (R_1 = 100), increase of the CO content generated by an oxidation fireplace

$$R_1 = \frac{+\Delta CO}{-\Delta O_2} \cdot 100 \quad (1)$$

- Breathing index (Young) R_2

$$R_2 = \frac{+\Delta CO_2}{-\Delta O_2} \cdot 100 \quad (2)$$

- Carbon oxides index
- Ethylene index C_2H_4 /18/
- Acetylene index C_2H_2 /18/
- Absolute carbon monoxide flow q_{CO}

$$q_{CO} = C_i * Q * 10^{-3} \text{ [l/min]} \quad (3)$$

where:

C_i – carbon monoxide concentration ppm;

Q – air flow in the mine working [m^3/min];

10^{-3} – uniformity constant.

4 LIMITATIONS OF FIRE INDICES

Graham and Breathing indices are influenced by a series of factors, respectively they have certain limitations.

4.1 Graham index R1

This index is influenced by the following factors:

4.1.1 Adsorbed oxygen content

In Romania, ΔO_2 is 0.3% vol., but in practice there are no limitations from this point of view.

For solving this problem, there is proposed to use another index in parallel and especially in the range 0 ÷ 0.4 % vol. of the oxygen concentration adsorbed in the oxidation process, namely: absolute CU flow "q_{CO}" which has a critical value of $q_{CO} \geq 10$ l/min. This critical value is recognized at European level [5, 6]. In figure 1 are drawn up the ΔO_2 = ct lines in a (R_1; CO) system of coordinates. Figure 2 presents the variation curves of the proposed q_{CO} index in a (Q; CO) system of coordinates.

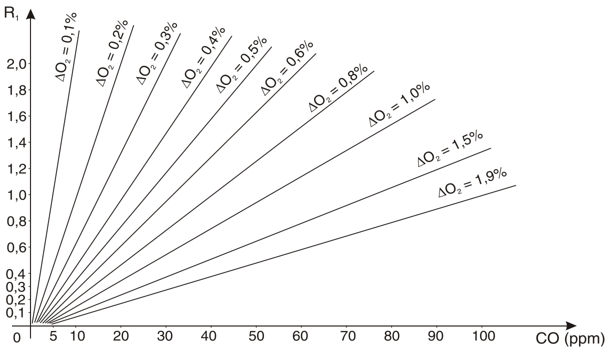

Figure 1: ΔO_2 = ct

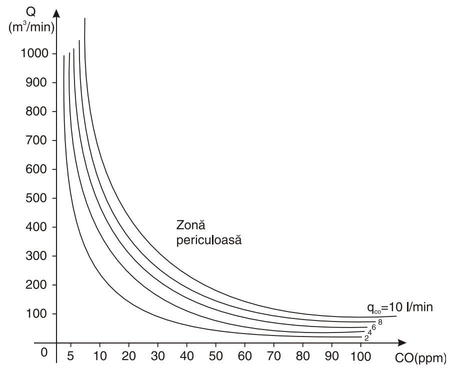

Figure 2: q_{CO} index variation curves

4.1.2 Carbon monoxide content

This may arise from the following sources, different the oxidation fireplace:

- From the base level of carbon monoxide generated from slow coal oxidation, but whose values remains small and approximately constant (several ppm). Error due to this source may be cancelled by performing the difference between CO concentrations from the head gallery and the base gallery of a coal face.
- From sources arising from the surface and which enter the mine's general ventilation circuit, sometimes up to 10 ppm.
- From blasting works or from Diesel engines operating on the horizon in the fresh air circuit. These sources may reach in short time tens of ppm, but they disappear after a time period.
- From coal spontaneous combustion.

Due to these facts, few sources consider that the Graham index can have a normal interpretation only if the CO concentration > 20 ppm. For Jiu Valley mines, the proper value is considered to be 10 ppm.

4.1.3 Graham index interpretation

The Graham index value may point out the spontaneous combustion process development. The lower limit under which the situation is considered to be normal varies from country to country.

- In Romania: $R_1 < 0.4$ – normal situation
  $R_1 \geq 0.4$ – self-heating phenomenon start

R_1 = 2 - 3 – lower limit of the auto-ignition process when the fire may be noticed by smell

$R_1 \to 25$ – endogenous fire

$R_1 \to 60$ – exogenous fire.

As a consequence, for an interpretation of the Graham index as clear as possible are required research through which its' non-hazardous values for each seam can be determined.

4.2 Breathing index R2

Breathing index depends on the following parameters:

- Adsorbed oxygen content.

This parameter has the same effect as the one presented for the Graham index.

- Carbon dioxide content

Carbon dioxide may arise both from atmospheric air, as well as from sources other than the oxidation process, namely:

- Exhaust gas from internal combustion engines;
- Gases resulting from the blasting process;
- Human factor presence, carbon dioxide resulting due to physiological activities;
- Natural releases from the deposit'
- Carbon dioxide adsorption in water or in the deposit;

The interpretation of this index is the following:

- $R_2 \leq 60$ – normal situation
- $R_2 > 60$ – signals the existence of an auto-ignition phenomenon.

5 NON-INVASIVE MONITORING OF SPONTANEOUS COMBUSTIONS

In addition to fire indices for monitoring the evolution of spontaneous combustion phenomena are used other technical methods. Of these methods, of high interest is the method for temperature measurement, parameter which is directly proportional to the development of the spontaneous combustion phenomenon. For measuring temperature are used classic thermometers, sensitive thermometers, and electronic equipment.

Temperature was measured using electronic equipment in two variants:

- With electronic thermometers – devices type ECON-S;
- With infrared thermometers – infrared imaging type 469PROBEYE; MEL, respectively infrared thermometers type INFRATRACE –1000 and HEAT–SPY.

Currently, there exist electronic equipment such as thermal vision cameras which are able to scan and view temperature fields at the level of the targeted object. Such an equipment is Drager UCF 7000 presented in Figure 3 [7].

Figure 1: Drager UCF 7000 thermal vision camera

By using this equipment there can be obtained not only the visualisation of temperature fields, but also the temperatures of targeted objects in a non-invasive manner. By focusing the infrared fascicle is obtained from the distance the temperature value of the chosen area, and by directing the device towards a certain area is instantly obtained its' temperature spectrum. Within a coalface, during the monitoring period may be obtained a thermal image of the coal face – Figure 4. In this figure weren't noticed clear heating areas. Also, there may be tracked staff in the coal face, as presented in Figure 5.

Figure 4: Coalface – thermal imprint

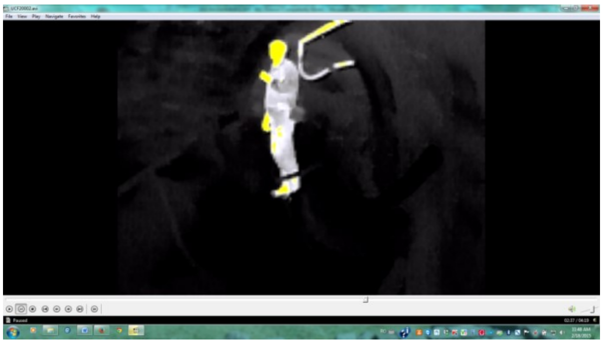

Figure 5: Coalface – human thermal imprint

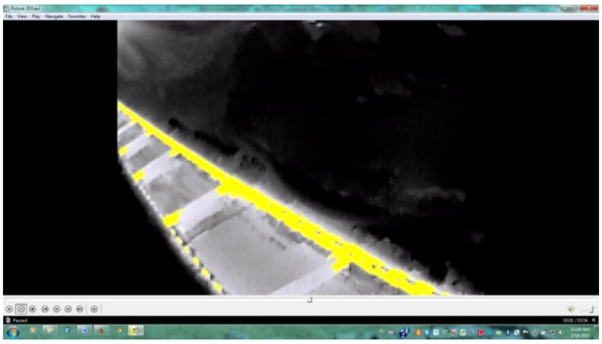

Figure 6: Coalface – conveyor thermal imprint

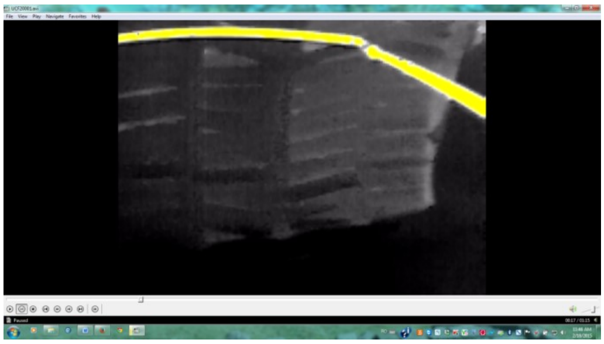

Figure 7: Coalface – electrical cable thermal imprint

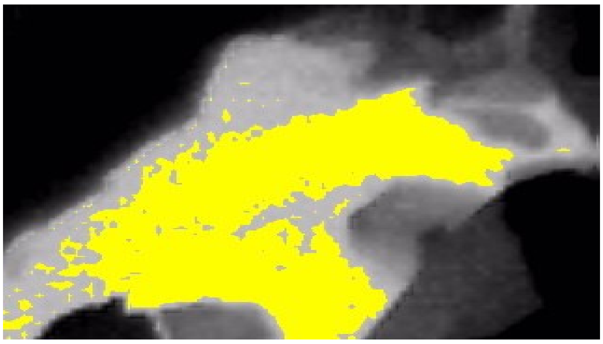

Figure 8: Coalface – heated water thermal imprint

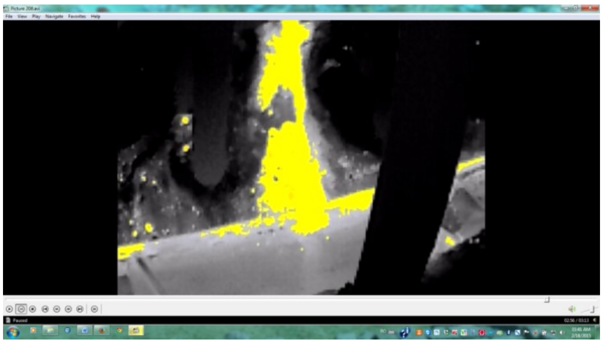

Figure 9: Coalface – discharged heated coal thermal imprint

Figure 10: Coalface – coal from the massif thermal imprint

If the conveyor increases in temperature due to friction, this phenomenon may also be tracked – Figure 6, if there are overburdened electrical cables then their imprint may be obtained – Figure 7. Figure 8 presents the imprint of heated water from the coalface. In case of an in development self-heating phenomenon in the goaf or at the level of the undermined coal bed from the work sublevel, the discharged coal has a temperature which is higher than the normal one as presented in Figures 9 and 10.

Using this method for determining the temperature, the time for investigating a coalface is diminished, the safety in tracking the heated areas increases, there may be determined the temperatures of areas from the goaf located at high distances and the time for sample collection in order to track down the incipient phases of spontaneous combustion phenomenon decreases.

6 CONCLUSIONS

Underground coal mining involves the presence of major risk factors. Such a risk is represented by the occurrence of spontaneous combustion which may lead to endogenous fires.

In order to control these phenomena and to follow-up their evolution in time, a series of fire indices emerged, of which the most important ones are the Graham index (R_1) and the Breathing index (R_2).

In addition, there may be applied other fire indices such as the absolute carbon monoxide flow q_{CO}.

Besides fire indices, for the early detection of spontaneous combustion phenomena are used methods for determining temperature using thermal vision cameras.

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UPDATING THE VENTILATION NETWORK OF PETRILA MINING UNIT SUBJECT TO CLOSURE

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ABSTRACT

Maintaining health and safety conditions in the underground, especially where there is possible the occurrence of potentially explosive atmospheres, mainly depends on the manner in which the ventilation system is achieved, applied and conducted. The optimization of the ventilation system's management involves in depth and complex analyses upon the ventilation network, requiring huge amount of data which can only be processed using computer technology. In this paper, there is presented an analysis of Petrila mining unit ventilation network using computer technology for simulating situations which may occur in the ventilation systems during the closure process.

KEYWORDS

closure, modelling, simulation, solving, ventilation

1 INTRODUCTION

Optimal management of the ventilation system of a mine unit involves the use of computational techniques in order to achieve a proper analysis and to successfully prevent the occurrence of hazardous situations. Forecasting changes which may occur in the ventilation network based on possible hypotheses can be performed by simulating them using specialized software in the mine's solved ventilation network [1, 3].

2 GENERALITIES

For obtaining optimal underground work conditions, the primary protection has to be ensured, namely the ventilation. Mine workings ventilation aims to reach three main objectives:

- Ensuring the oxygen concentration required for underground staff;

- Diluting explosive and/or toxic gases from the mine workings network;
- Taking over heat released in the mine workings network due to human activities and geo-thermal gradient.

For achieving proper ventilation at the level of each mine working is required the optimization of air flow repartition over each branch of the network. In this regard is required the ventilation network solving. An example of a complex ventilation network is the one belonging to Petrila mine unit.

3 PETRILA MINE UNIT VENTILATION NETWORK

Petrila mine unit ventilation network has been extremely complex. Nowadays, due to subjective causes – explosions or objective causes-depletion of useful mineral substances reserve, it is subjected to closure. Therefore, the ventilation network comprises two shafts for fresh air input: Center Shaft and New Shaft with Skip. Also, it comprises a ventilation shaft with the related ventilation station (Ventilation Shaft), two underground mine workings disposed over 5 horizons (horiz. -250; horiz. -200; horiz. -150; horiz. ±0; horiz. +150). These mine workings consist of cross-sectional galleries, directional galleries, diagonal galleries, numbering cross-sectional galleries, inclined plane, coal faces, connection risings.

The entire network comprises 126 junctions (nodes) and 154 branches [2].

4 MINE VENTILATION NETWORK SOLVING

In order to solve such a complex ventilation network was used the Hardy Cross method for successive approximations. This method lays ground for Canadian specialized software, CANVENT [3, 5]. Using this software there could be performed the ventilation network solving and the optimization of air flow repartition at branch level.

Solving the ventilation network of Petrila mine unit required several steps to be performed, namely:

- Marking the junctions (nodes) of the ventilation network on the spatial map of the mine;
- Collecting geodesic coordinates for the identified junctions;
- Inputting the geodesic coordinates of the existing junctions and branches into the database of the software – Figure 1;

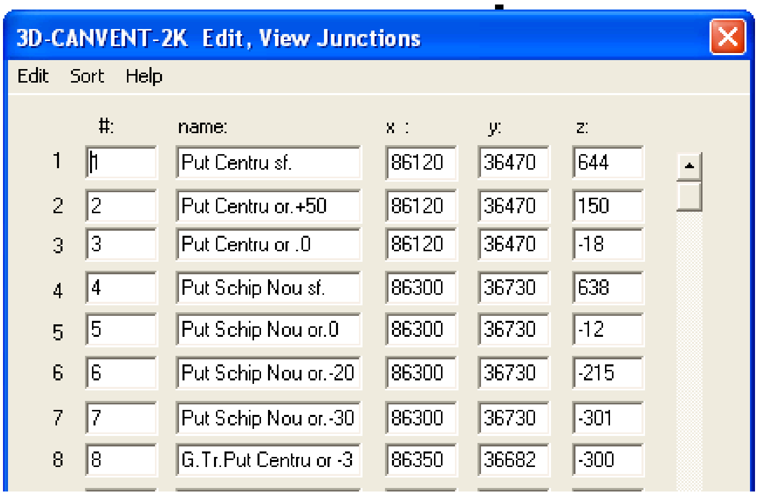

Figure 1: Geodesic coordinates specific for the ventilation network

- Carrying out specialized measurements „in situ”:
  - Measurements regarding the aerodynamic parameters of the mine workings;

- Measurements regarding the geometric parameters of the mine workings;
- Measurements regarding the physical parameters of air.

- Calculating the aerodynamic resistances related to each branch;
- Inputting the values of specific parameters of the ventilation network into the database of 3D-CANVENT – Figure 2

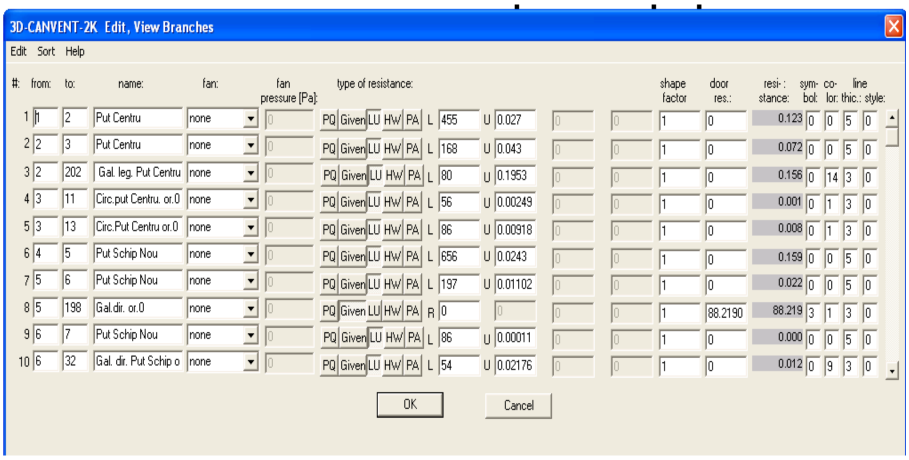

Figure 2: Parameters specific for the ventilation network

- 2D or 3D representation of the ventilation network;
- Balancing the ventilation network;
- Solving the ventilation network. This phase identifies the direction and optimal repartition of air flows over each branch – Figure 3;
- Results obtainment

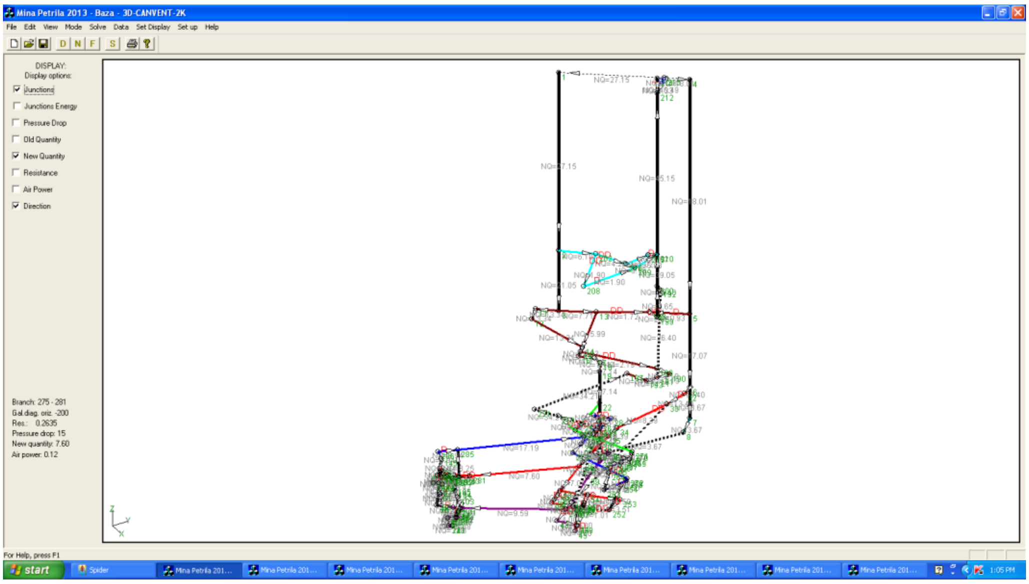

Figure 3: Petrila mine unit ventilation network

In this final phase, the data regarding the graphical solving of the ventilation network are available electronically or in paper.

Ventilation network of Petrila mine unit was updated in 2013. For solving the ventilation network, the entire ventilation network of Petrila mine unit was taken into account.

The current update of Petrila mine unit ventilation network has been performed in relation with the previously solved ventilation network. Also, it was taken into account the fact that the undermined coal beds 434E and 434W are mined in a single field 434 at sublevel II, under horizon -150, and that the undermined coal faces 431 and 433 are mined in a single field 433 at sublevel V – floor, horizon -250.

In order to update the ventilation network were removed the following circuits and mine workings: circuit related to undermined coal bed no. 237W, seam 3, Bl. II, horizon -250; circuit related to undermined coal bed no. 238, seam 3, bl. II, sub-horizon -250; circuit related to undermined coal bed no. 239, seam 3, bl. II, horizon -250; circuit related to undermined coal bed no. 331, seam 3, bl. II, horizon -250; circuit related to undermined coal bed no. 333, seam 3, bl. II, sub-horizon -200; circuit related to undermined coal bed no. 434W, seam 3, bl. II, sub-horizon -150; circuit related to undermined coal bed no. 434E, seam 3, bl. II, sub-horizon -150; circuit related to undermined coal bed no. 336, seam 3, bl. II, sub-horizon -150; main cross-sectional gallery horizon -250; cross-sectional gallery horizon – 250; rising 433, between horizon -250 and -215 elevation; cross-sectional gallery 433 horizon -200; cross-sectional gallery 434 horizon -150; directional gallery W, horizon -200, PO 15 circuit horizon -100.

Also, there have been inserted into the ventilation network: circuit related to undermined coal bed no. 433, seam 3, bl. II, horizon -250; circuit related to undermined coal bed no. 434, seam 3, bl. II, horizon -150; rising 434, between horizon -250 and -200; cross-sectional gallery 434 horizon -200; cross-sectional gallery 433 horizon -200; cross-sectional gallery 434 horizon -150.

At the same time have been placed ventilation constructions on the following locations: main cross-sectional gallery -250; cross-sectional gallery no. 237 horizon -250; cross-sectional gallery 433 horizon -250; directional gallery W, horizon -250; cross-sectional gallery 434, horizon -200; connection gallery coal face 434, sublevel II, sub-horizon -150; directional gallery W, horizon -150; inclined plane 336-337; cross-sectional gallery no. 336, horizon -200; cross-sectional gallery no. 237, horizon -200; diagonal gallery, horizon -150; cross-sectional gallery no 336, horizon -150; connection gallery horizon -250 to plane -300-250; directional gallery E, horizon -200; cross-sectional gallery horizon +150.

Compared to the previously solved ventilation network, the following results were obtained:

- Air flow on the fresh air supply circuit at horizon -250, main cross-sectional gallery significantly decreased with 2.44 % from 13. 92 m^3/s to 13.58m^3/s.
- Air flow at the level of the undermined coal bed no. 433 is 3.71 m^3/s.
- Air flow at the level of the undermined coal bed no. 434 is 3.23 m^3/s.
- Air flow at level of horizon -200, mai cross-sectional gallery significantly increased with 62.12 % from 9.03 m^3/s to 14.64m^3/s.
- Air flow at level of horizon -150, main cross-sectional gallery substantially increased with 204.87 % from 6.36 m^3/s to 19.39m^3/s.
- Air flow at level of horizon - 100, main cross-sectional gallery substantially increased with 82.54 % from 1.26 m^3/s to 2.30 m^3/s.
- On the main return air exhaustion circuit, horizon -100 ÷ horizon +0, air flow moderately increased with 23.37 % from 27.73 m^3/s to 34.21 m^3/s.
- At mine level, on the Ventilation Shaft, air flow moderately decreased with 12.47 % from 51.8 m^3/s to 45.15 m^3/s.
- At the level of the main ventilation station, air flow moderately decreased with 24.5 % from 61.93 m^3/s to 46.48 m^3/s.
- In terms of short-circuiting, on the Ventilation Shaft, air flow significantly decreased with 87.15 % from 10.35 m^3/s to 1.33 m^3/s.

5 SIMULATIONS PERFORMED ON THE VENTILATION NETWORK

CANVENT software for solving ventilation networks allows the simulation of changes which may occur in the ventilation network. Therefore, in the ventilation network of Petrila mine subject to closure were simulated the following situations:

Simulation no. 1 – Closure of undermined coal bed no. 433, seam 3, block II, sublevel V, horizon -250 and setting into the general depression of undermined coal bed no. 433, seam 3, block II, sublevel I, horizon -250.

Simulation no. 2 – Closure of undermined coal bed no. 434, seam 3, block II, sublevel II, sub-horizon -150 and setting into the general depression of undermined coal bed no. 434, seam 3, block II, sublevel III, sub-horizon -150

Simulation no. 3 – Closure of ventilation circuit no. 336, seam 3, block II, between horizons: -100 and -200.

Simulation no. 4 - Closure of ventilation circuit no. 433, seam 3, block II.

Simulation no. 5 - Closure of ventilation circuit no. 434, seam 3, block II.

Simulation no. 6 – Closure of productive horizons, between horizons -250, -200 and -150.

Simulation no. 7 – Closure of Blind Shaft (PO) 15 between horizons -250 and ±0.

Simulation no. 8 – Closure of horizon ±0 connections.

For exemplification is presented Simulation no.1 - Closure of undermined coal bed no. 433, seam 3, block II, sublevel V, horizon -250 and setting into the general depression of undermined coal bed no. 433, seam 3, block II, sublevel I, horizon -250.

In order to perform this simulation, there have been removed 6 branches related to undermined coal bed 433, seam 3, block II, sub-level V, horizon -250, respectively there have been inserted 9 branches related to undermined coal bed 433, seam 3, block II, sub-level I, sub-horizon -250.

Changes conducted within this modelling are presented in Figure 4.

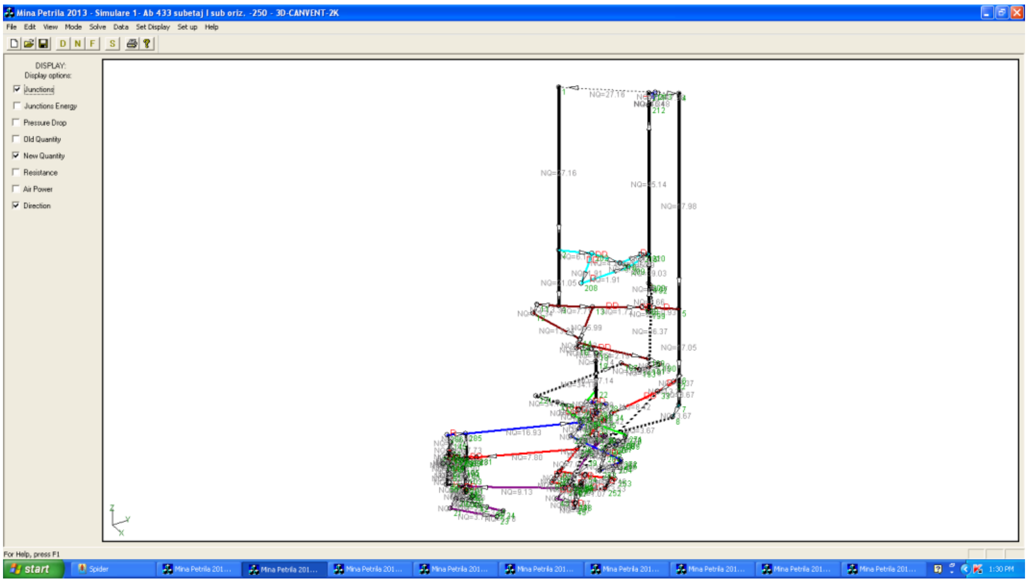

Figure 4: Ventilation network - simulation 1

Compared to the ventilation network updated in 2013, the following results were obtained:

- Air flow on the fresh air supply circuit at horizon -250, main cross-sectional gallery insignificantly decreased with 2.87%, from 13.58 m^3/s to 13.19 m^3/s.
- Air flow at the level of the undermined coal bed no. 433 insignificantly increased with 1.88%, from 3.71 m^3/s to 3.78 m^3/s.
- Air flow at the level of the undermined coal bed no. 434 insignificantly increased with 2.47%, from 3.23 m^3/s to 3.31 m^3/s .
- Air flow at level of horizon -200, main cross-sectional gallery insignificantly increased with 1.64%, from 14.64 m^3/s to 14.88 m^3/s.

- Air flow at level of horizon -150, main cross-sectional gallery insignificantly decreased with 19.39 m^3/s to 19.17 m^3/s.
- Air flow at level of horizon - 100, main cross-sectional gallery insignificantly increased with 1.13%, from 2.30 m^3/s to 2.34 m^3/s.
- On the main return air exhaustion circuit, horizon -100 ÷ horizon +0, air flow insignificantly decreased with 0.09%, from 34.21 m^3/s to 34.18 m^3/s.
- At mine level, on the Ventilation Shaft, air flow insignificantly decreased with 0.09%, from 45.15 m^3/s to 45.14 m^3/s.
- At the level of the main ventilation station, air flow remained the same 46.48 m^3/s.
- In terms of short-circuiting, on the Ventilation Shaft, air flow insignificantly increased with 0.75%, from 1.33 m^3/s to 1.34 m^3/s.

6 CONCLUSIONS

Solving ventilation networks using computational techniques is a giant step forward which allows the optimization of ventilation management and real-time visualisation of the network's changes.

The ventilation network used for exemplification belongs to Petrila mine unit and comprises 2 shafts, 1 ventilation shaft, horizons and many mine workings (cross-sectional, directional, diagonal galleries, inclined planes, connection risings and coal faces).

Solvingthe ventilation network of Petrila mine unit has been performed using CANVENT software and required 10 main steps for reaching this objective. The application of CANVENT software allowed the performance of eight simulations in the ventilation network of Petrila mine unit, of which simulation no. 1 was presented, and which represent changes which may occur in the ventilation system during the closure process.

The method for solving the ventilation network using computational techniques, allows modelling and solving ventilation networks, as well as any other simulation of changes which may occur in the ventilation system, regardless of its' complexity.

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THE ASSESSMENT OF ELECTRIC DETONATORS IN TERMS OF DELAYS ACCURACY, ACCORDING WITH EUROPEAN HARMONIZED STANDARDS

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Abstract

Determination of the delay precision of the electrical detonators regarding the legislation in force and the applicable standards on field, ensure the conditions of garanty the safety characteristics of these kinds of products. Applying procedure methodological instruments for testing and assessment of electrical detonators it is possible to evaluate the functioning (detonation) outside the range of the nominal succession for neighbour delay number.

KEYWORDS

Electric detonators, delay time, delay precision, algorithm, acceptance triangle, overlying probability

1. GENERALITIES

For an explosive charge to detonate at a stable speed level, conditions in which maximum energy is release, it must be excited / initiated with a sufficiently high shock, this is the role of the initiation systems.

Currently are used only constructive types of detonators (fig.1), for initiating the explosive for blasting, this having the significant structural differences and time delays ranging from instant millisecond or the order of seconds. The delay is intrinsically (resulting from the constructive parameters) or the electronic detonators is programmable in a wide range, noting that this type of detonators involves significant costs.

European harmonized standards EN 13763-16 SR: 2004 and SR EN 13763-1: 2004 states from the technical point of view the technical method for testing, regarding the precision determination of electric detonators delay.

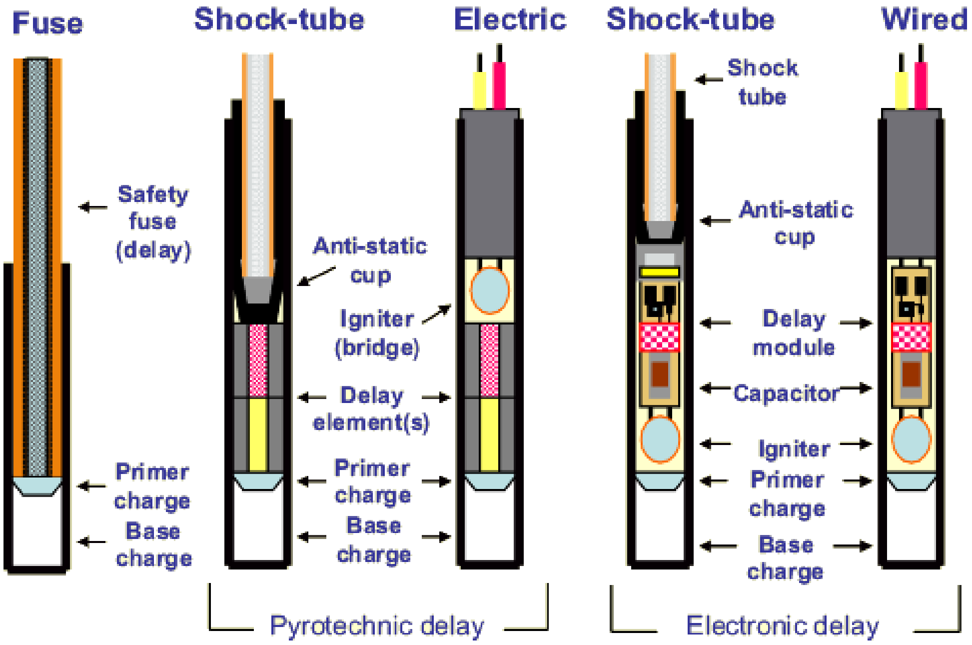

Fig.1 Constructive types of detonators for use in mining

2. THE CALCULATION ALGORITHM ON THE ACCURACY OF DELAY AT THE ELECTRIC DETONATORS

From a procedural standpoint, to determine the specific indicators to determine the precision of delay is required the following steps:

- Calculation of average time delay ($\bar{t}_k$) and the standard deviation (s_k):

$$\bar{t}_k = \frac{1}{n_k}\sum_{i=1}^{n_k} t_{ik} \qquad (1.1) \qquad\qquad s_k = \sqrt{\frac{\sum_{i=1}^{n_k}(t_{ik}-\bar{t}k)^2}{n_k-1}} \qquad (1.2)$$

where: n_k=30 represents the number of electric detonators which are test subjects for each stage of delay k=1÷10.

- The calculation of adjusted nominal delay time ($t_{nom\ adj,k}$) and adjusted nominal time difference ($\Delta t_{nom\ adj,k}$):

$$t_{nom\ adj,k} = t_{nom,k} + \frac{1}{4}\left(t_{nom,(k+1)} + t_{nom,(k-1)} - 2t_{nom,k}\right) \qquad (1.3)$$

where: $t_{nom,k}$ is the nominal delay time (in milliseconds) for the interval number k, indicated by the manufacturer with the operating instructions manual:

$$\Delta_{nom\ adj,k} = \frac{1}{2}\left(t_{nom,(k+1)} - t_{nom,(k-1)}\right) \qquad (1.4)$$

- Calculation of the largest and the smallest delay time ($t_{nom\ adj,kmin}$ și $t_{nom\ adj,k\ max}$):

$$t_{nom\ adj,k\ min} = t_{nom,k} - \frac{1}{4}\left(t_{nom,(k+1)} - t_{nom,k}\right) \qquad (1.5)$$

$$t_{nom\ adj,k\ max} = t_{nom,k} + \frac{1}{4}\left(t_{nom,k} - t_{nom,(k-1)}\right) \qquad (1.6)$$

- Determination of interval limits in accordance with Grubbs test for determining the exceptional values and the limits of the range using the adjusted nominal delay times and adjusted nominal time difference:

$$t_{Grubbs\ limit,k} = \bar{t}_k \pm 3{,}103\, s_k \qquad (1.5)$$

$$t_{nominal\ limit,k} = t_{nom\ adj,k} \pm \Delta t_{nom\ adj,k} \qquad (1.6)$$

- The calculation of factors c_k:

$$c_k = \sqrt{2}\, Q_{Fk} = \sqrt{2}\left[\frac{\frac{1}{2}\Delta t_{nom\ adj,k} - (\bar{t}_k - t_{nominal\ limit,k})}{s_k}\right] \qquad (1.7)$$

where: Q_{Fk} is the quality factor for the number of interval k.

- Setting up the triangles of acceptance following the calculation of the essential points:
- The height of the triangle, s_{kmax} (ms)

$$s_{kmax} = \frac{\Delta t_{nom\ adj,k}}{c_{min}\sqrt{2}} \tag{1.8}$$

- The lowest point of the triangle, t_{iv} (ms)

$$t_{iv} = t_{nom\ adj,k} - \frac{\Delta t_{nom\ adj,k}}{2} \tag{1.9}$$

- The uppermost point of the triangle, t_{uv} (ms)

$$t_{uv} = t_{nom\ adj,k} + \frac{\Delta t_{nom\ adj,k}}{2} \tag{1.10}$$

- Triangle center, t_c (ms)

$$t_c = t_{nom\ adj,k} \tag{1.11}$$

3. METHODOLOGICAL AND PRACTICAL INSTRUCTIONS FOR THE TESTING ACCURACY, FOR DETERMINATION OF ELECTRIC DETONATORS DELAY

From the methodological point of view trying to determine the accuracy of delay is carried out on specimens consisting of a total of 30 electric detonators for each number of delay time, with the same chemical composition, charge, size and material of construction.

Equipment necessary to carry out the test, consisting of a **power source** capable of producing a continuous current according to the manufacturer specification**, a timer device** or **oscilloscope** to measure the time of delay required between starting the impulse and the impulse to stop, means, both for the start-up an impulse (trigger circuit to ensure an effective electrical pulse when the ignition current is applied), and to provide an impulse stop, the timer / oscilloscope (optical sensor or pressure sensor capable of providing an electrical impulse when the base charge is initiated, respectively the secondary load of the electric detonators) and a conditioning room capable of maintaining a temperature in the range from about 15÷30 ^{0}C $\pm 2^0$C.

The procedure for testing these types of products, aiming a first stage conditioning them at least 2 hours before the test, at the temperature specified by the manufacturer, in the range from about 15÷30 ^{0}C, thereafter there follows the test phase, which must be made, in ± 2 ^{0}C from the temperature conditioning.

After connecting and the introduction of the electric detonators, inside the stand they are initiated, and then record the individual delays and the number of missed ignitions (Figure No. 2, 3 and 4).

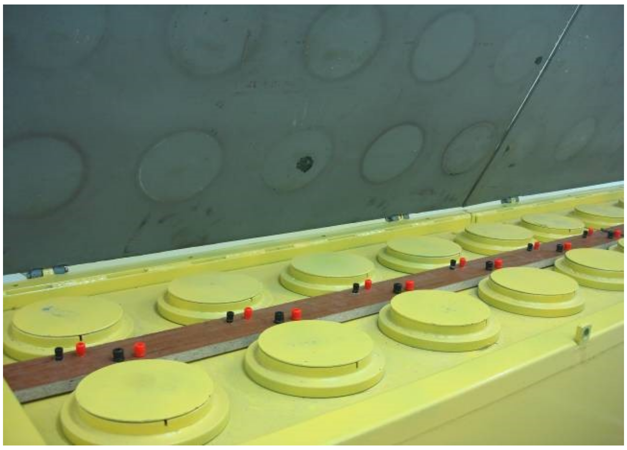

Fig.2. Stand for testing electric detonators as required by harmonized European standards

Fig. 3. Electric detonators prepared for testing

Fig.4. The measuring and command equipment for the stand for determine the precision of detonators delay

4. THE CASE STUDY

To determine the precision of delays, the millisecond electric detonators were made a number of attempts in the INSEMEX Polygon, with harmonized European standards SR EN 13763-16: 2004 and SR EN 13763-1: 2004.

After testing were obtained the following values of the delays (Table 1):

Table 1

Number of attempt sn_{ki}, k=1,10 i=1,30	The values of measurement delay times / of delay stage, to k=1,10									
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	Nominal time / Delay stage, (ms)									
	30	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**
	The times of delay measured (ms), t_k									
1	32,10	58,50	81,37	119,84	139,54	166,31	182,06	221,93	261,02	266,49
2	35,08	52,85	73,50	110,72	142,81	168,18	220,07	196,30	247,54	268,22
3	38,48	59,16	76,93	118,38	137,77	167,70	207,25	133,03	**30,966***	271,09
4	34,75	62,67	81,45	110,38	139,39	160,70	180,38	**74,42***	255,37	259,86
5	33,42	52,70	77,00	109,73	135,65	178,16	186,37	**85,09***	253,87	259,66
6	32,21	52,35	76,50	106,28	134,28	173,79	**46,515***	226,73	224,83	263,25
7	31,42	52,78	75,40	114,06	**31,120***	160,18	**3721,29***	223,95	226,42	270,47
8	23,20	54,91	82,51	104,29	140,11	173,61	196,32	167,73	257,72	**108,97***
9	34,00	58,23	84,34	104,22	134,36	166,47	193,22	162,51	236,57	212,04
10	26,83	52,01	80,65	107,54	139,33	174,75	**2893,45***	221,26	247,59	**39,684***
11	24,22	54,54	73,42	109,80	145,27	173,93	197,74	176,21	224,15	262,72
12	24,61	50,54	79,70	106,31	142,84	170,83	172,39	217,25	235,57	268,84
13	32,13	56,16	79,55	107,60	146,40	176,96	199,49	219,34	233,04	249,82
14	25,05	54,58	73,80	110,48	141,39	176,12	201,27	102,74	221,11	259,60
15	32,81	55,89	70,80	**50,08***	133,86	175,83	176,65	227,98	232,97	**173,81***
16	30,04	55,85	82,20	103,94	136,18	176,75	**53,833***	233,67	226,06	262,71
17	31,43	50,32	90,30	109,04	140,34	177,75	188,09	241,33	233,87	278,95
18	35,80	55,93	81,00	122,58	141,36	170,75	188,39	**69,63***	216,88	261,81
19	32,56	54,21	79,55	106,30	133,19	171,75	179,96	231,91	231,37	**198,29***
20	33,03	53,75	88,00	115,42	135,15	166,16	184,13	**56,08***	246,24	259,55
21	30,64	51,46	77,52	109,86	133,45	174,44	190,40	138,31	248,08	247,73
22	29,60	57,86	95,20	103,57	**4034,40***	174,91	197,60	**57,72***	222,23	265,97
23	32,00	50,77	84,90	106,77	138,45	175,73	193,00	220,06	245,54	268,46
24	33,62	55,64	84,00	116,85	134,20	165,07	**5589,99***	**114,9***	**5196,799***	277,12
25	27,81	57,38	76,82	107,26	130,55	168,25	196,00	**62,42***	**58,683***	**187,40***
26	25,62	56,95	85,39	106,47	131,12	173,32	194,31	**53,84***	225,89	277,10
27	33,61	56,67	80,75	103,84	146,11	174,64	193,10	19,53	251,36	264,02
28	34,63	55,11	80,54	103,19	124,41	175,23	194,73	228,46	251,80	**154,24***
29	31,78	49,21	83,90	108,20	133,67	174,54	192,45	146,67	225,83	228,74
30	25,69	48,53	78,00	106,00	138,34	173,15	194,85	191,24	224,54	**6564,44***

Note: *- exceptional values according SR EN 13763-16:2004

After statistical processing of the specific values of tests carried out resulted in the following synthetic indicators (table 2):

Table 2

Result indicators		**Delay stage, for k_i, i=1,30**									
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
		Nominal time/ Delay stage (ms)									
		30	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**
		The times of delay measured (ms), t_{ki}									
The average of delay times, $t_{k\ med.}$, (ms)		30,939	54,7231	80,833	109,132	137,482	172,303	192,008	198,195	237,313	255,556
Standard deviation, s_k		3,885466	3,175094	4,992858	5,095756	5,066773	4,525412	10,02035	35,2432	13,08942	16,1223
Number of ignitions missed		0	0	0	0	0	0	0	0	0	0
$t_{Grubbslimit}$	Inf.	18,88	44,87	65,34	93,31	121,76	158,26	160,91	88,83	196,69	205,52
	Sup.	42,99	64,57	96,32	124,94	153,20	186,34	223,10	307,55	277,92	305,58
$t_{nominal\ limit}$	Inf.	15	45	75	105	135	165	195	225	255	285
	Sup.	45	75	105	135	165	195	225	255	285	300
Number of "exceptional" values		0	0	0	1	2	0	5	7	**3**	7
The factor, c_k		5,117857	4,330752	1,652406	1,146744	0,693003	2,282514 (c_{min}^*)	-0,42216	-1,0755	-1,91091	-9,2591
Nominal time of delay, $t_{nom,k}$		30	60	90	120	150	180	210	240	270	300

Note: *- the factor c_k minimum according to the standard SR EN 13763-1:2004

Graphic-analytical representation of the results obtained through acceptance triangles (Figure No.5) allows highlighting how compliance/non-compliance with the requirement applied, depending on the positioning of the points represented in the diagram whose coordinates are statistical parameters specific to each slot number, respectively average value and standard deviation.

Thus, the result located within the triangle of acceptance, afferent number of interval the requirement is considered fulfilled, otherwise ascertaining the failure to fulfill the requirement.

To configure triangles of acceptance was necessary to calculate the critical points whose values are shown in Table 3:

Table 3

Parameters of triangles for acceptance										
Delay stage	1	2	3	4	5	6	7	8	9	10
The height	50,24	50,24	50,24	50,24	50,24	50,24	50,24	50,24	50,24	50,24
Lowest point	15,00	45,00	75,00	105,00	135,00	165,00	195,00	225,00	255,00	285,00
Uppermost point	45,00	75,00	105,00	135,00	165,00	195,00	225,00	255,00	285,00	150,00
Center	30,00	60,00	90,00	120,00	150,00	180,00	210,00	240,00	270,00	217,50

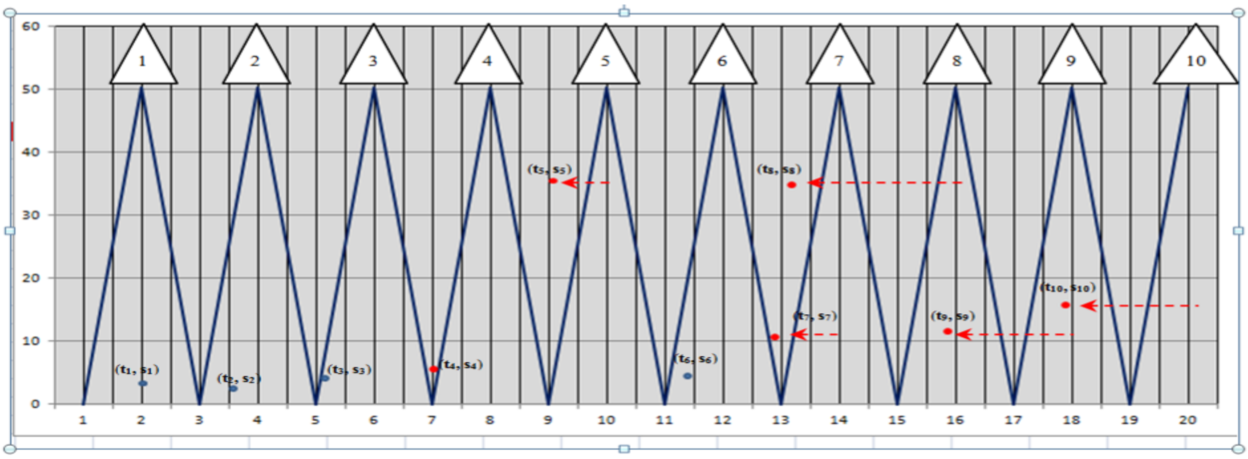

Fig.5. Graphical representation of acceptance triangles, to assess whether compliance / non-compliance to achieve the level of requirement applied

From the analysis of the diagram can be seen in Figure No. 5 that for late stages 1, 2, 3 and 6 applied the requirement is met, in fact supported by positioning points inside the blue of the triangles corresponding of acceptance the delay involved and the delay stages 4, 5, 7, 8, 9 and 10 red points are located outside of the acceptance triangles, emphasizing while a displacement to the left thereof, which proves the existence of overlapping high probability of delay time over the interval numbers adjacent afferent or confirmation detonation outside the proposed sequence.

5. CONCLUSIONS

- The test for the determination of the accuracy of the electric detonators delay shall be made in accordance with the European harmonized standards EN 13763-1: 2004, in order to guarantee the security quality of such products;
- After statistical processing of the data obtained from measurements made with suitable equipment, such as: the average delay and standard deviation; nominal delay time adjusted and the nominal time difference adjusted; limits of the time interval delay, according to Grubbs test; c_k factor, specific indicators are obtained by numerical results that can be quantified and valued by graphic-analytical triangles acceptance;
- The study case highlights in the test of the electric detonators recently tested at the INSEMEX Polygon, the graphic-analytical method for determining the probability of overlapping of the delay times over those afferent of interval numbers adjacent as confirmed by finding out the detonation sequence proposed for delay steps 4, 5, 7, 8, 9 and 10.
- Failure to fulfil of this functional parameter for the electric detonators may cause technical events that can result either with partial failures, or situations that may lead to cut of the connectors for holes loads or disturbing the pattern front. These technical incidents can generate considerable economic loss due to costs for their elimination or accidents resulting in human casualties.

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INFLUENCE OF THE NATURAL DRAFT'S DEPRESSION UPON MINING VENTILATION NETWORKS

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ABSTRACT

In underground hard coal exploitation is required the circulation of significant air flows at the level of all underground works. Air flows are circulated using powerful fans located at the surface within the main ventilation stations. For the optimization of the mining ventilation are required both the knowledge of air flow repartition at branch level and the knowledge of the ventilation network's evolution in perspective. By using specialized software for solving ventilation networks, there can be identified and modelled situations technically possible and the manner in which the ventilation is performed in such situations. In this paperwork will be presented a particular situation, technically possible, regarding the influence of the natural draft upon the ventilation network which is subject to restructuring, in case of accidental stop of the main ventilation fan.

KEYWORDS

natural draft, ventilation, ventilation network

1 INTRODUCTION

Mine ventilation is an extremely sensitive and complex domain that includes several disciplines used to accomplish and preserve safe conditions in underground [1, 5]. In this spirit, a good ventilation network developed with the IT is a huge step forward that allows the experts to see in real time the changes occurred in this network and, more important, to anticipate the possible disturbances in the ventilation system.

2 GENERAL NOTIONS

The mine network necessary for the mining of useful mineral substances displays a high complexity, different shapes and cross-sectional areas and can reach tens of kilometres in length.

For getting the best possible working conditions in underground, it is necessary to provide the primary protection, i.e. a suitable ventilation. The purpose of this ventilation is to:

- provide the concentration in oxygen necessary for the personnel currently working in underground;
- dilute the explosive and/or toxic gases existing in the mine network;
- diminish the heat emitted inside mine workings, both due to human activities and to thermal gradient.

A good ventilation of each mine working involves the best possible repartition of air flows along each branch of the ventilation network. In this spirit it is necessary to settle the ventilation network of each mine. An example of complex ventilation network is the one belonging to Uricani mine.

3 DESCRIPTION OF THE VENTILATION NETWORK OF URICANI MINE

The ventilation network of Uricani mine is quite complex. Therefore, the ventilation network includes three ventilation shafts: Skip Shaft, 4 Shaft, 8 Shaft and 15 ventilation incline. It also includes two ventilation shafts with the related ventilation stations (East Shaft and West Shaft) and underground mine workings located on four levels (level 580; level 500; level 400; level 300). These mine workings are made of main cross sectional galleries, directional galleries, diagonal galleries, plain cross sectional galleries, inclines, working faces, connection raises.

The whole ventilation network includes 291 junctions (knots) and 300 branches [2, 3, 4, 6]

4 PROVIDING THE SOLUTION FOR THE VENTILATION NETWORK OF THE MINE

For providing the best solution available for such a complex ventilation network, we have used the Hardy-Cross method for successive approximation. This method represents the grounds of anexpert software CANVENT designed in Canada. This software helped us to provide the solution for the ventilation network as well an optimization of the air flow distribution within the ventilation branches [6]

This process made necessary to run several stages:

- Marking the junctions of the ventilation network on the spatial diagram;
- Determining the geodesic coordinates of the identified junctions;
- Inputting the geodesic coordinates of junctions and the existing branches into the database of the software - Figure 1;
- The carrying out of measurements in situ; these measurements include:
    - measurements of the aerodynamic parameters of mine workings;
    - measurements of the geometrical parameters of mine workings;
    - measurements of the physical parameters of the air;
- Calculation of aerodynamic strength specific to each branch;
- Inputting the values of parameters specific to the ventilation network into the expert software CANVENT - Figure 2;

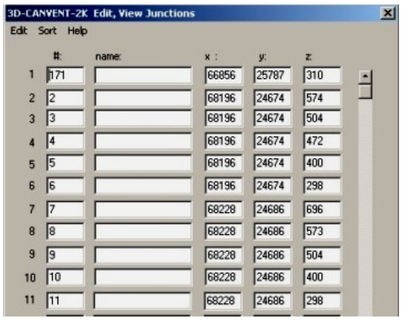

Figure 1: Geodesic coordinates of junctions

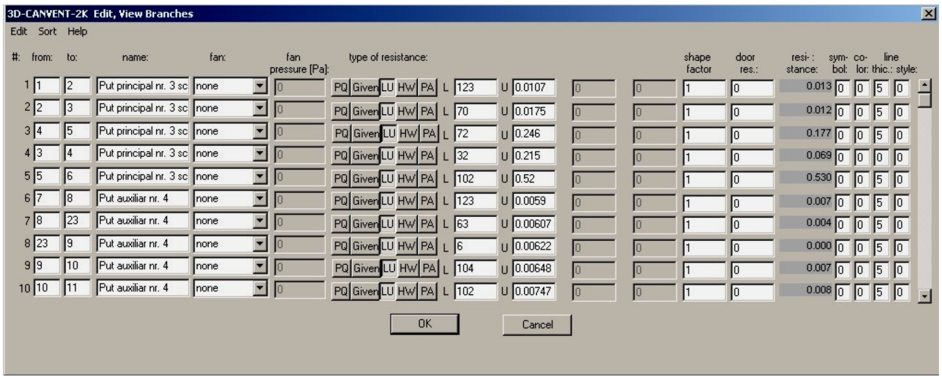

Figure 2: Values of parameters

- The 2D or 3D drawing of the ventilation network;
- Balancing the ventilation network;
- Settling the ventilation network. Both the direction and the optimum distribution of the air flows along each branch are being identified in this stage - Figure 3.
- Getting the results.

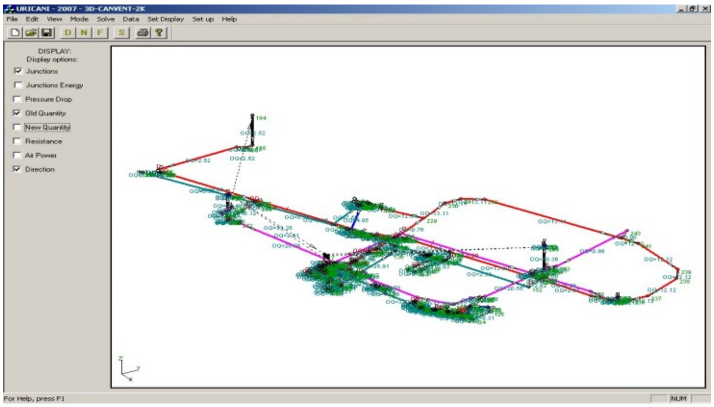

Figure 3: 3D presentation

This final stage provides the data on electronic support or paper regarding the graphic settlement of the ventilation network. The method shown above allows to give solutions to any ventilation network, irrespective of their level of complexity.

5 PROSPECTIVE SIMULATION OF THE VENTILATION NETWORK

There has been performed a simulation using 3D CANVENT in order to view the prospective operation of the ventilation network if it will be restructured by stopping a main ventilation stations (West ventilation Station), respectively of related ventilation circuits. For simulating the ventilation network of Uricani mine unit were removed 95 junctions and 143 branches. Changes performed are presented in Figure 4.

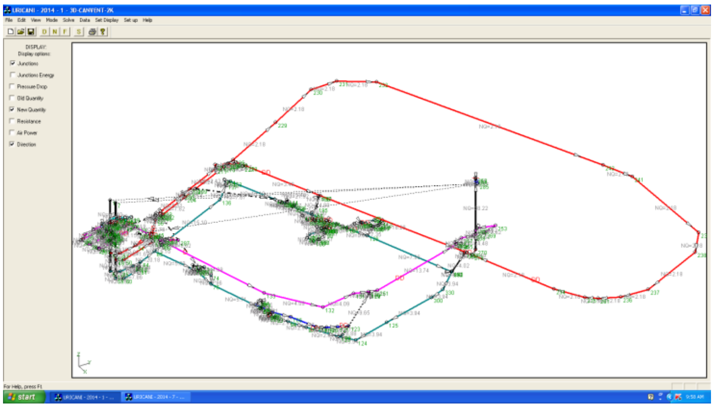

Figure 4: Restructured ventilation network

There have been removed from the ventilation network the following circuits and mine workings: circuit of shaft W horizon 500 and horizon 400; circuit of main gallery W horizon 300, circuit of transportation plane horizon 300-400; circuit block III N horizon 300-400; circuit of conjugated directional gallery bl. V-S; circuit of diagonal gallery bl. V-S and VI-S horizon 340; main collector gallery no.1 horizon 500; coal face panel no. 14, seam 5, bl. IV-N; undermined coal bed panel , seam 3, bl. IV-S, surface connection workings.
There have been inserted in the ventilation network the following workings: inclined plane access Silo bl. IV S horizon 300; front face panel 17, seam 5, bl. IV N,; undermined coal bed 5, seam 3, bl. IV S; directional gallery E horizon 300; surface connection workings.
There have been modified ventilation constructions on the following locations: shaft with skip – aux. shaft horizon 500; cross-sectional gallery access plane 15 horizon 500; main eastern gallery horizon 500; main conjugated gallery horizon 400; delta demag. Horizon 400; cross-sectional gallery head ventilation rising bl. VI S, 300-40; main eastern gallery horizon 300; ventilation gallery horizon 340; access gallery panel 2, seam 3, horizon 340; ventilation gallery horizon 340.
Also, there have been placed ventilation constructions in the following locations:

- Ventilation doors: dir. Gal. E horizon 500; main Demag. Gal. horizon 400; access plane panel 5/3/IV S; ventilation gal. bl. IV S horizon 340; E main gallery; coal face panel 17, seam 5, bl. IV N horizon 300;
- Ventilation dams: main W gallery horizon 500; main gal. W demag. Horizon 300; belts flow; delta gal. horizon 400 ; ventilation gallery horizon 400; panel 5 seam 3 bl. IV S; pan. 5 seam 3 bl. IV S; head gal. panel 5 seam 3; panel 14 seam 5; panel 14 seam 5; gal. access Silo horizon 300 bl. V S; gal. access rising 300-400 horizon 340 bl. VI S; ventilation gal. pan 3 seam 5 bl. V S; rising300 - 350 bl. VI ; vent. Rising. bl. VI S 300.

Compared to the current optimized situation, the following results have been obtained:

- Air flow on the fresh air supply circuit horizons 300, 400 and 500 decreased from 56.94 m^3/s to 38.22 m^3/s.
- Air flow on the inclined plane 500-400 is 10.19 m^3/s.
- Air flow on the inclined plane 400-300 is 7.67 m^3/s.
- Air flow on the southern frame horiz. 300 is 5.09 m^3/s.
- Air flow on the southern frame horiz. 500 is 4.09 m^3/s.
- Air flow on the northern frame horiz. 400 is 2.18 m^3/s.
- Air flow on the longwall no. 17, seam 5 bl. IV N is 6.04 m^3/s.
- Air flow on the undermined coal bed no. 8, seam 3 bl. IV S is 8.57 m^3/s.

- On the return air exhaust circuit related to bl. V S, air flow at horizon 500 decreased from 25.74 m^3/s to 9.65m^3/s.
- At mine level, air flow decreased from 43.89 m^3/s to 38.22 m^3/s on ventilation shaft E.

6 INFLUENCE OF THE NATURAL DRAFT IN CASE OF THE MAIN FAN'S ACCIDENTAL STOPPING

After the prospective solving of Uricani mine unit ventilation network, there was needed to know the air flow reparation in size and direction at branch level in case of the accidental stopping of the main fan. For performing this simulation was taken into account the prospective modelled and solved ventilation network.

There has to be mentioned the fact the the natural ventilation through natural draft of underground mine workings is allowed by the OHSR – CNH Petrosani – 2007. The aeration of a ventilation network only through natural draft is accidentally performed if the main ventilation station is stooped.

The natural draft permanently operates upon ventilation networks and has different values and directions depending on the day-night cycle, seasons, and on weather and microclimate conditions.

For calculating the natural draft was used Protodiakonov's method [1, 5].

$$h_n = 353 \cdot g \left[\frac{z_1}{T_1} - \frac{z_1 - z_2}{T} - \frac{z_2}{T_2}\right] \quad \text{(Pa)} \qquad (1)$$

where:

z_1 – depth of the air input shaft (m), (in our case 398 m);

z_2 – depth of the air output shaft (m) (in our case 402 m);

T_1; T_2 – air absolute temperatures in the two extremities (K), (in our case 298.16 K respectively 295.16 K);

T – average absolute temperature between the two extremities (K), (in our case 293.16 K).

h_n = 353 · 9.81(398/298.16 - 4/ 296.66 - 402/295.16)

h_n = 3462.93 (1.3348 – 0.0134 –1.3619)

h_n = - 140.24 ≈ - 140 Pa

For conducting this simulation, there is removed the depression generated by the main ventilation stations and is applied at the E shaft a negative depression of 140 Pa, which means a reverse in air flow direction at the level of the entire ventilation network. Changes performed in this modelling are presented in Figure 5.

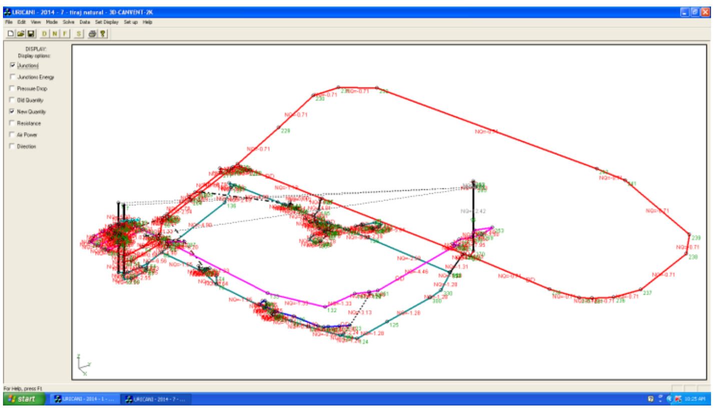

Figure 5: Effect of the natural draft upon the ventilation network

Comparing with the prospective optimized situation, the following results have been obtained:

- Air flow on the fresh air supply circuit horizons 300, 400 and 500 decreased from +56.94 m^3/s to – 11.42 m^3/s.
- Air flow on the inclined plane 500 – 400 is -3.04 m^3/s.
- Air flow on the inclined plane 400 – 300 is – 2.29 m^3/s.
- Air flow on the southern frame horiz. 300, respectively horizon 500 is – 1.52 m^3/s, respectively – 1.22 m^3/s.
- Air flow on the northern frame horiz. 400 is - 0,65 m^3/s.
- Air flow on the main directional gallery E, demag. Horizon 400 is – 1.04 m^3/s.
- Air flow on the longwall no. 17, seam 5 bl. IV N is – 1.81 m^3/s.
- Air flow on the undermined coal bed no. 8, seam 3 bl. IV S is – 2.56 m^3/s.
- On the return air exhaust circuit related to bl. V S, air flow at horizon 500 decreased from +25.74 m^3/s to – 2.88 m^3/s.
- At mine level, air flow decreased from +43.89 m^3/s to – 11.42 m^3/s on ventilation shaft E.

7 CONCLUSIONS

Giving solutions for the ventilation networks with the help of it is a huge step forward that allows optimum ventilation and a visualisation of the changes made on the network in real time. The ventilation network given as example belongs to Uricani mine and includes 3 shafts and one ventilation incline, 2 ventilation shafts, 4 levels and several underground workings (cross-sectional galleries, directional galleries, diagonal galleries, inclines, connection raises and working faces).

The best solutions available for the ventilation network of Uricani mine have been obtained with the help of the Canadian software called CANVENT. It includes the run of 10 main steps.

Using the specialized software as performed a prospective modelling and solving of the ventilation network in case of removing a main ventilation stations and related circuits. On the prospective modelled and solved ventilation network was simulated the situation in which the natural draft operates upon the network. There has been noticed the fact that the circulated air flow at network level drastically decreased and the air flow directions was reversed.

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RESEARCHES REGARDING DETERMINATION OF THE ELECTRICAL PARAMETERS FOR SAFE AND RELIABLE INITIATION OF THE ELECTRICAL DETONATORS

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ABSTRACT

This paperwork approaches the performance improvements in the present electric detonators testing system aiming for a safe initiation during blasting works.

KEYWORDS

Keywords: electric detonators, electric parameters, ignition current

1. Generalities

The electric detonators have been used on a wide scale within industrial activities as component of the blasting process, both in underground and surface workings. In order to mitigate the explosion risk in these environments - potentially explosive atmospheres generically named "Ex zones", equipment in special construction for potentially explosive atmospheres are to be used, which shall not generate energy sources that could initiate an explosion, and the blasting operations have to take place in reliable and sure conditions.

The field of civile use explosives is represented by the European Directive 93/15/EEC of 5th of April 1993 regarding harmonization of provisions regarding placing on the market and control of civile use explosives. The electric detonators used in blasting processes have to meet the essential safety requirements addressing their safe and reliable ignition. Testing of electric detonators is of a particular importance taking into consideration the existing explosion risk that has to be minimized in order to ensure safety of human life and health.

2. Construction, operating and classification of electric detonators

Regardless of the electric detonator's type [1], from a constructive standpoint they are similar. The main components are shown in figure 1 and they consist in:

1 electric detonator's tube;
2 initiation charge;
3 intermediary charge;
4 disruptive charge;
5 ignition cherry consisting in: filament, flammable paste deposed on the filament and filament electrodes;
6 insulating protective sleeve;
7 obturating plug;
8 Copper or steel wires;
9 delaying body;
10 delaying charge;
11 indicator for the delaying step

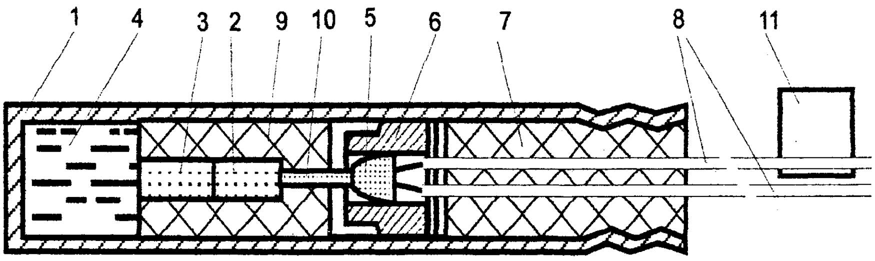

Fig. 1. Construction of an electric detonator

Electric detonators operating is based on the head released by the filament towards the flammable paste when an electric current passes through it. The amount of heat developed by the filament may be expressed by the following formula:

$$Q = 0.24 \cdot I^2 \cdot R_f \cdot t \qquad (1)$$

In the formula it can be noticed that the main role in developing the amount of heat required for flammable paste ignition, is held by the value of current and its duration of passing through the filament. Thus, when a sufficiently high amount of current (a specific value) is passing through filament, the amount of heat developed is enough to start the paste ignition reaction, respectively detonator's operation. Otherwise, the thermal balance may settle in at a temperature inferios to the one required to ignite the paste (approx. 260 ÷ 280 °C), case when the electric detonator does not work, regardless of the current travelling duration.

Classification of electric detonators based on the non-ignition current is given in table 1.

Tabelul 1

Electric detonators class	Class 1	Class 2	Class 3	Class 4
Non-ignition current, I_{nf} (A)	$0{,}18 < I_{nf} < 0{,}45$	$0{,}45 \le I_{nf} < 1{,}20$	$1{,}20 \le I_{nf} < 4{,}00$	$4{,}00 \le I_{nf}$
Non-ignition minimum impulse, W_{nf} (mJ/Ω)	0,5	8	80	500
ESD (electrostatic discharge) impulse(mJ/Ω), for the "electrode-to-electrode" configuration	0,3	6	60	300
ESD impulse, (mJ/Ω), for the "electrode-to-mass" configuration	0,6	12	120	600

3. Analysis of testing methods for electric parameters of electric detonators

The test for determination of non-ignition current of electric detonators is performed starting with a preliminary test (for example a Bruceton test) using 30 detonators [3], in order to obtain an estimate on the value of current for a 50% ignition ($I_{0,5}$) and the standard deviation (s). The squared impulse duration has to be adjusted at 10 s, if the non-ignition current declared by the manufacturer is lower or equal to 2 A, and 5 min if is higher than 2 A. The non-ignition current is then calculated using the PBBS tests. The probability and trust levels are set at 0,01 % and respectively at 95 %. The non-ignition current is calculated and it should correspond to the class specified by the manufacturer.

For the test for determination of ignition current of electric detonators connected in series, the current amplitude is set at ignition current in series I_s declared by the manufacturer, and a time period is chosen for the impuls of at least t_I, given by:

$$t_I = 5 \cdot \frac{W_{af}}{I_s^2} \tag{2}$$

where W_{af} = the total ignition impulse in J/ohm, declared by the manufacturer.

The electric detonator is connected to the power supply and the I_s is applied for a time t_I , in miliseconds, then the time of reaction to current is recorded, t_b, in miliseconds. Finally the minim value of time of reaction to current $t_{b\ min}$ is determined, and for the instantaneous detonators the average value $\bar{t}_b$ is calculated, as well as the standard deviation s_b. No ignition failures should occur during the in series ignition test.

The safe ignition impulse represents the minimum electric energy required to ignite all the detonators connected in series, divided by the value of the total resistance of the complete circuit.

The non-ignition impulse represents the maximum electric energy divided by the value of the total resistance of the complete circuit, that, when delivered over a short time, does not generate ignition on any of the electric detonators [2].

Improvement of testing methods is aquired by developing test stands for electric detonators, by aquiring a voltage supply of high current needed in order to fulfill the testing requirements of detonators electric parameters.

Fig. 2. High current voltage supply

The laboratory high current voltage supply (fig. 3) provides a good testing accuracy for electric detonators, such as to ensure a high current required for high intensity detonators at the following tests: ignition current, non-ignition current and safe operation impulse of electric detonators.

This voltage supply has a high range of currents, with the following features: Această sursă are un domeniul inalt al curentului având următoarele caracteristici:
0–50 Ampers, 0 – 20 Volts, digital display, energy supply from the common distribution network - 220 V.

4. Conclusions

The requirements regarding the electric parameters of detonators, materialized by a series of tests such as determinatio of ignition current, determination of non-ignition current, determination of non-ignition impulse, have a considerable weight in their testing process.

Testing of electric detonators is of a particular importance taking into consideration the explosion risk and this is the reason why the requirements regarding detonators electric parameters have to be fulfilled aiming to obtain a safe and reliable igniton of detonators.

Analyzing the safety requirements of electric parameters of detonators pointed out a need of improving the testing methods and procedures and to achieve this goal, a voltage supply should be aquired, capable to generate high currents. Thus, the ability of performing tests on the whole range of electric detonators is extended, from the low intensity ones up to the high intensity electric detonators.

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PARTICULARITIES OF ELECTRICAL EQUIPMENT WITH TYPE OF PROTECTION FLAMEPROOF ENCLOSURE "D" DESIGNED FOR USE IN FIREDAMP UNDERGROUND MINES

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ABSTRACT

The purpose of the paper is to underline the constructive particularities that electrical equipment with type of protection flameproof enclosure must exhibit and, in the same time, to highlight the criteria used for their evaluation in order to provide protection to explosion.

KEYWORDS

Keywords: type of protection, flameproof enclosure, firedamp mines.

1. Generalities:

The risk of explosion represents an important aspect when referring to technological installations used for extraction of existing energetic resources (in solid form – coal, liquid form – oil or gaseous form – natural gases), processing, storage or transport of them or of the resulting combustible substances [2].

Equipments that operate in hazardous explosive atmospheres must be subjected to certification procedures, according ATEX Directive 94/9/EC [4] (transposed in Romanian legislation by Government Decision no. 752/2004).

Equipments intended for use in mines susceptible to firedamp - Group I equipments, according ATEX Directive 94/9/EC, are divided in two categories [4]:

- Category M1 - equipment that must continue to operate when a potentially explosive atmosphere is present;
- Category M2 - equipment that does not operate when a potentially explosive atmosphere is present.

If electrical equipment is to be placed in a hazardous explosive area, this shall be designed, manufactured and operated so as not to cause the ignition of the surrounding explosive atmosphere. There are three basic approaches to provide explosion protection to electrical circuits in hazardous location [3]:

- Explosion confinement
- Ignition source isolation
- Energy limitation.

The type of protection represents all specific measures applied to electrical equipment in order to avoid ignition of a surrounding explosive atmosphere in which these equipments are designed to operate [6].

The type of protection flameproof enclosure applies generally to electrical apparatus which in normal operation produces electrical arcs and sparks, and consists in placing the parts that could ignite an explosive atmosphere inside of an enclosure that can withstand the pressure developed during an internal explosion of an explosive mixture and which prevents the explosion transmission to the explosive atmosphere surrounding the enclosure. This type of protection is based on explosion confinement approach [5].

Electrical equipment with type of protection flameproof enclosure has a general use, this beeing used in any place in which gases, vapours or mists can occur and form explosive atmospheres in mixture with air. Thus, a lot of electrical equipment placed in the underground of firedamp mines (electric motors, luminaires, junction boxes, push buttons, electric pannels etc.) are made with type of protection flameproof enclosure.

2. Safety parameters of electrical equipments with type of protection flameproof enclosure "d"

The potentially explosive atmosphere, generated by flammable substances in the technological process, is capable of entering inside of the equipment enclosure, where it can be ignited and generating an explosion. Preventing the transmission of an internal explosion to the external explosive atmosphere that surrounds the enclosure is due to the fact that all the external connections of the enclosure are made in a special form of joints and calibrated gaps [3].

These gaps have the property of cooling the flame and products resulted from an internal ignition, due to heat absorption (by the materials of the flanges) and adiabatic expansion. The cooled burned gases and particles made and heated in the explosion, at their exit from the enclosure, are not capable of igniting the explosive mixture from the surrounding atmosphere [3].

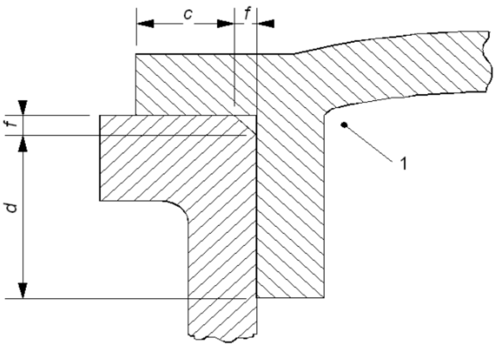
The specific elements that ensure the protection to explosion for flameproof "d" equipment are represented by flameproof joints. A flameproof joint represents the place where the corresponding surfaces of two parts of an enclosure, or the conjunction of enclosures, come together, and which prevents the transmission of an internal explosion to the explosive atmosphere surrounding the enclosure [5].

There are three types of flameproof joints: non-treaded (flanged, cylindrical, spigot), threaded (cylindrical threaded joints and taper threaded joints) and special joints (cemented joints).

Non-threaded flameproof joints are characterized by two parameters: the width and the gap of the joint.

The width of flameproof joint, L, represents the shortest path through a flameproof joint from the inside to the outside of an enclosure.

The gap of flameproof joint, i, represents the distance between the corresponding surfaces of a flameproof joint when the electrical apparatus enclosure has been assembled. For cylindrical surfaces, forming cylindrical joints, the gap is the difference between the diameters of the bore and the cylindrical component [5].



Key:
c – width of the plane part;
d – width of the cylindrical part;
f - faze

Fig.1 Spigot joint

Flameproof enclosures and all supporting elements are subjected to mechanical calculus, taking into account the maximum pressure of the explosion that occurs inside the enclosure [3].

When designing flameproof enclosures a series of factors shall be considered, like:

- explosion group of the gas for which the equipment was designed – influencing the dimensions of flameproof joints and over the thickness of enclosure walls;
- ignition temperature of the gas for which the equipment was designed - influencing the size dimensions of enclosure that has to ensure dissipation, in the surrounding environment, of the thermal energy generated inside the enclosure in order to limit the external temperatures;
- the apparatus mounted inside the enclosure - influencing the enclosure dimensions, construction and assembling of covers to the enclosure, distribution of pressures following an internal explosion etc.

Explosionproof electrical apparatus, with the type of protection flameproof enclosure „d”, intended for use in the underground mines susceptible to firedamp are included in Group I of electrical equipment (according [4]and [6]).

For electrical equipment of Group I, the maximum surface temperature shall not exceed [6]:

- 150 °C on any surface where coal dust can form a layer,
- 450 °C where coal dust is not likely to form a layer (i.e., inside of a dust protected enclosure).

3. Testing of electrical equipments with type of protection flameproof enclosure "d"

For certification of electrical apparatus with the type of protection flameproof enclosure, this is subjected to type and routine tests [1].

In the routine tests category is included the overpressure routine test (that has to be performed by the manufacturer), which has the purpose of verifying enclosure resistance to pressure and that the enclosure does not contain holes or cracks connecting to the outside of the enclosure.

In the type tests category are included, beside other tests, the tests in explosive mixtures which are in fact the most important tests in order to verify the safety characteristics of this type of protection [1]. There are three kinds of tests in explosive mixtures that have to be performed:

A) Determination of explosion pressure

The reference pressure is the highest value of the maximum smoothed pressure, relative to atmospheric pressure, observed during these tests.

Each test consists of igniting an explosive mixture inside the enclosure and measuring the pressure developed by the explosion.

For Group I electrical equipment three tests shall be performed with (9,8 ± 0,5) % methane, in volumetric ratio with air and at atmospheric pressure [5]. This explosive mixture is considered to give the highest explosion pressures when ignited.

B) Overpressure test

For Group I electrical equipment the test shall be made using either of the following methods, which are considered as equivalent [5].

a) Overpressure test – First method (static)

For group I electrical equipment, the relative pressure applied shall be:

- 1,5 times the reference pressure, with a minimum of 3,5 bar, or
- 4 times the reference pressure for enclosures not subject to routine overpressure testing, or
- 10 bar, when reference pressure determination has been impracticable.

The period of application of the pressure shall be at least 10 s and the test is made once.

b) Overpressure test – Second method (dynamic)

The dynamic tests shall be carried out in such a way that the maximum pressure to which the enclosure is subjected is 1,5 times the reference pressure, but with a minimum of 3,5 bar.

When the test is carried out with mixtures specified for the determination of the reference pressure, these may be precompressed to produce an explosion pressure of 1,5 times the reference pressure. The test shall be made once for electrical apparatus of Group I.

C) Test for non-transmission of an internal ignition [5]

C.1 Preparation of test samples

Gaskets shall be removed and the enclosure is placed in a test chamber. The same explosive mixture is introduced into the enclosure and the test chamber, at atmospheric pressure.

The flamepath lengths (engagement) of threaded joints of the test specimen(s) shall be reduced (as presented in Table 1).

Flanged gaps of spigot joints, where the width of the joint L consists only of a cylindrical part shall be enlarged to values of 1 mm for Group I.

Table 1 – Reduction in length of a threaded joint for non-transmission test

Type of threaded joint	**Reduction in length**
Cylindrical, complying with ISO 965, fit medium or better	No reduction
Cylindrical, with larger tolerances than permitted above	1/3
Taper thread (NPT)	No reduction

C.2 Gas mixtures used for the test

The gaps i_E of the enclosure shall be at least equal to 90 % of the maximum constructional gaps i_C as specified in the manufacturer's drawings ($0{,}9\ i_C \le i_E \le i_C$).

For electrical apparatus of Group I, the explosive mixture to be used, in volumetric ratio with air and at atmospheric pressure, is (12,5 ± 0,5) % methane-hydrogen [(58 ± 1) % methane and (42 ± 1) % hydrogen].

In case the gaps of a test specimen do not fulfill the above condition, one of the following methods may be used for the type test for non-transmission of an internal ignition:

- a gas/air mixture with a smaller MESG value:

i_E / i_C	**Mixture**
≥0,75	55 ± 0,5 % H2
≥0,6	50 ± 0,5% H2

- precompression of the normal test mixtures according to the following formula:

$$P_k = \frac{i_C}{i_E} \times 0{,}9$$ (1) where Pk is the precompression factor.

With the help of equation (1), the pressure of the explosive mixture could be calculated for different values of i_E/i_C ratio. The same equation is applied for equipment of group IIA and IIB. The diagram in Figure 2 [1] presents the influence of i_E/i_C ratio over the testing mixture in case of Group I, IIA and IIB equipment and also a comparison to the influence of i_E/i_C ratio over the testing mixture in case of Group IIC equipment (where $P_k = i_C/i_E \times 1{,}35$).

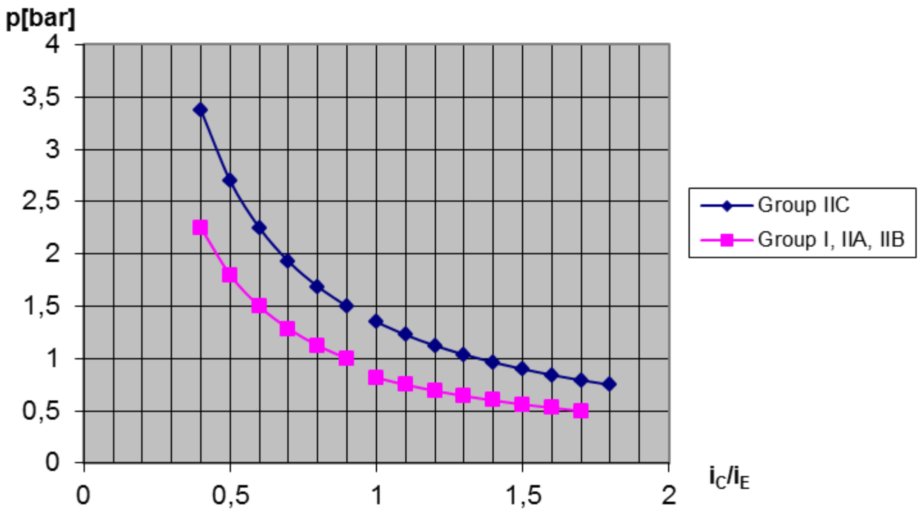


Fig.2 Influence of i_E/i_C ratio over the testing mixture pressure

From the diagram it observes that for small values of the testing gap relative to the constructive gap, high values of the testing mixture pressure are obtained; and for the testing gap values smaller than those of the constructive gap, smaller values of the explosive mixture pressure are obtained, possible smaller even than the atmospheric pressure. Because of this reason, in case of testing gap value higher than the constructive gap value, the non-transmission of an internal ignition test for a group I equipment will be done at the atmospheric pressure.

For apparatus with flamepaths, other than threaded joints, and intended for use at an ambient temperature above 60 °C, the non-transmission tests shall be conducted under one of the following conditions [5]:

- at a temperature not less than the specified maximum ambient temperature;

- at normal ambient temperature using the defined test mixture at increased pressure according to the factors in Table 2;
- at normal atmospheric pressure and temperature, but with the test gap iE increased by the factors noted in Table 2.

Table 2 – Test factors to increase pressure or test gap (i_E)

Temperature up to (°C)	60	70	80	90	100	110	120	125
Test factors (12,5 % CH_4/H_2)	1,00	1,06	1,07	1,08	1,09	1,10	1,11	1,12

During the tests in explosive mixtures it was observed that, when the enclosure of the equipment has the internal free volume in the form of a mono volume regular geometric shape (cylinder, parallelepiped, cube, sphere), the pressure curve resulted after the test for determination of explosion (reference) pressure has a pattern like the one presented in fig. 3.

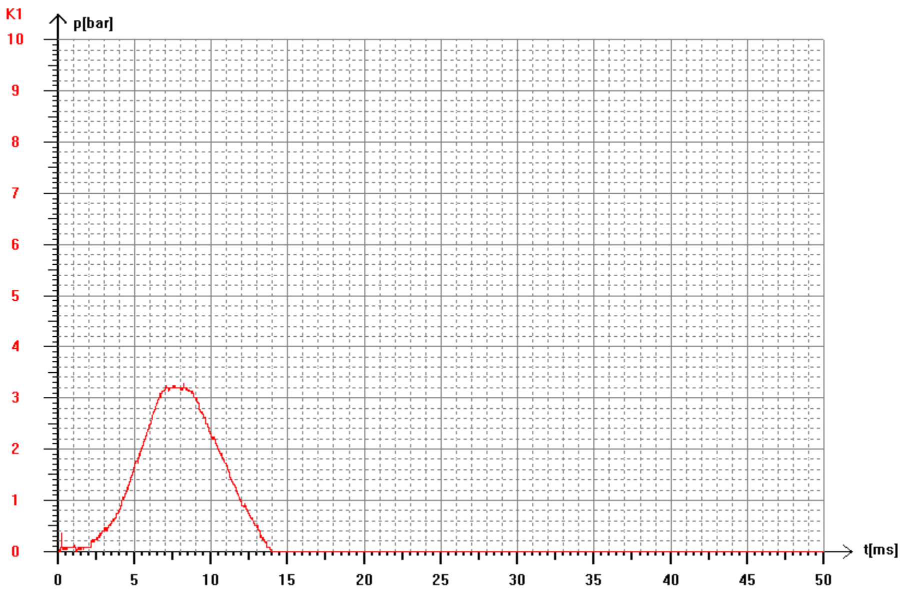


Figure 3. Example of pressure diagram resulted from testing of group I flameproof enclosures having a regular geometric shape

Also, in case of equipments with the internal free volume in the form of a regular geometric shape, when performing the overpressure test, with an air-gas mixture at 1,5 bar, the pattern of the pressure curve remains the same as in case of reference pressure determination, and the maximum pressure is approximately 1,5 times higher than in case of reference pressure determination.

When testing equipments with enclosures having the internal free volume divided in two or more compartments that communicate between them through small orifices (for example the enclosure of an electric motor) the pattern of the pressure curve resulted after the test for determination of explosion (reference) pressure is like the one presented in fig. 4. In this case the pressure pilling phenomena (which represents the results of an ignition, in a compartment or subdivision of an enclosure, of a precompressed gas mixture, for example, due to a primary ignition in another compartment or subdivision) occurs, resulting in higher values of the pressure than in case of non-compartmented enclosures.

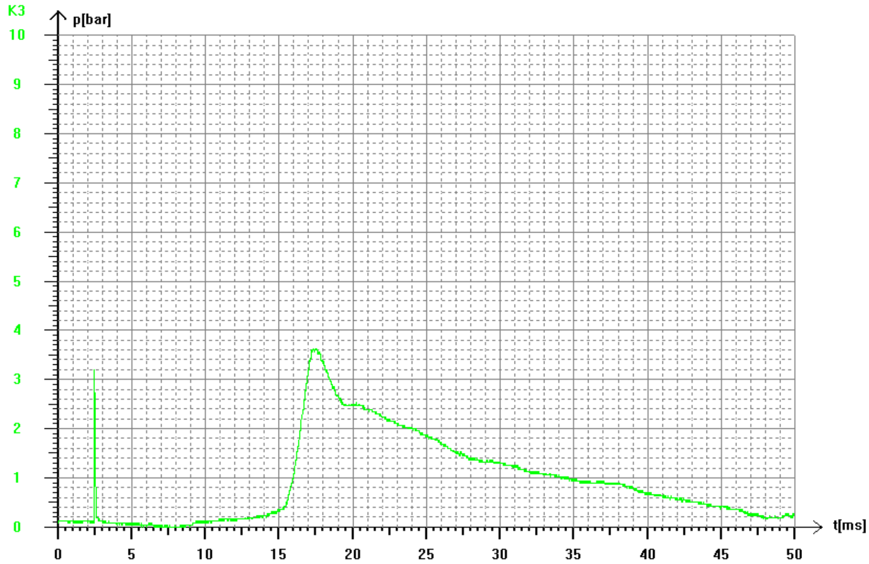


Figure 4. Example of pressure diagram resulted from testing the main compartment of a Group I electric motor

4. Conclusions:

This paper revealed the constructive particularities and safety characteristics of equipments with type of protection flameproof enclosure "d" designed for use in the underground mines susceptible to firedamp.

The specific methodology for performing the tests in explosive mixtures (which are in fact the most important tests) of Group I electrical equipment was also underlined.

It was analyzed the influence of the gap over the precompression factor of the explosive mixture for the non-transmission of an internal ignition test.

The pressure pilling phenomena was considered. It is not recommended that the pressure pilling to occur when testing the enclosures in explosive mixture because of the high stresses to which the enclosure is subjected during the tests, higher than in normal conditions (without the precompression of the gas). From this point of view, it is a recommendation for the manufacturers to find the best designing solutions for the flameproof enclosure equipments in order to prevent, as much as possible, the occurrence of pressure pilling when running the tests in explosive mixtures.

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INVESTIGATION OF AIR HUMIDITY INFLUENCE OVER THE IGNITION SENSITIVITY OF GASEOUS EXPLOSIVE ATMOSPHERES FROM THE UNDERGROUND OF FIREDAMP MINES

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ABSTRACT

This paper presents an investigation by statistical analysis of the influence of humidity on the ignition sensitivity of explosive gas atmospheres in the underground of firedamp mines from the low current equipment and installations.

The first part briefly describes the test rig used and the results obtained from experimentation.

Because of the stochastic behavior of the results there were used statistical methods of analysis.

The second part presents statistical analysis of experimental results obtained from tests with explosive mixture of air-methane.

The third part presents the resulted theoretical model.

KEYWORDS

firedamp mines, explosive atmospheres, sensitivity to ignition, humidity.

Introduction

The process of coal mining by using underground mine works is constantly accompanied by the risk of explosion due to the presence of methane and coal dust, released into the atmosphere from underground during the extraction of coal.

Considering the classifications of explosive atmospheres one can say that the atmosphere in the underground of firedamp mines has the highest ignition threshold, whether it takes into account the electrical criteria (260 μJ) or the thermal criteria (450 $^{\circ}$C).

Experimental study of the probability of ignition [4] revealed an approximately exponential dependence [2] of the probability of ignition depending on voltage, in capacitive circuits. Other mentions [5] presents an exponential dependence of the ignition probability depending on the logarithm of the current value, in inductive circuits.

Another concurrent factor influencing the sensitivity to ignition of underground atmospheres, characterized by the presence of methane, is its humidity content.

On the other hand, the phenomenon of explosion propagation in areas characterized mainly by one-dimensional development involves pre-compression phenomena and increase the speed of propagation of the explosion wavefront and leads to events of very high gravity that includes both casualties and material losses.

Additionally, an explosion causes in the underground damage to ventilation system that has cascading consequences in terms of reducing the capacity of exhausting the methane emissions and also decreasing the capacity of providing the required oxygen level to the workers caught in the associated underground mine works [1].

Experimental study of the dependence of ignition sensitivity of methane explosive atmospheres against humidity showed a slight linear relationship to the logarithm of the number of rotations at which the ignition of the test mixture has occurred [3].

Brief presentation of experimental data

Experimentation was carried out using the test infrastructure for ignition by spark (spark test apparatus). A chamber, that contains a transducer, has been additionally connected at the air intake for measuring environmental parameters including humidity.

An 8,3% air-methane test mixture was used and having the relative humidity of the air at the intake between 11 ÷ 38% RH.

The electric parameters of the circuit in which the spark test apparatus has been connected were U_o=24Vcc, L=121mH, I_o=110÷111mA.

During the performance of the test the inlet air humidity varied according to the diagram in Figure 1 and the value of the number of rotations at which the ignition occurred is shown in the diagram in Figure 2.

The procedure for conducting the experiments included successively:

- conditioning of spark test apparatus according to B.1.3 in [5] at the beginning of the test series then
- cycles of 15 tests conducted as follows:
    - purging with air of the transducer chamber for a period of between 4 to 10 minutes;
    - purging the chamber of the spark test apparatus and related gas ducts with 10 volumes of mixture;
    - starting the spark test apparatus with specified electrical parameters;

- recording the number of revolutions to which the ignition has occurred;
- reading the indicated value for the intake air humidity and recording, in an identical manner, for all the tests in the cycle. The reason is to allocate the time needed to stabilize the humidity value indication of the device.

For the first 140 tests the time needed to stabilize the instrument indication wasn't booked, that is the reason why these were dropped-out (on the left of the line) - see Figure 1.

Although the conditioning of the cadmium disk was performed, on the first 60 tests an anomaly was found in the distribution of the number of rotations values at which the ignition had occurred. See Figure 2.

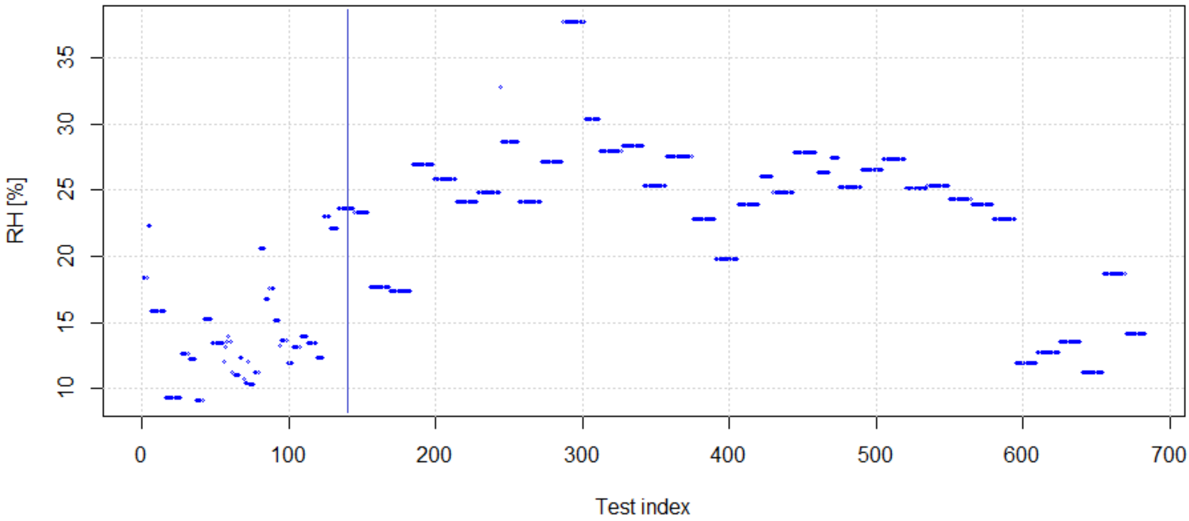

Figure 1. Variation of the intake air humidity

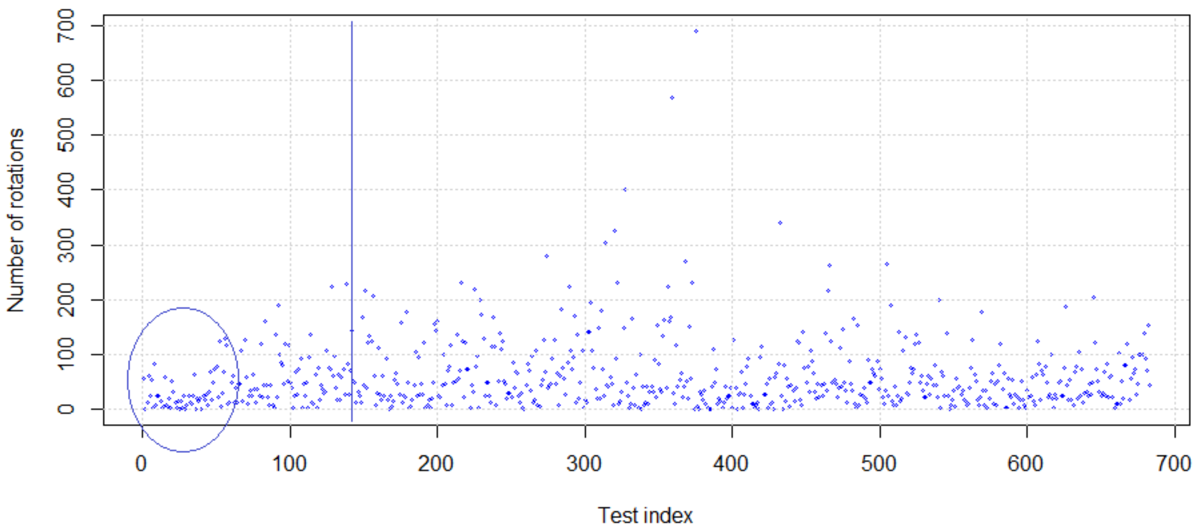

Figure 2. The number of rotations at which the ignition occurred

Distribution of values of the air relative humidity at the inlet and of the number of rotations at which the ignition has occurred is shown in the diagrams in Figures 3 and 4.

After removing the first 140 tests from the initial set of experimental data the density distribution diagram was built - Figure 5.

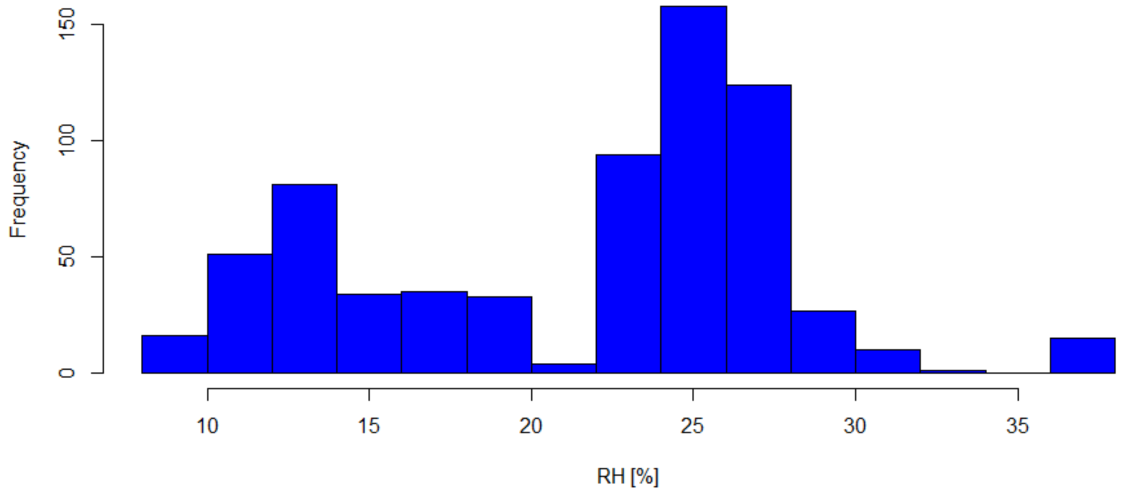

Figure 3. The histogram of values of air relative humidity at intake

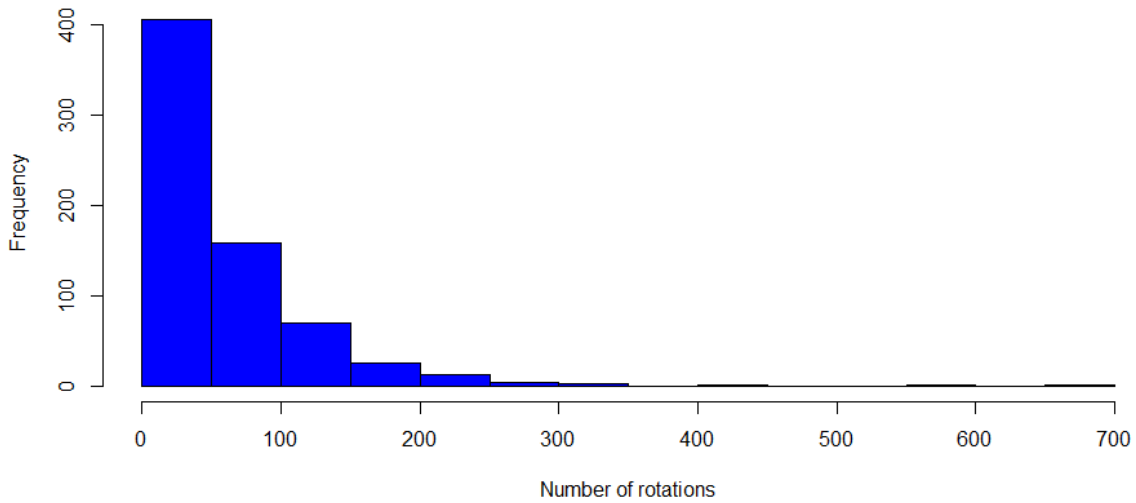

Figure 4. The histogram of the number of rotations at which the ignition has occurred

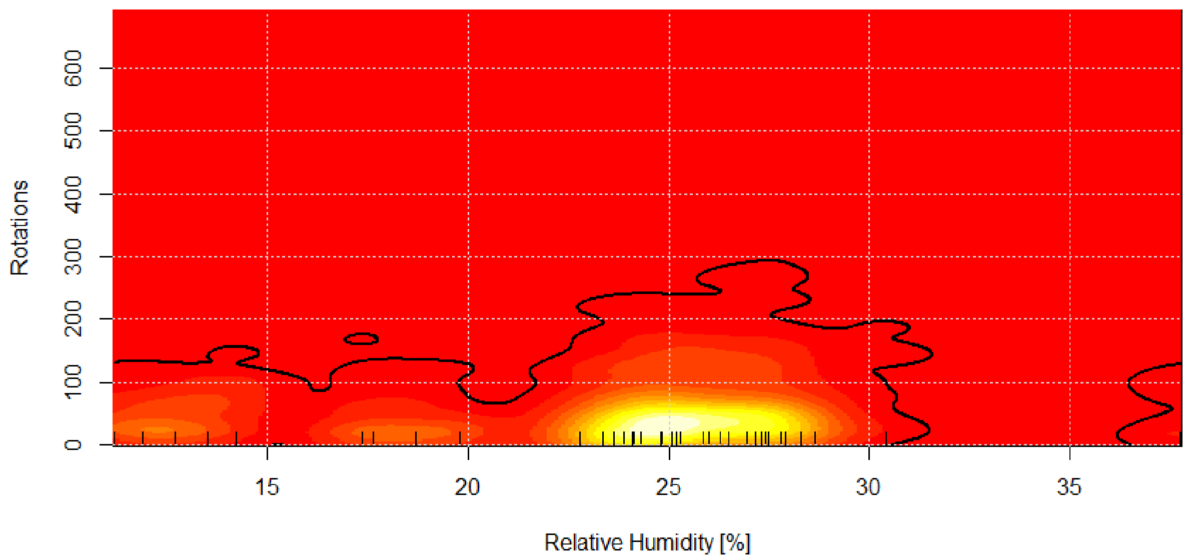

Figure 5. Distribution of density for the number of rotations at which the ignition occured and relative humidity of air at intake

Preliminary statistic test

The set of results was divided in two series, one with the air relative humidity at intake smaller than 21 % RH and the other with higher relative humidities.

Application of the statistical test for the two series showed application of Student test for the two series showed that the difference between the arithmetic mean of rotations for the two sets is statistically significant - is between 5.75 ÷ 26.40 (means 50.16729 and 66.24389 rotations) with a confidence level of 95%.

Theoretical model of transformation

In order to highlight the influence of the air relative humidity at the intake on the ignition sensitivity for normalization of rotation values at which the ignition has occurred, the function in equation (1) was proposed, based on the combination of logarithm function with the CoxBox transformation.

$$T(x,\lambda) = \frac{(ln(x))^{\lambda}-1}{\lambda} \quad (1)$$

In equation (1) the λ parameter is a coefficient and its value is determined by an optimization process that reduces the value of the objective function proposed in equation (2).

$$F(X,\lambda) = \left(skewness\left(T(X,\lambda)\right)\right)^{4} + \left(3 - kurtosis\left(T(X,\lambda)\right)\right)^{2} \quad (2)$$

In equation (2) X represents the vector of rotations values at which the ignition has occurred and λ represents the argument of the optimization function.

Following the application of the optimization process a value of 1.303125 for λ has resulted.

Then the function defined in equation (1) applied on the rotation vector values to which the ignition has occurred.

The histogram of the converted values of rotations at which the ignition has occurred together with the empirical density distribution curve and the theoretical density curve (Gauss) are shown in the diagram in Figure (6).

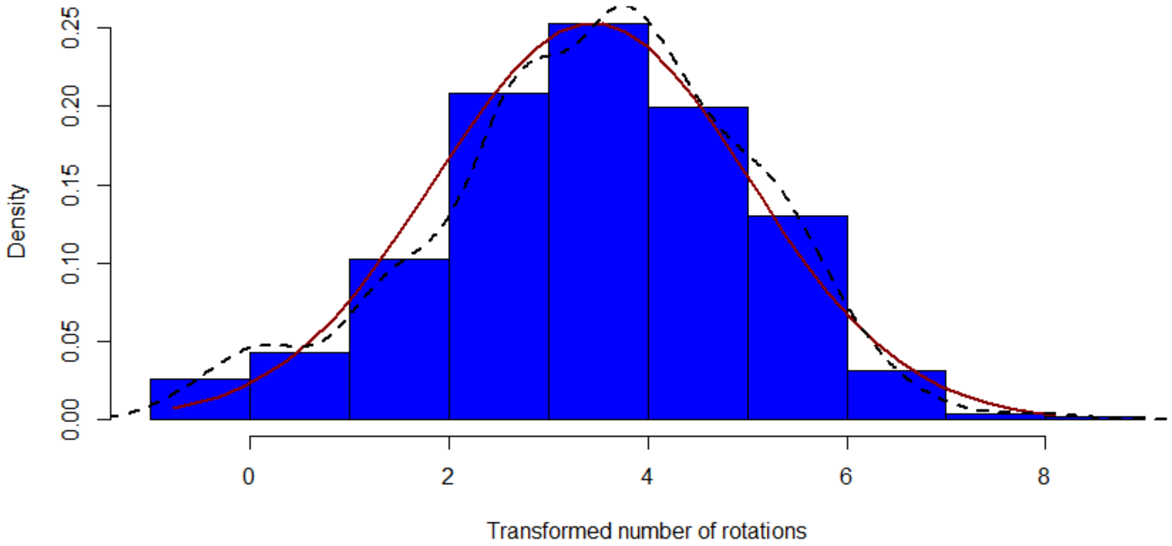

Figure 6. The histogram of converted values of rotations at which the ignition has occurred

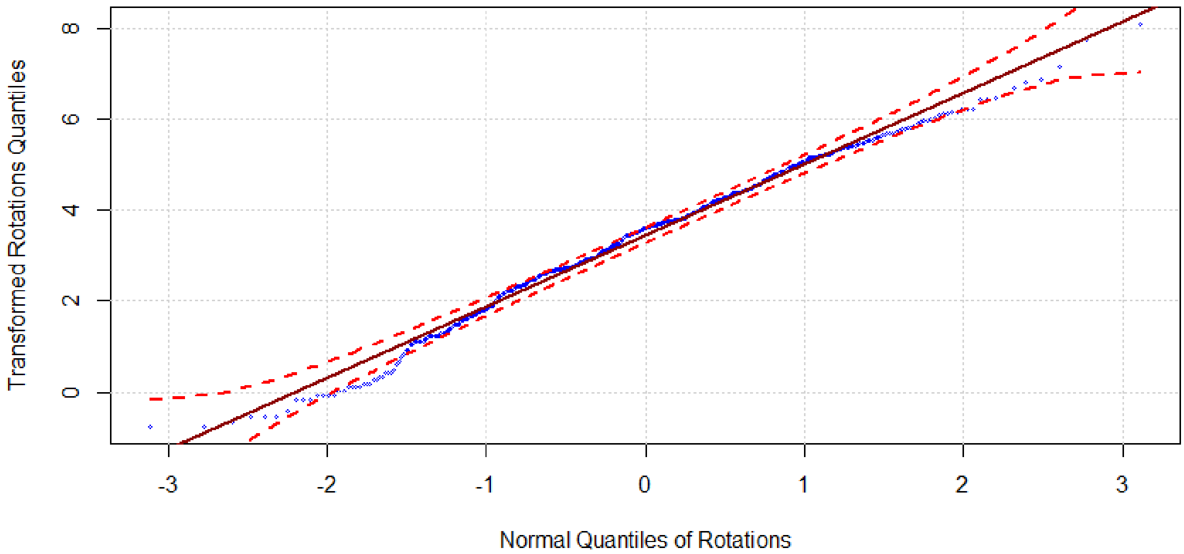

Figure 7. QQ diagram of values for rotations transformation to normal distribution (Gauss)

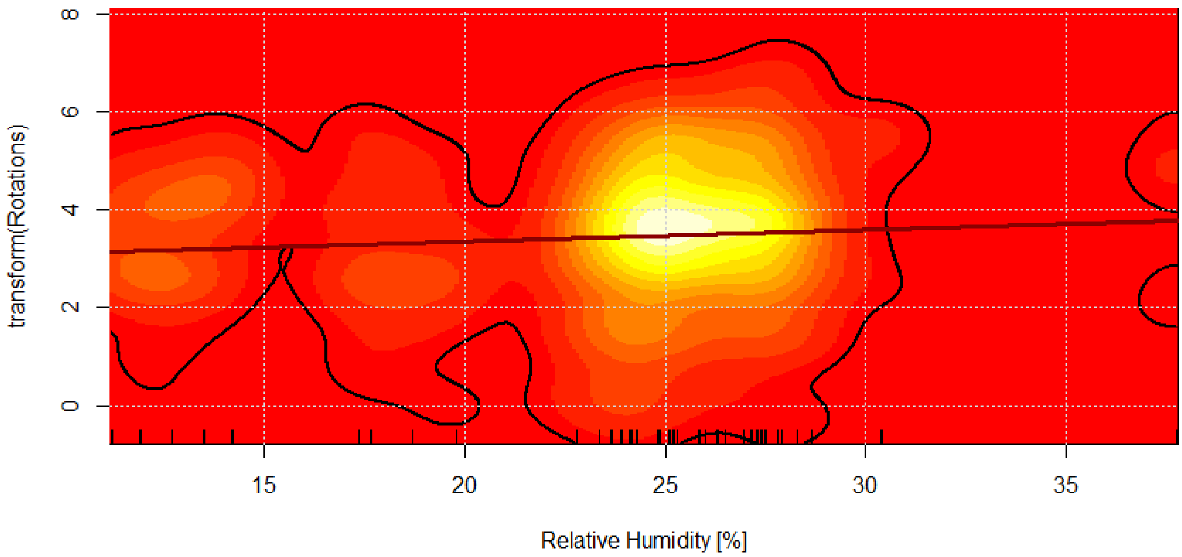

Figure 7. Distribution density of the transformation of the rotations number at which the ignition has occurred and the relative humidity of the air at the inlet

On the density diagram of experimental points the transformation of rotation versus the relative humidity of air at intake the regression line was drawn whose slope is observed that is slightly positive.

Application of Student statistical test for the slope value of the diagram of rotation transformation depending on the air relative humidity at intake revealed that its value is in the range 0.0004697686 ÷ 0.04825771 with a confidence level of 95%. Also, the probability for the slope to be zero or negative is 0.6%.

Further, boostraping has been applied for the regression slope value of random subsets of values and distribution of slope values is shown in the diagram in Figure 8.

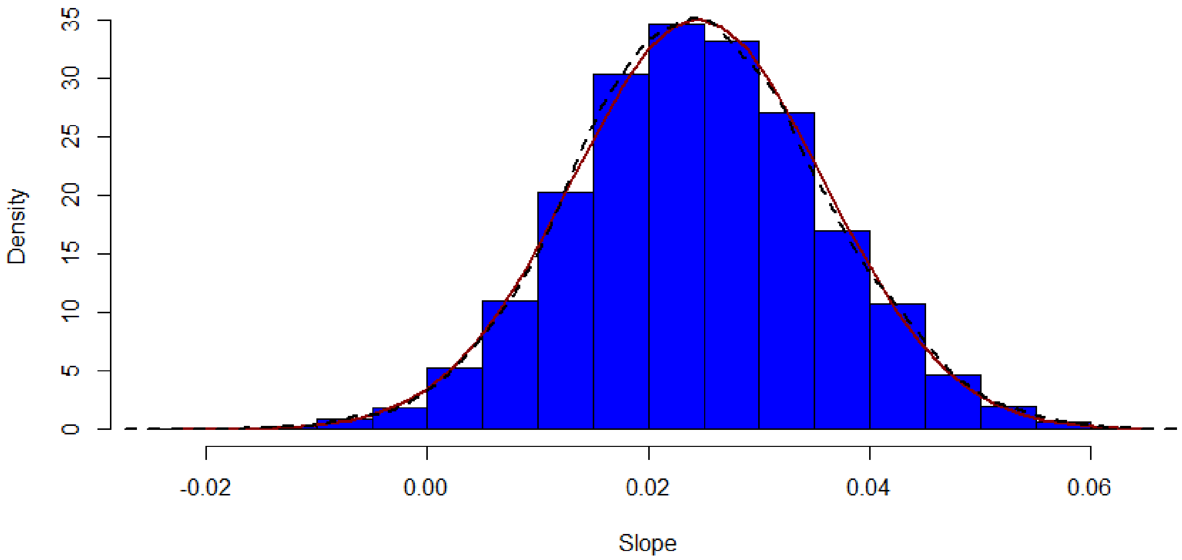

Figure 8. Histogram of regression line slope values

CONCLUSIONS

1) Preliminary analysis of data resulting from experiments showed that there is a statistically significant difference between arithmetic mean of the number of rotations at which the ignition occurred for relative humidities of air at intake below 21% and those over 21%.
2) Due to the asymmetric shape of the distribution of rotation values at which the ignition of the test mixture occurred, the use of a transformation based on a combined logarithm function and Box-Cox was proposed.
3) In order to determine the λ parameter of the chosen transformation an objective function was proposed and used, which aims to reduce both asymmetry and excess kurtosis.
4) For the data set obtained after applying the transformation the regression line was determined and its slope was analyzed.
5) Following statistical analysis of the slope of the regression line resulted that this has values greater than zero, with a probability of 99.4%.
6) Due to the large dispersion of values for the number of rotations at which the ignition has occurred, this paper failed to identify a dependency relationship to ignition sensitivity, but only established that the relative inlet air humidity significantly influences the sensitivity to ignition of 8.3% air + methane mixtures.

ACKNOWLEDGMENTS

This paper represents a summary of the researches regarding the determination of the humidity influence of the air used in the test mixtures of 8.3% air + methane on the ignition sensitivity. Preliminary tests and statistical analysis were performed in the national project "Study of the test mixture humidity influence over the sensitivity of the spark test apparatus" National Research Program no.45N / 31.01.2007-2015.

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IGNITION TIME IN COMPUTATIONAL SIMULATIONS OF METHANE-AIR EXPLOSIONS

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ABSTRACT

This paper treats the first step of the methane-air combustion reactions, by computational modelling of the preheating phenomena of the reaction compounds from the proximity of the spark location. By means of the CFD tools provided by ANSYS FLUENT, the computational simulations aimed to develop an ignition model of the air-methane mixture with incorporated chemical kinetics, respectively the oxidation mechanism of the species produced during the oxidation process of methane in presence of the oxygen. An optimized combustion mechanism GRI-Mech 3.0 was used, mechanism with 53 species and 325 reactions, reduced to the import capacity of FLUENT application. As final result, the time between the spark activation and fast development of the combustion was monitored. These times are known as ignition time, induction time or preheat time. Afterwards, the ignition time was verified by comparison with physical experiments and results from the specialized literature.

KEYWORDS

ignition time, methane combustion, methane explosion, methane reactions

1 INTRODUCTION

Combustible mixtures may be ignited by electrical spark, by adiabatic compression, by heating up to the ignition temperature, by chemical reaction which can generate local high temperatures, by detonating substances, by contact with hot surfaces, by compression waves, by catalytic surfaces etc.

Between the local heating of the combustible mixture up to the temperature required for ignition and the beginning of the combustion passes a certain time period, namely the ignition time. This time is considered to represent the period required for forming a concentration fo radicals, enough for supporting a flame or for the propagation of an explosion [1].

Although the explosion may be seen as a singular event due to its extremely fast development, the phenomenon may be divided into several actions which take place each time and which have their own rules. The chained reactions which characterise an explosion type phenomenon may be defined by three phases:

- Initiation, during which are formed atoms or free radicals through the action of initiators, of light or temperature;
- Propagation, phase in which are formed products, as well as new atoms or free radicals which can generate other propagation reactions;
- Interruption, defined by reactions in which atoms or free radicals disappear, after the consumption of reactants.

The initiation and interruption phases take place only once or few times during the process, while propagation reactions take place repeatedly until the consumption of reactant elements.

In time, concerns for explaining the combustion phenomenon lead to the development of mechanisms which to comprise oxidation reactions and the reduction of these mechanisms down to the smallest possible number of reactions, in order to ease the calculation process (i.e. Jones and Linstedt with a 4 step mechanism for methane oxidation).

One of the mechanisms which is frequently used nowadays for the computational modelling of methane gas combustion is GRI-Mech 3.0, comprising 325 chemical reactions and 53 species [2]. GRI-Mech 3.0 is provided by the Combustion Laboratory at the University of California at Berkeley, Stanford University, The University of Texas at Austin, and SRI International.

2 REDUCING THE METHANE'S OXIDATION MECHANISM

It is useful to know that CFD tools are large consumers of hardware resources. Therefore, the entire community which uses such applications tries to find manners for simplifying the models, from the geometry up to the methods for reproducing fluid flow, for impact analysis etc., without influencing the final results.

This simplification is desired especially when integrating chemistry in virtual simulations, because every chemical species added leads to an increase of the mechanism's number of reactions.

Taking into account that each species participates in the simulation with 14 NASA polynomial coefficients only for defining specific heat, enthalpy and entropy, and each reaction holds three terms required for the Arrhenius equations used for calculating the reaction rate coefficient, besides the other properties of the species and equations which define chemical and thermodynamic mixing laws, the concerns for simplifying the computational chemical mechanisms fully justify their importance.

In this regard, for reducing the GRI-Mech 3.0 mechanism there has been used in this work Chemked, an application intended for thermodynamic data and chemical kinetics processing in order to solve complex issues of gaseous phases.

The thermodynamic databases and chemical reaction can be generated by the application in Chemkin format, a text file format and used as input data in Chemkin type subroutines or other applications [3].

Based on the GRI-Mech 3.0 mechanism graph (Figure 1 [2]) there could be established the fact that for a 0.0001 seconds value of air-methane ignition time corresponds a temperature of 1712 K ($10^4/T = 5.84$), this representing the first input data for the present case.

Starting from this, the GRI-Mech mechanism has been imported into Chemked, with 53 species and 325 reactions, for the conditions of 2.04 atm. pressure, 1712 K temperature and $\varphi = 1$, where φ is the equivalence ratio.

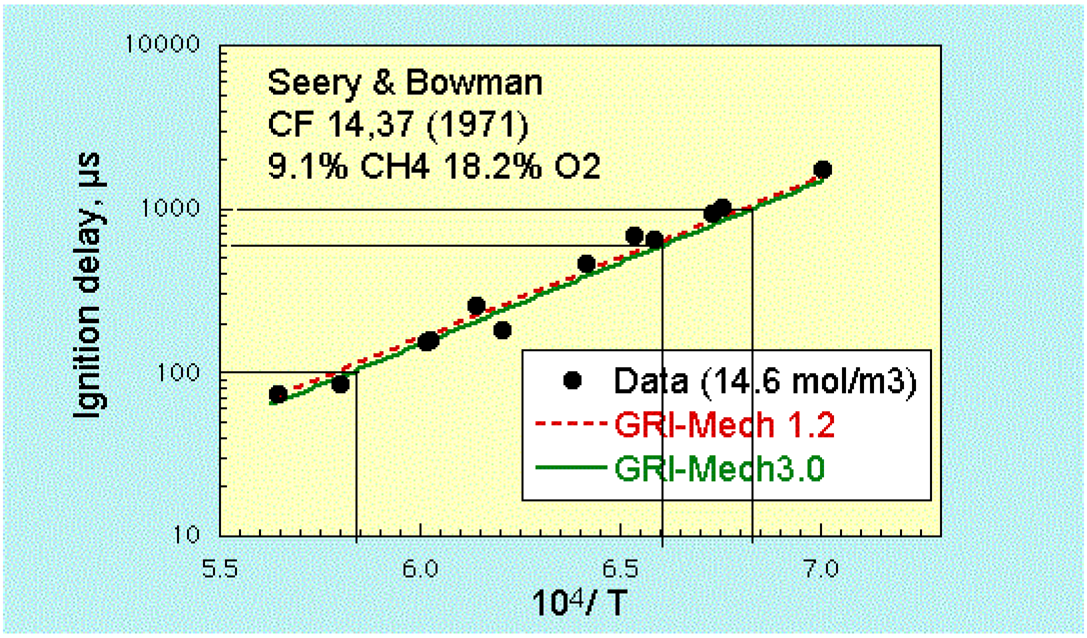

Figure 1: Ignition time for GRI-Mech 3.0 mechanism

Based on these values and on the thermodynamic database of GRI-Mech mechanism, the evolution of temperature in time has been drawn up using the Chemked solver.

Benefiting of the same thermodynamic database but by removing the argon – which does not participate in methane oxidation – there has been developed a mechanism consisting of 42 reactions.

As in the case of the 325 reactions mechanisms, for the 42 reactions mechanisms has been drawn up the temperature curve in time, in the same conditions for pressure (2.04 atm), temperature (1712 K) and with the same equivalence ratio φ = 1. By comparison with the GRI-Mech mechanism, Figure 2 a and b presented the two graphs for the temperature evolution.

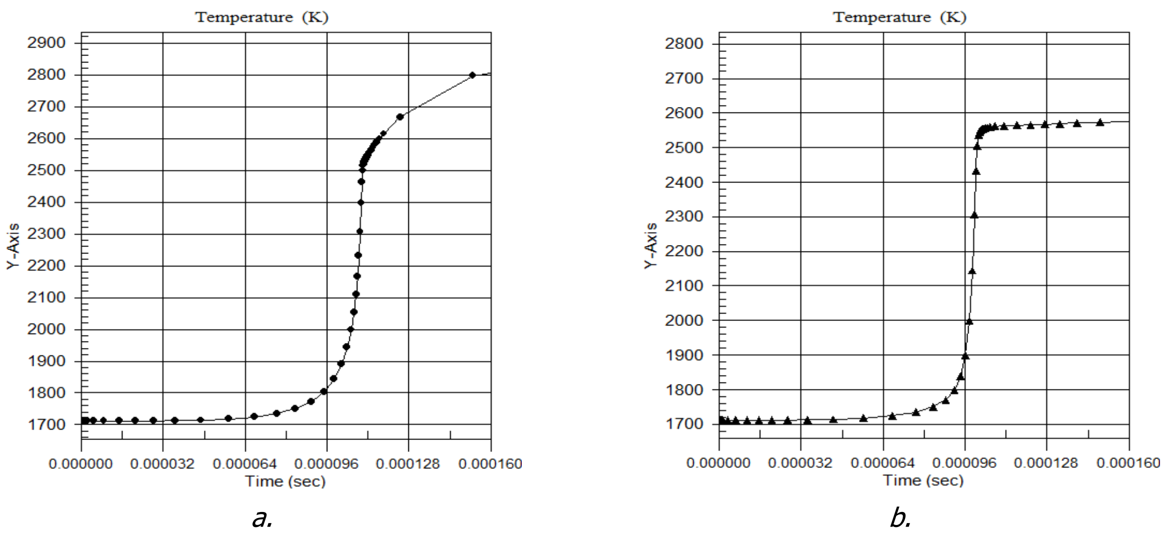

Figure 2: Temperature evolution related to GRI-Mech 3.0 (a) and to the 42 reactions mechanisms (b)

It may be noticed that the difference between the two ignition periods is in the order of 10^{-6}, an irregularity which may be assumed considering the major reduction of the original mechanisms, from 325 reactions to only 42 reactions, thus leading to the significant decrease of a virtual model's processing time. The 42 reactions representing the reduced mechanism are presented in Table 1.

Table 1: Reactions comprised by the reduced mechanism

1.	$O + CH_4 <=> OH + CH_3$
2.	$O_2 + CO <=> O + CO_2$
3.	$O_2 + CH_2O <=> HO_2 + HCO$
4.	$H + O_2 + N_2 <=> HO_2 + N_2$
5.	$H + O_2 <=> O + OH$
6.	$H + CH_3 (+M) <=> CH_4 (+M)$
7.	$H + CH_4 <=> CH_3 + H_2$
8.	$H + CH_2O (+M) <=> CH_3O (+M)$
9.	$H + CH_2O <=> HCO + H_2$
10.	$OH + OH (+M) <=> H_2O_2 (+M)$
11.	$OH + CH_3 <=> CH_2(S) + H_2O$
12.	$OH + CH_4 <=> CH_3 + H_2O$
13.	$OH + CO <=> H + CO_2$
14.	$OH + CH_2O <=> HCO + H_2O$
15.	$OH + C_2H_6 <=> C_2H_5 + H_2O$
16.	$HO_2 + CH_3 <=> O_2 + CH_4$
17.	$HO_2 + CH_3 <=> OH + CH_3O$
18.	$HO_2 + CO <=> OH + CO_2$
19.	$HO_2 + CH_2O <=> HCO + H_2O_2$
20.	$CH_2 + O_2 <=> OH + H + CO$
21.	$CH_2 + CH_4 <=> CH_3 + CH_3$
22.	$CH_2(S) + N_2 <=> CH_2 + N_2$
23.	$CH_2(S) + O2 <=> H + OH + CO$
24.	$CH_3 + O_2 <=> O + CH_3O$
25.	$CH_3 + O_2 <=> OH + CH_2O$
26.	$CH_3 + H_2O_2 <=> HO_2 + CH_4$
27.	$CH_3 + CH_3 (+M) <=> C_2H_6 (+M)$
28.	$CH_3 + CH_2O <=> HCO + CH_4$
29.	$CH_3 + C_2H_6 <=> C_2H_5 + CH_4$
30.	$HCO + O_2 <=> HO_2 + CO$
31.	$CH_3O + O_2 <=> HO_2 + CH_2O$
32.	$C_2H_5 + O_2 <=> HO_2 + C_2H_4$
33.	$N_2O + O <=> N_2 + O_2$
34.	$N_2O + OH <=> N_2 + HO_2$
35.	$N_2O (+M) <=> N_2 + O (+M)$
36.	$NNH <=> N_2 + H$
37.	$NNH + M <=> N_2 + H + M$
38.	$NNH + O_2 <=> HO_2 + N_2$
39.	$NNH + CH_3 <=> CH_4 + N_2$
40.	$O + CH_3 <=> H + H_2 + CO$
41.	$CH_2 + O_2 <=> H + CO_2 + H$
42.	$CH_2 + O_2 <=> O + CH_2O$

3 COMPUTATIONAL SIMULATION OF A METHANE-AIR EXPLOSIVE MIXTURE IGNITION

In order to define the ignition time of the air-methane explosive mixture in case of using the 42 reactions mechanisms into a mathematical model, in ANSYS Fluent has been conducted a 2D computational simulation, based on the primary input data of the two cases described before.

For reasons of the model's simplification (once again simplification), the geometry consists in a rectangle having 50x200 mm, its mesh having 10000 cells and 10251 nodes. The ignition source has been placed on the left side wall, the right side wall being of outlet type. The other sides are defined as wall type.

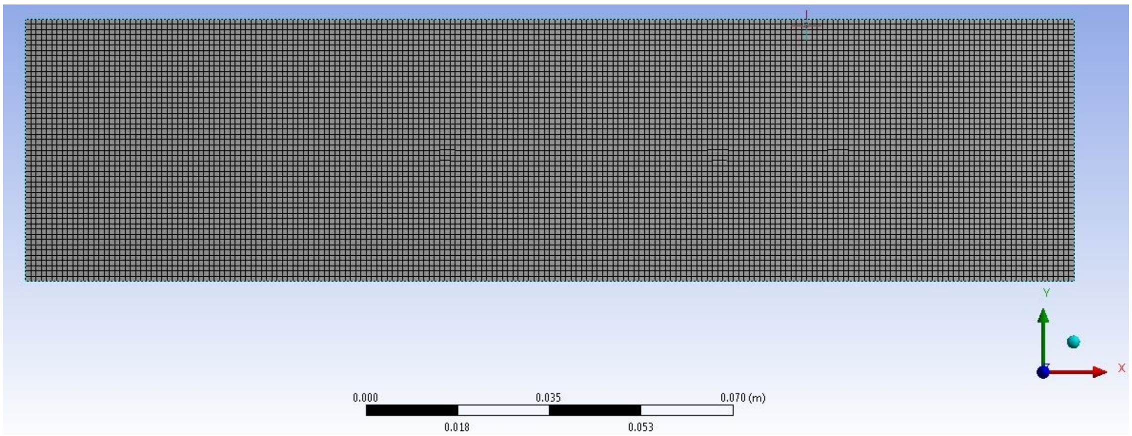

Figure 3: Virtual model geometry mesh

Input data have been the same as the ones used in Chemked, respectively 2.04 atm. pressure, 1712 K temperature and the equivalence ratio φ = 1. There has to be mentioned the fact that there haven't been brought changes on the reaction ration or specific heat, fact which could have been performed by UDF (user defined functions), changing the evolution if temperature in time. Also, the air-methane mixture has been defined as ideal gas, its specific heat calculation being performed using the mixing law. Following the computational simulation, the graph in Figure 4 has been obtained.

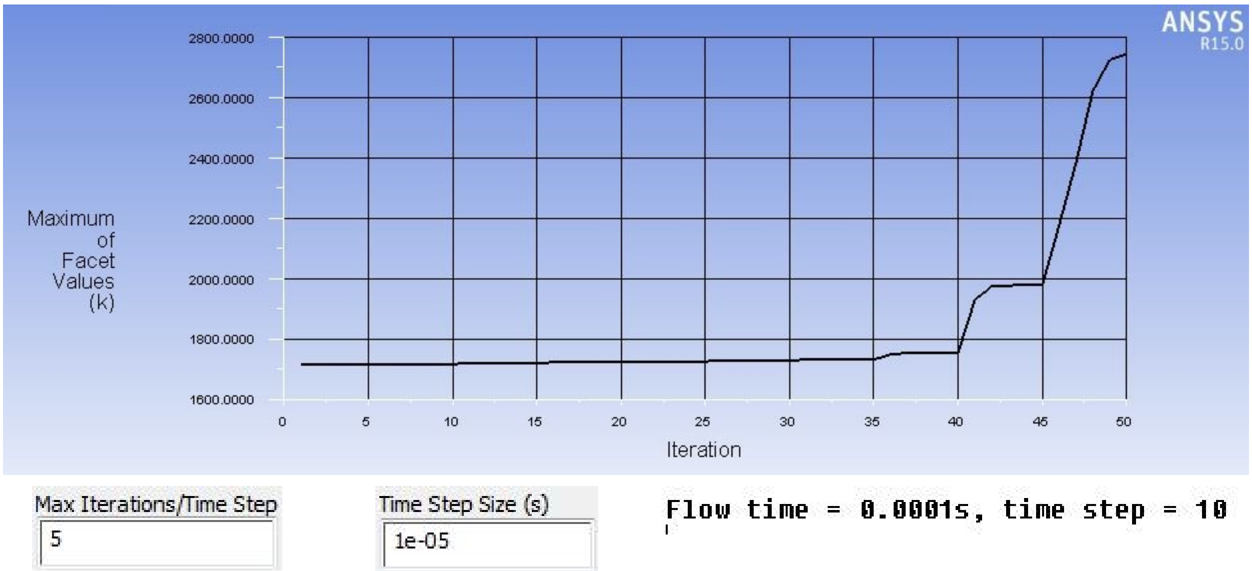

Figure 4: Temperature and time step size increase

From Figure 4 there can be noticed that the temperature's increase ratio starts to increase its value from iteration 40, corresponding to a time of 0.00008 seconds, resulting e deviation of only 0.02 ms from the ignition time of the 325 reactions mechanism.

4 CONCLUSIONS

- Using Chemked for reducing chemical mechanisms of methane oxidation provides results with an extremely low deviation from the original mechanisms, providing at the same time the possibility for exporting in a format compatible with ANSYS Fluent. Although Chemked is an open source application, it proved to be an extremely useful tool for CFD analysts, leading to high-precission results.
- The final error of the ignition time compared to the GRI-Mech 325 reactions mechanisms, after conducting the computational simulation using the 42 reactions mechanism is of the order of 10^{-5}, extremely acceptable for most cases which require a higher precission.
- In the case of the 42 reactions mechanisms, time for performing the simulation was 16.8 seconds, while in case of using the 325 reactions mechanisms this time was of the order of several hours.

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CONSIDERATIONS REGARDING THE CONSEQUENCES OF SPONTANEOUS COMBUSTION ON MINE VENTILATION SYSTEMS

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ABSTRACT

During the last years significant progresses were achieved regarding the diminishment of spontaneous combustion assurance hazard in underground mines. However, several cases of unprepared collieries for this kind of emergency situations are registered, mainly due to the introduction of techniques and equipment which can develop unanticipated mine fires potential risks. New materials in use can generate extremely toxic combustion products. In the present paper, the authors are describing the effects induced by these on mine ventilation systems.

KEYWORDS

Mine ventilation, Spontaneous Combustion, Consequences

1. INTRODUCTION

One of the most threatening hazards for the underground active personnel consists in the so-called Spontaneous Combustions. The fresh air supply is reduced and, consequently, mine workings will be embedded with smoke and noxious gasses, both toxic and explosive. The priority in these issues is related to the extinguishing, emergency and-not at the least-the warning actions, major decisions being adopted in view of minimizing the ignition sources and combustible materials in the affected subsurface area. When a fire occurs, a fast action is essential.

On the other hand, in several mines the working faces are completely isolated and the mounting of classical communication systems is very expensive. The usual warning systems, in use both in Romania and abroad, are using air flows or compressed air networks to transport chemically generated odors. Even if the disadvantages of the above-mentioned systems are well known, especially for low values of air velocities, it is used on a large scale, while other ones are not available and/65 efficient.

In the same time, the systematical control of mine workings in view of detection of mine fires will remain the basic method for determining the ignition location of a mine fire, even if the method claims a sustained effort, particularly in large collieries, where the inspectors are submitted to serious hazards of indication with gasses, smoke and particulate, and often the location of fire cannot be properly assessed because the inspector cannot physically go further in an affected area.

The early detection of a spontaneous combustion can considerably increase the probability of miner's survival and, also, the decrease of the time lapse required to re-entry of personnel after such a technical accident. The detection of a mine fire in early stages facilitates also the evacuation of the workers from the underground, before smoke and noxious gasses can reach dangerous levels or affects the visibility.

2. EFFECTS OF MINE FIRES ON VENTILATION SYSTEMS

The relationship between a mine ventilation network and a spontaneous combustion process can be mainly approached by two ways:

a) Ventilation magnitude and air leakages, which are representing major causes of the self-ignition process;

b) The existence of spontaneous combustions induces consistent alterations in the ventilation system.

The most appropriate conditions for mine fires are generated by alternative increases and decreases of air losses through the goaf or the reversal of their direction. The part of air leakages can be explained by the quantitative changing of heat transferred in the rock massif submitted to fracturing processes. This variation of air leakages corresponds to the start of the self-heating process. The time lapse which separates this stage from the symptoms specific to a fire varies from a few days to several months.

If compared with the total air quantity ventilating a mine, the air having fairly small values, but anyway high enough to dissipate the resulting heat and to avoid the temperature increase until the stage of self-heating.

It is obvious that the major cause of air leakages results from high aerodynamic resistances specific to main return ways from the mine, inducing correspondently high values of pressure losses. Over-dimensioned air flow leads, meanwhile, to pressure loss increases and-implicitly – to increased air losses through the goaf.

The main elements allowing the anticipation of an open fire consists in:

- air moisture content is increasing, perspiration of coal surfaces and presence of mist;
- aromatic hydrocarbons and sulphide dioxide smells;
- air, water and surrounding rock temperature increases.
- combustion products and smoke are appearing.

Open flame fires are inducing an air temperature increase.

The air expansion, as a consequence of the spontaneous heating, acts on the ventilation system by two specific effects, namely;

• the throttling effect, resulting from air expansion in both ways of the airway together with an air quantity diminishment;

• the natural draft effect, caused by heat conversion in mechanical energy, due to air density decrease and heated air capacity increase.

The understanding of both effects improves the possibility of a rigorous design of mine ventilation systems, determining also the adequate selection of mine fire suppression strategy.

2.1 The throttling effect

In view of determining the throttling effect magnitude, we will consider an airway before it will be affected by the mine fire. In this case the air is flowing through the branch with a mass M (Kg/s), achieving a frictional mechanical work F (J/Kg).

The energy loss induced by friction (P), and yielded to the surrounding environment of F and M, namely:

$$P = F \cdot M, (W) \tag{1}$$

The occurrence of a mine fire has as consequence on the friction lass energy (P) a status depending on natural ventilation pressure and alterations induced in the whole ventilation network. If a deliberate action on these parameters it's not carried out, it would be rational to estimate that P can sensitively with the square of air quantity.

Consequently:

$$F = \frac{h}{\rho} = R_t \cdot Q^2, \quad J/kg \tag{2}$$

where:

h – frictional pressure loss, Pa;

ρ - air density, Kg/m3;

R_t – total aerodynamic resistance of the airway induced by turbulence, m^{-4}

Q – average value of air quantify, m^3/s.

Combining the equations (1) and (2), it results:

$$P = F \cdot M = R_t \cdot Q_2 \cdot M$$

or

$$P = R_t \cdot \frac{M^3}{\rho^2}, W \tag{3}$$

considering that:

$$Q = \frac{M}{\rho}$$

Equation (3) can be rewritten as:

$$M = \left(\frac{P}{R_t}\right)^{\frac{1}{2}} \cdot \rho^{\frac{2}{3}} \tag{4}$$

While P and Rt are representing constant values, if follows that;

$$M \; \alpha \; \rho^{2/3} \tag{5}$$

where α means "proportional to"

While the instantaneously presence of ,,heated air + gasses" mixture diminishes the air density, it comes that the fluid mass will decrease for the same energy loss value. This phenomena produces the throttling effect.

Because $M = \rho \cdot Q$, equation (5) can be expressed as:

$$Q \; \alpha \frac{1}{\rho^{\frac{1}{3}}}, \; m^3/s \tag{6}$$

It can be observed from equation (1) that as the fluid mass M increases, the mechanical work required to surpass friction, should increase for every Kilogram of air and, implicitly the air quantity and turbulence should follow the same trend.

The throttling effect can be assumed as an artificial increase of the airway's resistance. For standard air density, the value of this ,,false resistance", R'_t, can be estimated as a function of temperature . From equation (3) it comes that:

$$R_t = P\frac{\rho^2}{M^3}\ ,\quad m^{-4}$$

So, for any fixed (standard) value of air density and constant energy consumption, the value of R'_t can be obtained by the following equation:

$$R'_t\ \alpha\ \frac{1}{M^3}$$

From equation (5) it results that M α $\rho^{2/3}$ (representing the fluid mass diminishment at the considered time), by substitution it will be obtained:

$$R_t^1 \alpha 1/\rho^2$$

For simplification purposes, substituting the density from the law of ideal gases low, it results:

$$\rho\,\alpha\,\frac{1}{T}$$

where:

T – absolute temperature, Kelvin.

and:

$$R'_t\alpha\ \frac{1}{T^2}$$

The value of R'_t is proportional to the square of absolute temperature. This increase can be estimated through the content of carbon dioxide released by combustion.

2.2 The buoyancy natural draft effect The buoyancy natural draft effect

The direct effect exerted by the fire-generated heat an air flows is strictly local. A decreased density determines the elevation and displacement of air and combustion products mixture along the mine working's roof. This leads to generation of a smoke and hot gasses layer along the roof, which in a descending working will turn off in a counter –current against the main direction of airflow, developing problems in the areas located upstream from fire's hotbed.

This roll-back effect is hardly observable in the condition of smoke and mist presence. Anyway, even if high carbon monoxide and other noxious gasses concentrations are registered, they have no time-lasting persistence.

The basic method applied to suppress the roll-back effect is a gradual increase of air quantity in the ventilated mine working. This technique must be very carefully employed, because sometimes it can lead to a higher than acceptable fire spreading velocity.

CONCLUSIONS

Hard coal exploitation in Valea Jiului basin is conducted in difficult mining and geological conditions, causing numerous hazards relating to the health and safety of underground personnel. To the most serious mining hazards belong underground fires and firedamp explosions, which far too many times were the reason of mining catastrophes. However, in spite of many achievements of science and technology in this field, fires and explosions still occur, creating a potential hazard for miners and contributing to the generation of considerable costs of fire-fighting and rescue actions, temporary output suspension or loss of longwalls. As coal gets hotter, oxidation reactions become more efficient meaning more products produced for less oxygen consumed. Detailed observations were carried out, in time, regarding the spontaneous combustions, and lots of data were gathered and interpreted on the subject.

Despite all the improvements achieved in prevention of mine fires, it can be stated that there is not, at the time, available a model dedicated to the quantification of complex interactions between mine fires and underground ventilation systems. New software, allowing computer simulation of the process, will be a valuable tool for all those concerned by mine safety and health.

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USE OF CIVIL EXPLOSIVES IN THE FIELD OF OIL EXTRACTION

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ABSTRACT

Due to the characteristics they have, explosives for civil are used in various fields of national economy, for various technical purposes.

One of the most important domains where Romania has a long tradition and remarkable achievements significant the use of explosives and where is the oil.

The energy developed by detonating them in boreholes at established depths produce opening oil fields, important step in exploiting these mineral resources.

For this operation are developed blasting techniques, including special charges and charges of explosives called perforation, assembled in different configurations for the achievement a system that allows producing oil releasing holes.

The charges must meet certain essential safety and performance requirements, for specific characteristic working conditions.

KEYWORDS

Explosives for civil uses, shaped charge, blasting techniques, safety requirements, performance requirements.

1. INTRODUCTION

To open the oil layers are developed specific blasting techniques in which are used explosives for civil use.

Explosives for civil uses are placed in special metal constructions which must meet certain security requirements.

Such special explosive construction are considered also shaped charges 1 11/16" and shaped charges 2 1/8".

1.1. In order to be used under pressure

Shaped charge 1 11/16" (fig.1), respectively shaped charge 2 1/8" (fig.2), are made up of housings, made of alloy AE/OL/Zn 12, inside which is compressed on a metal cone from powder mixture copper and tungsten (2), explosive hexogen phlegmatized (4) and non phlegmatized (3).

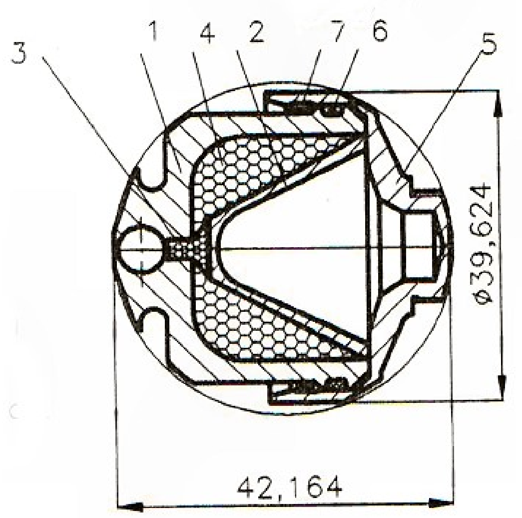

Fig.1 - Shaped charge 1 11/16"

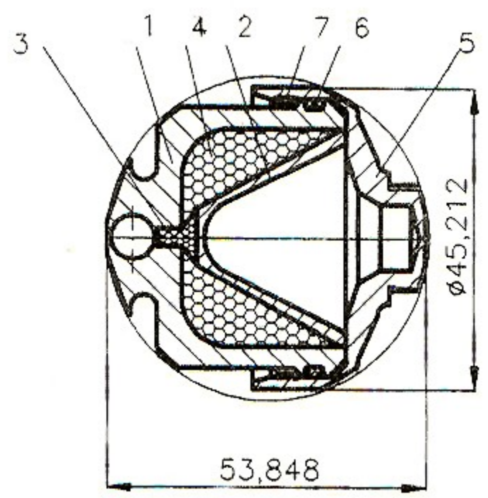

Fig.2 - Shaped charge 2 1/8"

The housing is composed of housing body (1), provided with a ring, through it passes the detonation cord which initiates the explosive charge from the inside, the housing cover (5), the two are assembled with a retaining ring (7) and a „o-ring" (6), both made of rubber.

Shaped charge 1 11/16" is component part of the drill 1 11/16 respectively shaped charge 2 1/8" is component part of the drill 2 1/8, both of them are used in drilling activities in oil industries for layers opening.

Layout loads along the length of drills are carried out in one, two or four generators.

The initiation of the perforation charges is made by detonation cord with a minimum explosive charge of 16 g / ml, which must meet specific security requirements conditions of use imposed by the geophysical blasting operations.

Technical characteristics of the „Shaped charge 1 11/16" ". (Fig.3).

Fig.3. Shaped charge 1 11/16"

- Explosive charge: - Hexogen non phlegmatized 1,5-2 g;
  - Hexogen phlegmatized 11,5-12 g.
- The outside diameter of the housing: max. 39,624 mm;
- Length of the housing: 42,164 mm;
- Weight load: 136 g;
- Maximum working pressure: 600 bar;
- The maximum working temperature: 120^0C.

Performance characteristics:

- The hole diameter at the entry into steel target: 8-14 mm;
- Depth perforated in steel target: min. 45 mm.

Technical characteristics of the „Shaped charge 2 1/8" " (Fig.4):

Fig.4. Shaped charge 1 11/16"

- Explosive charge: - Hexogen non phlegmatized 1,5-2 g;
  - Hexogen phlegmatized 13,5-14 g.
- The outside diameter of the housing: max. 45,212 mm;
- Length of the housing: 53,848 mm;
- Weight load: 226,8 g;
- Maximum working pressure: 800 bar;
- The maximum working temperature: 120^0C.

Performance characteristics:

- The hole diameter at the entry into steel target: 7-12 mm;
- Depth perforated in steel target: min. 63 mm.

For rational exploitation of resources, blasting works carried out in borehole to open oil layers, using explosive construction which presents a high degree of reliability.

The verifications of performance parameters of these explosive charges is mainly done by conditioning them to temperature and pressure for a certain period of time.

The conditioning is carried out with special equipment that is capable of reproducing the conditions under which they must operate.

In the following are presented the results of research conducted in order to verify the influence of pressure and temperature on the performance parameters specified.

To check the influence of pressure, shaped charges were individually weighed, they were placed in a special stand (fig.5) in which was made a pressure of 600 bar for „Shaped charge 1

11/16" ", respectively 800 bar for „Shaped charge 2 1/8" ", maintained at this pressure for 1 minute.


Fig.5. Stand for pressure conditioning

After removing from stand, charges were individual reweighed to ascertain any differences between the masses, situation that would highlight a major non-conformity of products.

To check shaped parameters, after maintaining the charge, at hydrostatic pressure were taken three shaped charges/product type, which were detonated individual with detonating cord initiated with electric detonator (fig.6) measuring the amount of penetration, hole diameter and the amount of fragmentation.

The tests were carried out on a steel block OLC45.

Results of tests for resistance to hydrostatic pressure „Shaped charge 1 11/16"" respectively „Shaped charge 2 1/8" " are shown in Table 1.

Table 1

No. Crt.	Type of shaped charge	Pressure applied (bar)	Weight of the charges (g)		Functional parameters		
			Before the test	After the test	Penetration value (mm)	Diameter hole (mm)	Value fragmentation (mm)
1.	1 11/16"	600	140,80	141,01	57,33	8,84	13,59
2.			140,89	141,10			
3.			140,31	140,50			
4.			140,75	140,94			
5.			140,46	140,65			
6.			140,90	141,07	55,23	8,65	11,31
7.			141,22	141,43			
8.			141,33	141,41			
9.			140,51	140,70			
10.			140,69	140,86			
11.			140,35	140,52	55,39	8,43	9,19
12.			140,71	140,80			
13.			140,13	140,24			
14.			140,41	140,51			
15.			141,02	141,14			
16.			234,08	234,25	92,32	9,35	14,97
17.			232,22	232,43			
18.			232,7	232,98			

No. Crt.	Type of shaped charge	Pressure applied (bar)	Weight of the charges (g)		Functional parameters		
			Before the test	After the test	Penetration value (mm)	Diameter hole (mm)	Value fragmentatio n (mm)
19.	2 1/8"	800	231,37	231,59			
20.			234,08	234,29			
21.			231,76	231,99	89,13	9,03	22,86
22.			233,10	233,28			
23.			233,14	233,34			
24.			232,94	233,18			
25.			232,36	232,58			
26.			232,60	232,88	91,82	9,86	13,31
27.			231,9	232,23			
28.			232,94	233,17			
29.			232,25	232,37			
30.			231,25	231,46			

To check the influence of the temperature on the operating parameters shaped charges (3 buc./product type), were kept in an oven at a temperature of 125^{0}C for 1 hour, which were detonated individual with detonating cord initiated with electric detonator (fig.6) measuring the amount of penetration, hole diameter and the amount of fragmentation.

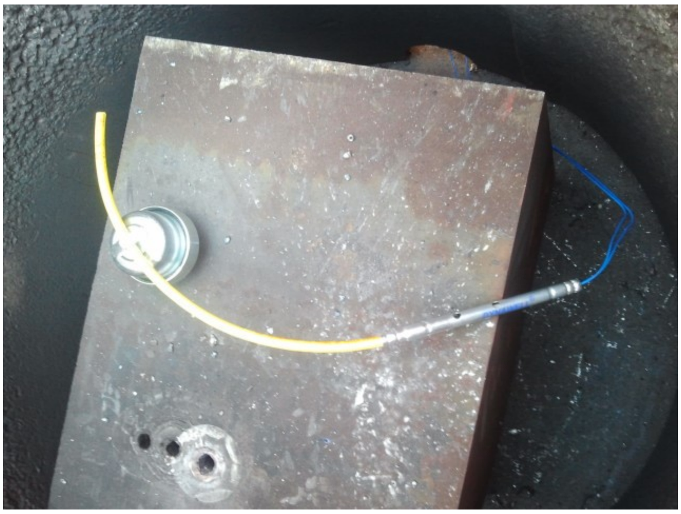

Fig.6

The tests were carried out on a steel block OLC45.

Test results on determining the safety and reliability at extreme temperatures are shown in Table 2.

Table 2

Type of shaped charge	Penetration value (mm)	Diameter hole (mm)	Fragmenta-tion value (mm)	Results: DC =detonates complete ND = no detonation
1 11/16"	59,44	9,78	10,56	DC
	57,75	9,54	10,08	DC
	54,27	8,66	10,10	DC
2 1/8"	88,84	9,80	18,25	DC
	89,70	8,16	15,51	DC
	94,52	9,78	17,39	DC

2. CONCLUSIONS:

The very small differences in masses, determined after the weighing the perforation charges before and after being maintained under pressure, does not indicate a non-compliance on the tightness of carcasses.

The values of results obtained in the tests carried out after maintaining at pressure and temperature, are within the ranges specified.

Research shows that pressure and temperature to which were conditioned did not influence the functionality and performance parameters which have to meet shaped charges to be used for the purpose for which they were made.

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ASPECTS RELATED DRILLING THE RESERVOIRS SECTIONS WITH WITH ENVIRONMENTAL DRILLING FLUID

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ABSTRACT

Maximizing productivity of the well is the key objective in designing the optimally drilling fluid for crossing productive layers. The first mechanism to minimize the invasion of solids particles or higher aqueous phase in productive reservoirs layers involves creating a thin, waterproof, mud cake. This small and thin mud cake will not affect the production rate of the well and will not interfere with well completion operations. The paper aims to present some specific design aspects of drilling fluids used for drilling and crossing productive reservoirs, as certain criteria for selection of the systems in accordance with the nature of productive layers.

KEYWORDS

productive layers, environmental drilling fluids, layers crossing

1. INTRODUCTION

Continuarea interesului în dezvoltarea şi exploatarea unor noi perimetre productive, la adâncimi din ce în ce mai mari şi temperaturi ridicate, creşterea regulilor impuse din punct de vederea al mediului înconjurător privind eliminarea detritusului şi a performanţelor limitate a fluidelor de foraj pe bază de apă în zone greu accesibile, a stat la baza dezvoltării unor sisteme de fluide de foraj cu o performanţă ridicată şi a îmbunătăţirii lor continue pe baza datelor din şantier. Lucrarea actuală îşi propune să actualizeze şi să contribuie prin aducerea de noi date, la elaborarea unui fluid de foraj performant și adaptat continuu la cerințele sondelor.

Fluidele de foraj existente pe bază de apă au uneori performanțe limitate comparativ cu fluidele de foraj pe baza de produse petroliere sau sintetice. Performanțe legate de:

- inhibiţie;
- rata de avansare;
- condiţionarea fluidului de foraj.

Sistemul de fluid de foraj ultrainhibitiv cu proprietăţi superioare de inhibiţie a argilelor, nu doar îmbunătăţeşte forajul secțiunilor superioare, dar de asemenea are aplicaţii în întreaga operaţie de săpare a sondei la adâncimi mari şi temperaturi ridicate. Fluid de foraj ecolologic îmbunătățit reprezintă un plus în tehnologia sistemelor pe baza de apă comparativ cu aplicațiile fluidelor de

foraj prezente, permițând sistemului de fluid de foraj ecologic îmbunătățit, să fie compartiv cu sistemele pe baza de produse petroliere şi/sau sintetice.
Sistemul de fluid de foraj ecologic îmbunătățit este foarte inhibitiv, elaborat și gândit pentru a asigura o stabilitate superioară şi o capacitatea de forabilitatea a formațiunilor de argile reactive şi dispersabile. Sistemul propus poate ajuta într-un mod semnificativ și la traversarea cu foarte bune rezultate a formațiunilor productive ce prezintă un interes maxim. Fluidul de foraj ecologic îmbunătățit este proiectat să asigure:

- o inhibiție maximă a argilelor;
- o stabilitate maximă a găurii de sondă;
- o acumulare de particule de rocă dislocate, aproape de zero pe ansamblul garniturii de foraj şi pe racordurile prajiniilor de foraj;
- menținerea uşoară a proprietățiilor fluidului de foraj;
- flexibilitate în densitatea cu care se lucrează ;
- flexibilitate în alegerea sursei de ioni (potasiu, sodiu);
- aplicabilitate în diferite zone sensibile din punct de vedere al reglemenatrilor cu privire la mediu.

2. PRODUŞI COMPONENȚI AI FLUIDULUI DE FORAJ ECOLOGIC ÎMBUNĂTĂȚIT

Inhibitorul principal al argilelor (figura 1) în sistemul propus de fluid de foraj ecologic îmbunătățit este o poliamida, urmat de un polimer cationic acrilamida împreună cu un glicol polialcalin, ce asigură inhibiția secundară a argilelor şi stabilitatea de încapsulare a detritusului.

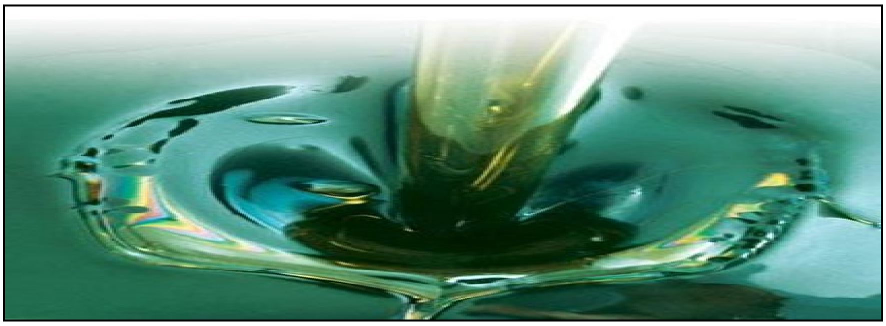

Figure 1: Inhibitorul principal al fluid de foraj ecologic îmbunătățit

Inhibiția secundară a argilelor traversate poate fi obținută prin cationi de substituție cu formațiunea de argile, prin utilizarea ionilor de potasiu şi / sau sodiu în formularea sistemului de fluide de foraj. Sistemul va conține deasemenea un produs care va preveni antiacumularea detritusului, va ajuta la creşterea ratei de avansare şi va ajuta la micşorarea gradului de frecare. Fluid de foraj ecologic îmbunătățit, are multiple mecanisme de inhibiție, asigurate de inhibitorii primari şi secundari ai argilelor.

Primul component este o poliamida, un aditiv lichid ce acționează ca un reținător la hidratarea argilelor, prin intercalarea şi reducerea spațiului dintre stratele de argilă astfel moleculele de apă nu vor putea penetra şi cauza umflarea argilelor. Concentrația recomandată este: 1.5 % - 3% v/v, funcție de reactivitatea argilelor traversate. Acest produs asigură şi alcalinitatea sistemului eliminând orice aditie de NaOH sau KOH [2, 3].

3. INHIBITORI SECUNDARI AI FLUIDULUI DE FORAJ ECOLOGIC ÎMBUNĂTĂȚIT

Al doilea component al sistemului este un polimer cationic acrilamida (figura 2), responsabilă pentru încapsularea şi stabilizarea argilei. Concentrația în sistem este de 3-6 kg/m3 asigurând o căptuşire protectivă de polimer ce îi conferă o integritatea bună rocii dislocate şi previne lipirea pe site sau a particulelor de rocă între ele.

Figure 2: Polimer cationic acrilamida

Componentul al treilea este un poliglicol ce asigură un grad foarte mare de inhibiție al argilelor împreună cu componenții mai sus mentionați, stabilitatea pereților găurii de sondă, reducerea filtratului în condiții de temperatură şi presiune ridicate, precum şi lubricitatea. Concentrația în sistem este de 1- 2%. Este de asemenea foarte potrivit pentru forarea formațiunilor nisipoase depletate, unde există pericolul lipirilor diferențiale, la sondele în ape adânci şi la sondele puternic deviate sau orizontale ce traversează argile foarte reactive.

4. AGENȚI DE CONTROL AI FILTRĂRII

Produsul PAC (celuloză polianionică) este de o calitate superioară fiind un polimer solubil în apă pentru controlul fitrării, cauzând doar o mică creștere în vâscozitatea fluidelor de foraj. Produsul celuloză polianionică, este foarte eficient în controlarea filtratului în fluide cu conținut de săruri (apă de mare, NaCl, KCl). În aplicații unde curățirea găurii de sondă este o grijă esențială (sonde de tip: ERD, sonde orizontale), produsul celuloză polianionică împreună cu un derivat de amidon dezvoltă bune proprietății de control al filtrării şi îmbunătățeşte profilul reologic permințând o vâscozitatea mare la viteze de forfecare mici (LSRV mai mare) pentru o anumită valoare a YP-ului (tensiunii dinamice de forfecare). O concetrație între 8 – 14 kg/m3 de PAC va asigura un filtrat al sistemului de: 4 ml/30 min. Temperaturile mari întâlnite datorită forajului la adâncimi din ce în ce mai mari, presupune optimizarea fluidului de foraj ecologic îmbunătățit cu stabilizatori de temperatură şi polimeri sintetici pentru prevenirea degradării produşilor utilizați şi eliminarea riscului de creare a altor contaminări.

5. PRODUŞI DE ÎNVÂŞCOŞARE AI FLUIDULUI DE FORAJ ECOLOGIC ÎMBUNĂTĂȚIT

Profilul reologic optim a sistemului este obținut prin utilizarea biopolimerilor de gumă xanthanică (figura 3), folosind concentraţii începând de la 0.5 -3.5 kg/m3, depinzând de diametrul găurii de sondă şi profilul sondei. Fluidul de foraj ecologic îmbunătățit va dezvolta o reologie stabilă într-un domeniu larg de temperatură. Începând de la 15°C până la 200°C, formularea sistemului îşi menține capacitatea excelentă de suspensie şi curățire a găurii de sondă. Rezultând că sistemul este potrivit pentru sonde adânci şi cu temperaturi ridicate [2,3].

Figure 3: Biopolymer xanthan gum de grad superior

6. AGENŢI DE MICŞORARE A COEFICIENTULUI DE FRECARE

Produsul PAC (celuloză polianionică) este de o calitate superioară fiind un polimer solubil în apă pentru controlul fitrării, cauzând doar o mică creștere în vâscozitatea fluidelor de foraj. Produsul celuloză polianionică, este foarte eficient în controlarea filtratului în fluide cu conținut de săruri (apă de mare, NaCl, KCl). În aplicații unde curățirea găurii de sondă este o grijă esențială (sonde de tip: ERD, sonde orizontale), produsul celuloză polianionică împreună cu un derivat de amidon dezvoltă bune proprietății de control al filtrării şi îmbunătățeşte profilul reologic permințând o vâscozitatea mare la viteze de forfecare mici (LSRV mai mare) pentru o anumită valoare a YP-ului (tensiunii dinamice de forfecare). O concetrație între 8 – 14 kg/m3 de PAC va asigura un filtrat al sistemului de: 4 ml/30 min. Temperaturile mari întâlnite datorită forajului la adâncimi din ce în ce mai mari, presupune optimizarea fluidului de foraj ecologic îmbunătățit cu stabilizatori de temperatură şi polimeri sintetici pentru prevenirea degradării produşilor utilizați şi eliminarea riscului de creare a altor contaminări.

7. AGENŢI DE MICŞORARE A COEFICIENTULUI DE FRECARE

Primul produs este un amestec de surfactanți ce va minimiza efectul de acumulare a detritusului, de aderență a argilelor dislocate la suprafața metalului (BHA-ului şi/sau sapă) de asemenea va asigura lubricitate sistemului împreună cu cel de-al doilea component care este un ulei mineral. Concentrația optimă va fi de 1-1.5 % vol/vol pentru primul component iar pentru cel de-al doilea de 0.5-15 v/v, depinzând de greutatea specifică a fluidului şi de conținutul de solide.

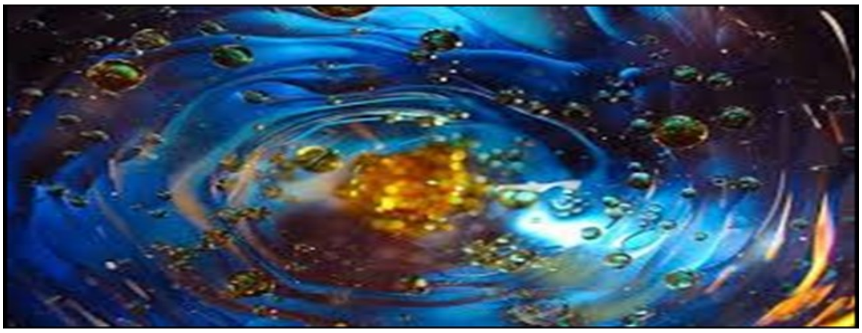

Figure 4: Agenți de lubrificare a sistemului

Pregătirea fluidului de foraj ecologic îmbunătățit este prezentat în tabelul 1.

Table 1: Concentrații uzuale și funcțiile produșilor

Material	**Funcţia**	**Concentratia Recomndată**
Apă dulce	Fluid de bază	
Sodă Calcinată	Control duritate	0.5-1.5 kg/m^3
Clorură de potasiu	Inhibiție	95-100 kg/m^3
Poliamină	Inhibitor argilă	1.5 – 3.0% (v/v)
Acrilamidă polimer	Încapsulare argilă	3-6 kg/m^3
Polimer celulozic	Control filtrare	8-14 kg/m^3
Poliglicol	Încapsulare argilă/Inhibiție	2-3 % v/v
Amidon modificat	Control filtrare	2-4 kg/m^3
Biopolymer xanthan gum de grad superior	Control reologie/LSRV	0.5 – 3.5 kg/m^3
Mix Surfactant	Anti-acumulare/ Lubricant	1.0 – 1.5% (v/v)
Ulei sintetic biodegradabil	Lubricant	0.5-1.0 % (v/v)
Micro Barită	Control densitate	În funcție de densitate
Materiale polimerice alcaline PTS 200 (MI)	Stabilizator temperatură/ Reducerea degradării polimerilor	6-10 kg/m^3
Micro carbonat de calciu	Control densitate /Podire	În funcție de proiect

Fluid de foraj ecologic îmbunătățit va putea fi preparat cu o varietatea de saramuri şi deasemenea cu un domeniu larg în alegerea şi utilizarea densităților. Tabelul 2 dezvoltă proprietățile fluidului de foraj ecologic îmbunătățit într-un domeniu minim - maxim pentru o concentrație de: 9-10 % KCl a sistemului propus spre analiză [2, 3].

Proprietati	**Valoare**	**Proprietati**	**Valoare**
Densitatea, SG	1.50 – 1.75	HTHP Filtrat, cc/30min	<3.0
Vascozitatea Funnel, sec/litru	55 – 80	MBT, kg/m^3	< 42
R3/R6	3-5 / 5-7	pH	9.0-9.5
PV, cP	< 42	Pm	3.0 - 6.0
YP, lb/100 ft^2	5 – 15	Pf/Mf	2.5-4.5 / 3.0-6.0
Gels, 10s/10m, lb/100ft^2	3-5 / 8-10	Chlorides, mg/L	>90 000
		Hardness (Ca^{++})	250 – 450

8. PREPARAREA ŞI CONDIŢIONAREA FLUID DE FORAJ ECOLOGIC ÎMBUNĂTĂȚIT

Unul din avantajele principale ale sistemului propus este simplitatea procesului de mixare. Produşi pot fi adaugați relativ repede, şi de fapt există şi produși care sunt sub formă lichidă, ceea ce salvează şi mai mult timp în procesul de preparare.
Posibilitatea de forfecare optimă a fluidului de foraj a demonstrat că o unitate de forfecare cum este un mixer puternic este benefică, astfel polimeri vor avea o hidratre mult mai bună şi fluidul de foraj va obține o performanță maximă. Abilitatea sitelor de a prelua debitul de lucru este îmbunătățită şi de proprietățile reologice ale fluidului. În Tabelul 3, este exemplificat modul de preparare a unei probe de fluid la densitatea de 1.56 SG (350 ml echivalent 1 bbl de laborator).

Tabelul 3 Exemplul modului de pregătire a fluidului de foraj ecologic îmbunătățit, având densitatea de: 1.56 SG respectiv 13.0 ppg.

Ordinea recomandată de mixare (pentru a obține o proba de 350 ml)	**Observatii**
1. Adaugarea de apă testată, curată în paharul metalic de laborator (v350 ml). Soda Ash dacă este cazul	Se poate dezvolata o ușoară spumare. Se tratează cu antispumant
2. Adaugare KCl pentru amestec cu apa, urmat de mixare	
3.Poliamina	
4. Adaugare **ACRILAMIDA POLYMER** prin mixerul Hamilton B	
5. Adugare PAC	
6.Poliglicol	
6. Adaugare XANTHAN GUM DE GRAD SUPERIOR	
7. Mixare Surfactant& Lubricant	.
8. Stabilizator de temperatură	
9. Ingreunarea fluidului la densitatea de 1.56 SG adăugând micro barita lichidă 10. Mixat până la 30 - 45 min noul fluid de foraj preparat prin mixerul Hamilton B	Timpul de forfecare a produșilor depinde de debitul maxim prin mixerul de preparare .

9. PERFORMANȚA FLUIDULUI DE FORAJ ECOLOGIC ÎMBUNĂTĂȚIT CU POLIGLICOLI

Fluid de foraj ecologic îmbunătățit este un fluid pe bază de polimeri îmbunătățit (prezentat în figura 5), care foloseşte tehnologia poliglicolilor pentru a realiza un grad foarte mare de inhibiție a argilelor, stabilitatea pereților găurii de sondă, reducerea filtratului în condiții de temperatură şi presiune ridicate, precum şi lubricitate.

Figura 5: Fluid pe bază de polimeri îmbunătăţit

Este de asemenea foarte potrivit pentru forarea formațiunilor nisipoase depletate, unde există pericolul lipirilor diferențiale, la sondele în ape adânci şi la sondele puternic deviate sau orizontale ce traversează argile foarte reactive.
Sistemul asigură un detritus mult mai ferm şi mai bine conturat, o turta de colmataj mai subțire şi mai rezistentă, reducerea ratelor de diluție zilnice, toleranță îmbunătățită pentru solide, îmbunătățirea performanțelor sapelor PDC, reducerea efectelor de manşonare a ansamblului de fund precum şi cresterea vitezei de avansare. În plus, acest sistem nu afectează mediul înconjurător, datorită toxicității lui foarte mici. Sistemul de fluid de foraj ecologic îmbunătățit are un plus de inhibiție asigurată de inhibitorul al treilea prin două mecanisme: prin adsorbție chimică și prin formarea unei microemulsii.
Adsorbția poliglicolilor pe suprafețele argilelor duce la formarea unei bariere protectoare împotriva apei şi a efectelor ei nedorite. Cel de-al doilea mecanism apare la atingerea unei anumite temperaturi ("Cloud Point") la care poliglicolii devin insolubili din total solubili, formând picaturi coloidale sau micele (tulburare).
La temperaturi peste acest punct, picăturile coloidale sau micelele duc la apariția unei microemulsii. Această microemulsie furnizează stabilitatea găurii de sondă prin podirea microfisurilor şi microporozităților şi prin formarea unei turte de colmataj mai subtire şi mai putin permeabilă. Sistemul de fluid de foraj ecologic îmbunătățit se formulează cu salinități diferite, în scopul reglării temperaturii de formare a microemulsiei şi a creșterii caracterului inhibitiv.

Principalele aspecte care trebuie avute în vedere pentru menținerea corespunzătoare a sistemului sunt:

- menținerea concentrației de inhibitori în sistem la un nivelul corespunzator;
- menținerea concentrației de KCl în domeniul proiectat;
- păstrarea concentrației de solide reactive la un nivel cât mai mic;
- valorile de MBT nu trebuie să depaseasca 42 kg/m^3 ;
- utiliziarea de micro barită sub forma de barită lichidă ;
- podirea se va realiza cu micro carbonat de calciu ;

O atenție deosebită trebuie acordată gradului de curățire a fluidului de foraj, menținerea valorii concentrației de solide în domeniul proiectat reprezentând o condiție esențială a păstrării valorilor reologice proiectate. Contaminarea cu solide provenite din detritusul de foraj duce la creşterea de clorură de potasiu, precum și la reducerea capacității de inhibare a fluidului de foraj. Pentru menținerea concentrației de solide la un nivel cât mai mic se recomandă echiparea sitelor cu plase cât mai fine posibil şi chiar utilizarea unui sistem de separare centrifugal. În cazul acestui fluid devine şi mai acută necesitatea folosirii centrifugilor în vederea micşorării ratei de diluție.

Tratamentele zilnice se vor face cu pre-mix în care concentrațiile de inhibitori şi clorura de potasiu să fie puțin mai mari, pentru a compensa consumul lor în timpul forajului. Creşterea parametrilor reologici se poate face adăugând biopolymer xanthan gum de grad superior, iar reducerea lor prin adăugarea de pre-mix şi folosirea cu eficiență maximă a tuturor echipamentelor de curățare mecanică a solidelor. De asemenea, pentru a se evita creşterea valorilor de vâscozitate plastică și yield point, conținutul de solide ușoare nu trebuie să depășească 6 %. Doi parametri reologici foarte importanți sunt zero-gel şi gelatia la 10 secunde, acestia ajutând foarte mult la suspensia şi transportul detritusului la viteze foarte mici de forfecare. Creşterea gelației la 10 minute reprezintă o indicație a încorporării de solide ultrafine în sistem. Pentru reducerea lor se recomandă înlocuirea unei parți din fluid cu fluid proaspăt.

Inhibiția sistemului trebuie controlată în permanență astfel încât aceasta sa nu scadă în timpul forajului (în special la viteze mari de avansare). Un detritus bine conturat şi uscat în interior constituie un indicator al bunei inhibiții [3].

10. CURĂŢIREA GĂURII DE SONDĂ CU FLUIDULUI DE FORAJ ECOLOGIC ÎMBUNĂTĂȚIT

Utilizarea unor programe de hidraulică (figura 6) înaintea începerii fiecărui interval va permite optimizarea parametrilor şi a regimului de lucru la forarea intervalului respectiv. Reologia şi valorile „Low Shear Rate Viscosity" trebuie ajustate în concordanță cu condițiile impuse prin utilizare produşilor de biopolymer xanthan gum de grad superior. Detritusul generat trebuie circulat deasupra ansamblului de fund înaintea unei noi conexiuni.

Figura 6. Imagine din timpul forajului (simulare)

De asemenea „manevrarea" fiecarei bucați trebuie luată în considerare. Acestea vor minimiza potențialul de cădere a detritusului în timpul conexiunii, evitând fenomenul de „packing off" sau de prindere a sapei. Înaintea marşurilor ce se vor efectua se va circula cel putin 1 ½ ori timpul „bottom –up", astfel se va preveni fenomenul de gaură strânsă şi a podirilor. Datorită caracterului foarte inhibitiv a sistemului analizat şi îmbunătațit, acest fluid de foraj ecologic va genera un detritus mai mare decat a sistemelor uzuale pe baza apă. Acest fapt se va putea constata dacă se va utiliza:

- reologia recomdată;
- debitul optim;
- rotaţia optimă a garniturii de foraj;
- viteze mai mari în spatial inelar și citiri optime ale valorilor 6 și 3 rpm acestea fiind necesare pentru transportul detritusului la suprafață.

Utilizarea programelor de hidraulică şi a recomadărilor următoare vor influența semnificativ procesul de foraj:

- alegera sapei de foraj este foarte importantă.
- rata de avansare (ROP) cu sistemul propus atinge valori ale performanței sistemelor pe bază de produse sintetice;

Creşterea reologiei excesiv poate reduce curățirea găurii de sondă. Primul pas când întâlnim probleme de curățire a găurii de sondă este de a creşte reologia sistemului şi pomparea dopurilor vâscoase. Ambele proceduri pot avea un impact hotărâtor asupra curățirii găurii de sondă, în mod special la sondele deviate, prin permiterea modelului de curgere să se strecoare deasupra aglomerării de detritus şi astfel înrăutățind problema. S-a observant că reologia trebuie să fie mentinuță într-un domeniu optim pentru a permite rocii dislocate de sapă în timpul procesului de foraj, sa fie efectiv îndepartată. Sistemul fluidului de foraj ecologic îmbunătățit, prin testele de reologie realizate, sugerează o valoare cuprinsă între 5-7 pentru citirile de 6 de la Fann 35/A, la un YP =5-15 lb/100ft2, depinzând de: diametrul găurii de sondă, densitatea fluidului de foraj, condițiile de foraj [3].

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EVALUATION OF WELLHEAD LOADS AND TENSIONS USING FEM FOR DEEP WATER DRILLING WELLS

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ABSTRACT

This paper aims an analysis of a complex situation over the well head for an offshore well with regards to the loads and stress impacting this equipment. The analysis is highlighting the effects of the daily operations over the well head along with the loads envelope supported. Those situations described are meant to verify the relevant API requirements but also an analysis is performed with regards to those emergency situations which may encounter during operations such as drive off and drift off. The objective of this paper is to evaluate the required time allowable for drilling operations until the well head may be the subject of a fatigue rupture and to propose improvement solutions in order to prolong the operational life of the equipment.

KEYWORDS

Keyword,

1. EVALUATION OF THE FATIGUE RUPTURE POSSIBILITY OF THE WELL HEAD

As the water depth increases the possibility of a fatigue rupture of the chances to encounter a well head rupture are more likely. Therefore, it is recommended that before starting the deep water operations, this possibility needs to be assessed since the beginning of the well design process.

The increased length of the riser column as well as the environmental factors specific for the operational location (waves, currents etc.) are influencing the stability of the riser column by inducing a specific movement in to the string and creating the conditions for the possibility of an early fatigue rupture of the well head. Taking in to considerations all these factors can be concluded that once the fatigue limit exceeded, the final rupture can occurs at any time.

For a normal well head the cyclic loads will highlight the manufacturing faults (normally the welded zone is the most exposed one). Once the critical zone is reaching the critical limits the final fatigue rupture will be initiated. In the picture 1 below are presented the most critical areas for a generic well head.

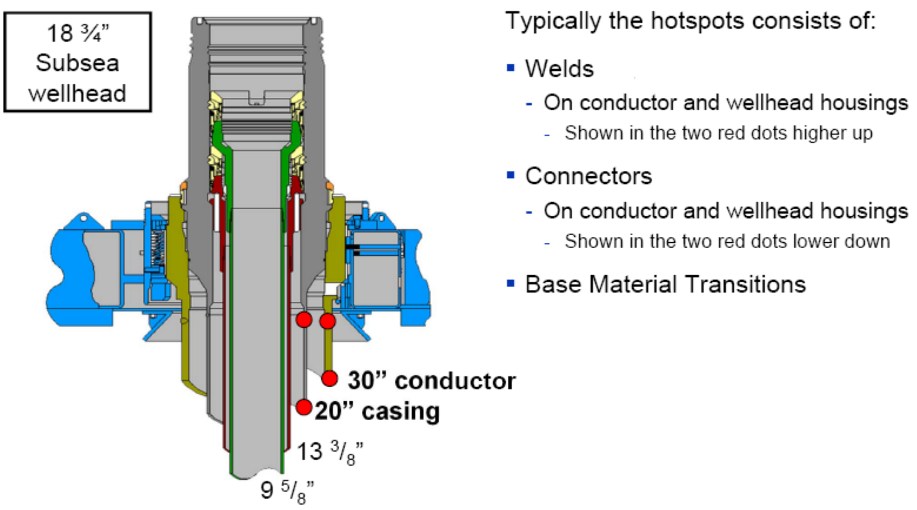
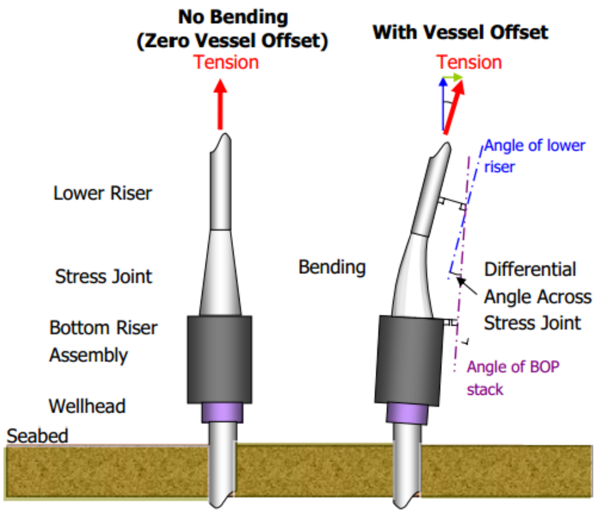


Figure 1: Well head hotspots

The well head is impacted by variable loads caused mainly by the environmental factors. One factor which has to be taken in to account is the relative movement of the drilling unit on the horizontal. In this case, if the tensioning system is not properly adjusted, may have an impact over the riser column and then this can cause additional tensions over the well head. Depending of the amplitude and the intensity of these loads, the well head is exposed to early fatigue rupture as is represented in the below picture.



Picture 2 – Load regime of the well head

As aforementioned, the early fatigue rupture of the well head is caused by excessive loads caused by the drilling unit movement as well as the action of the environmental factors over the raiser column. Therefore, a particular aspect of this issue is represented by the mechanical characteristics of the well head material. Actually, the fatigue occurs during normal drilling operations but the purpose of this paper is to highlight those factors which are amplifying this process leading to an early fatigue rupture. One of the functions of the well head is to provide stability of the BOP but this is in strict correlation with the soil characteristics as well as the quality of the cementing job for the first section of the well.

One of the most important characteristics of the soil is stiffness and the most usual method for establishing this is to apply P-Y curves. These are normally used to determine the foundation characteristics in civil engineering. In order to determine the P-Y curves, the following standards can be used:

- ISO 19901:4;
- ISO 19902;
- API RP 2A.

These standards show different methods for P-Y curves calculations depending on soil characteristics.

With regards to the fatigue resistance, this can be categorized as following:

- Small fatigue resistance, when the well head can take less than 105 cycles
- Increased fatigue resistance, when the well head can take more than 105 cycles

The firs case refers to a structure placed in the plastic deformation domain while the second case is suitable for the elastic domain. According with this analysis and due to the operational requirements the ideal case would be to have the well head placed in the second case.

2. THE LOADS REGIME OF THE DRILLING UNIT

A marine drilling system is the subject of different loads and forces which are impacting the well head in terms of cyclic loads accumulation and those can be summarized as following (see also picture 3):

Environmental data:

- Water depth
- Wind
- Marine currents
- Waves

Design characteristics of the drilling unit

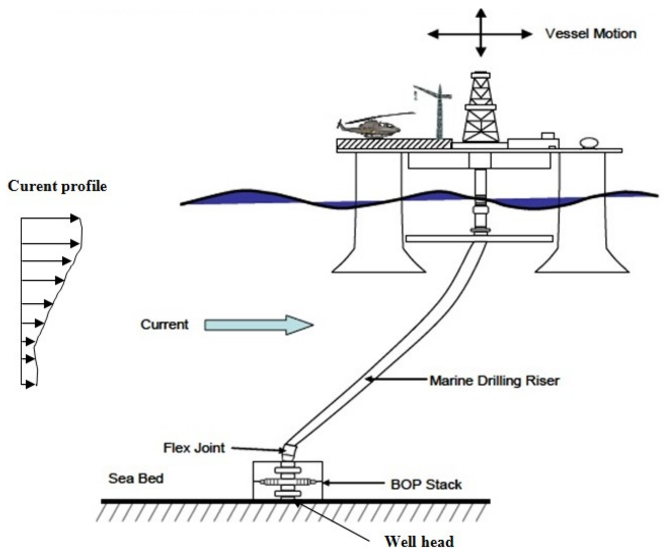
- Response of the drilling unit during waves and wind impact
- Marine currents response
- RAO curves (Response Amplitude Operator)

Riser column

- Diameter
- Wall thickness
- The weight of the riser column
- Tensioning system
- Dynamic and riser mechanics

Mooring lines (as applicable)

- Mechanical properties
- Tension values of the lines

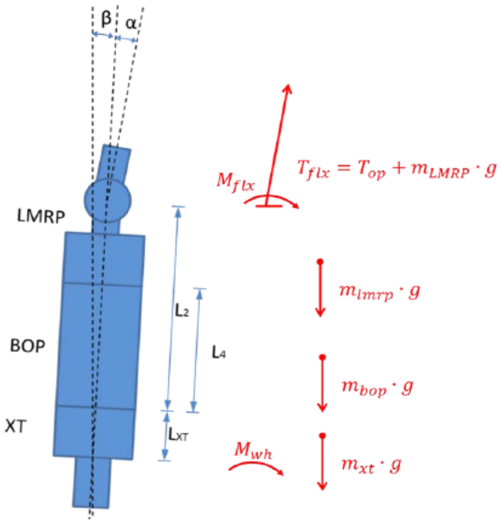


Picture 3 – General overview of the main factors impacting the drilling unit stability

3. SIMPLIFIED METHOD FOR DETERMINATION OF THE OPERATIONAL DAYS

The exact determination of number of operational days for the well head cannot be determined exactly due to multiple factors involved. However, a simplified method has been presented which is evaluating few main parameters and based on that an approximation can be made. Anyhow, the method presented in the biography section can provide an indication with regards to the performance or not of the subsea system. After the completion of the analysis, compensating measures can be taken in order to improve the system. The acceptance criteria defined is based on the concept of "standard BOP days" and the reference was set for 365 days in operation. If result of the analysis is exceeding this number, then compensation measures are to be taken. Anyhow, compensating measures can be taken in any case in order to improve the system performance as log those are economical viable. [1]

This method is using as input data basic the basic characteristics of the drilling system such as: the height of the BOP stack, over pull at LMRP connector and bending stiffness of lower flex joint.



Picture 4 – The loads of the BOP stack [1]

The method described above has been applied to a real drilling system in order to evaluate the performance of a given drilling system configuration. The result was not in accordance with acceptable criteria and, consequentially, compensating measures were proposed as following:

1. The BOP weight to be reduced by using suspension cables connected to the platform. There is a down side of this approach and is that the cables needs to be connected together with a compensating system which needs to be synchronized in order to reduce additional stress in to the BOP stack.
2. Remove one annular preventer from the BOP configuration.

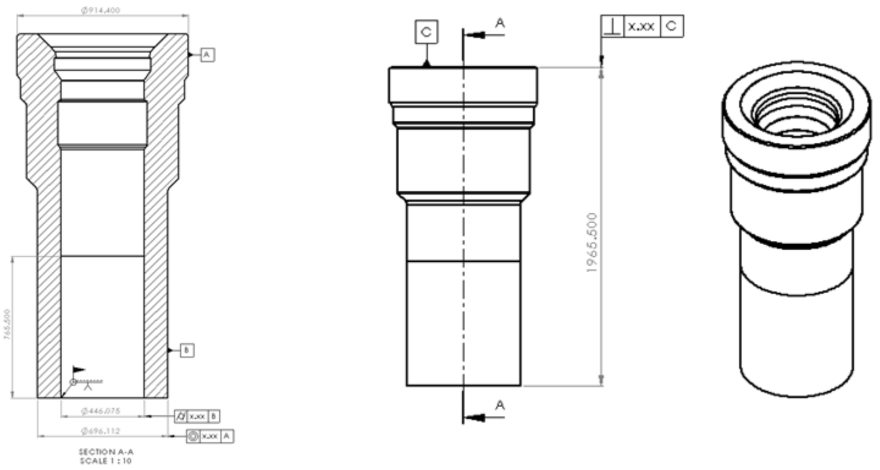
This measure proves to be feasible and is reducing not only the weight of the BOP but also the height.

It was proven an increase of 50 % of the performance of the system after taking the compensating measures.

In addition, in order to verify the theoretical data obtained an analysis was completed by using a software solution based on FEM method.

4. STATIC AND DYNAMIC STUDY OF THE WELL HEAD

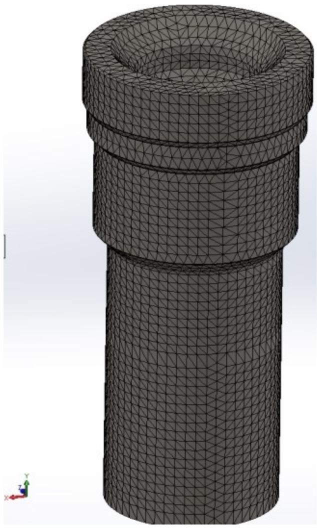
The study was completed using Solidworks software in order to create the stress diagrams in accordance with theoretical result obtained above. For this analysis the von Mises criterion was used. From constructive point of view, the well head is presented in the picture below:



Picture 5 – Well head, general overview

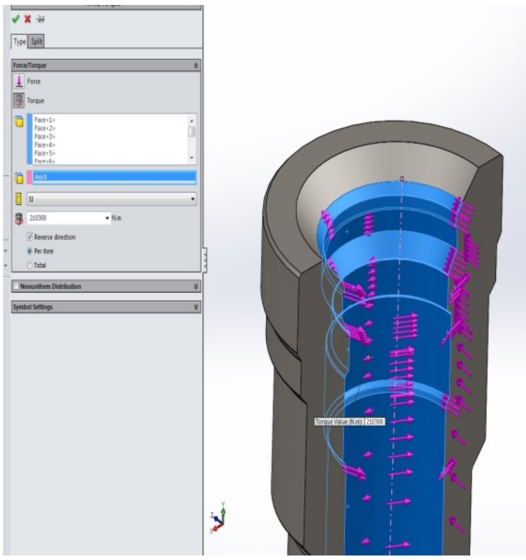
A 3D model of the well head was design (picture 6) which represents the mesh structure of the object.

The scope of this structure is to split the object in order to allow mathematical modeling of the structure and finally the mechanical simulation to be completed.



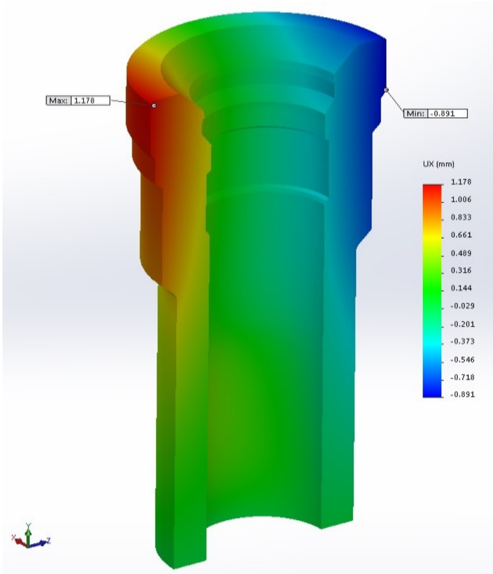
Picture 6 – FEM – mesh structure of the well head

In the picture 7 is represented the torque moment (app. 210 kNm) transmitted over the inner surface of the object for an inclination angle of 1 degrees.



Picture 7 – Torque moment for 1^0 angle

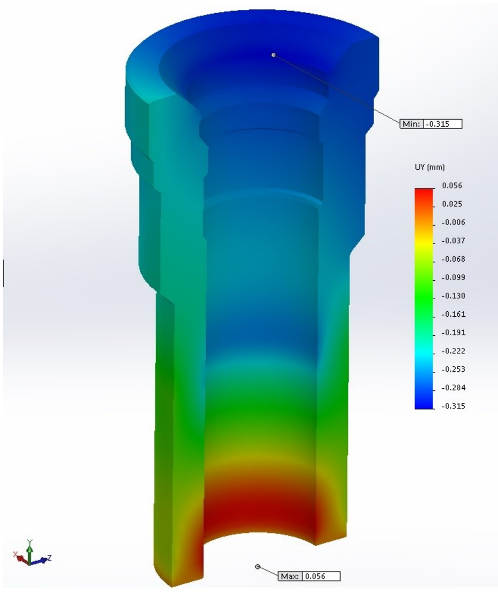
Picture 8 represents the diagram of specific elastic deformations (tangential) oriented by the X axis in Cartesian system for an angle of 1 degree. These tensions are produced in the support area of the BOP stack. Also, the symmetry between the opposite values of elastically deformations is given by the torsion and bending moments. Therefore, the blue area is influenced by the compression and the red one is under elongation impact.



Picture 8 – Diagram of elastic tangential deformation on X axis for 1^0 *angle*

Picture 9 is represented the diagram of specific elastic deformations following the Y axis of the Cartesian system. Precisely, at the basis (in the weld zone) the fibre of the material is the subject of elongation. This is generated by the bushing pressure in to the inner side which is corresponding to a rigid domain of the deformation system.

Also in the upper part (blue) on the outside area a compression of the material fibre is produced due to the inclination angle.

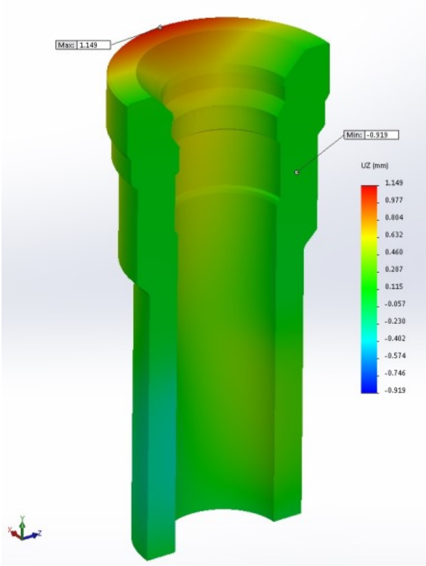


Picture 9 – The diagram of the elastic deformation for the Y axis for 1^0 *angle*

Picture 10 is representing the diagram of specific deformation (tangential) following the Z axis of the Cartesian system.

Like the case of the X axis, symmetrical elastically deformations is produced which can be observed in the picture. This picture also highlights the section with the elongation caused by the torsion and bending moments.

The compression would have been produced in the opposite side.



Picture 10 – The diagram of the tangential elastical deformations following Z axis for 10 angle

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RISER COLUMN STABILITY CONCERNS FOR DEEP-WATER AND ULTRA-DEEP-WATER DRILLING

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ABSTRACT

This paper proposes an analysis over the operational conditions encountered during drilling operations. The analysis refers to those factors which are impacting the riser column stability during operations. The results of these factors over the riser column are called riser mechanics. Thus, the objective of the work analyse to which extent the riser column fulfils the applicable API recommendations in force and obtaining theoretical results in this regard for drilling in deep waters. These results constitute the starting point in the simulation with the help of specialized software and getting useful results over optimal risers operations in deep water drilling conditions.

KEYWORDS

deep water, ultra deep water drilling

1. RISER MECHANICS – OVERVIEW

The riser column is a complex construction aimed to ensure the connection between the well head and the drilling unit. The functions of this assembly are complex and are not limited only to ensure the space necessary for cuttings removal from the well. As the water depth increases, the working conditions of this assembly becomes challenging due to the complex forces and extreme environmental conditions which are impacting the operational mode as well as the stability. In this paper several aspects concerning riser mechanics and the behaviour of the riser column will be evaluated against different operational situations.

1.1 THE DESIGN OF THE RISER COLUMN AND THE SELECTION CRITERIA

The optimal configuration of the riser column plays an important with regards to the operational parameters. The dynamic characteristic of the drilling unit are taken in to consideration since the design phase of the riser column being an important parameter during this stage and the riser column should fulfil these minimum conditions:

The riser column should cope to the design forces which may affect the stability but also integrity during the drilling process

- Regardless the normal operational conditions, the riser column should be able to fulfil also designed emergency situations

- Fatigue elements and the extreme loads which can occur are design elements which have to be taken in to account during the design phase

An important aspect which has to be taken in to consideration during this design stage is the determination of the optimal weight of the riser column in the water. As a matter of fact, the correct assessment of the buoyancy elements and correct positioning of those can ensure an optimal stability of the riser column. A neutral position can be obtained in order to achieve a reduction of the top tension as this is important for the tensioning system. However, there is a down side in this scenario: the lower tension can increase and this will result in overloading the well head [3]. The riser column can be considered a tube with high thickness walls which is impacted by different type of loads (e.g. shear forces, compression etc.)

The forces acting over the riser column can be evaluated by using von Mises & Tresca relations and the result have to comply with acceptable limits of the materials composing the riser column.

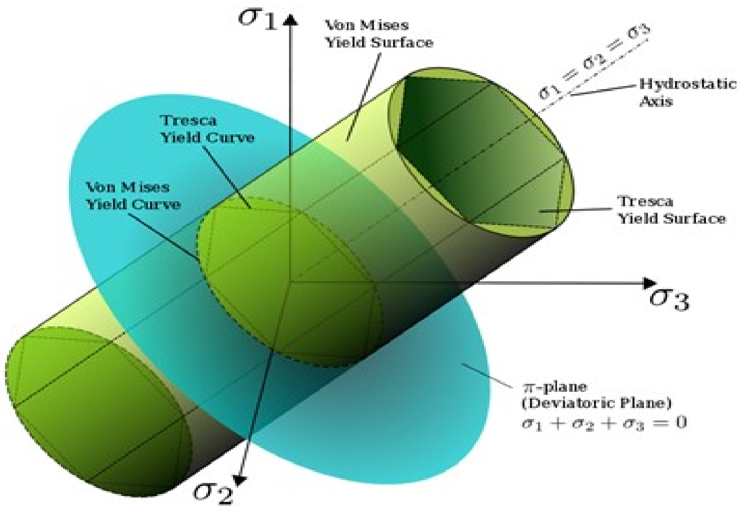

Figure 1: von Mises & Tresca applied for a riser section [4]

Moreover, the requirements for the top and lower tension must be verified in order to ensure the riser column stability for all operational phases, emergency situations included. As first step in this direction should include stability verification of the riser column towards limit conditions which may comprise of:

- Maximum water depth
- Maximum mud density
- Environmental conditions in connected mode

Moving forward, if the first condition has been fulfilled, the vertical deviation of the riser column must checked against requirements as well as fulfilling safety operational conditions, regardless the factors which may affect this. The API 2RD recommends a structural and dynamic analysis of the riser column if is considered that the operational environment impose further risk increase. Special simulations will be completed with a dedicated software, usually installed onboard the drilling units, in order to evaluate the vertical deviations of the riser column.

1.2 MAIN FORCES WHICH INFLUENCE THE STABILITY OF THE RISER COLUMN Sub

The riser column can be represented as a beam connected at both ends with a spherical articulation. The various axis movement of the drilling platform are compensated by dedicated equipment (telescopic riser, upper flex joint and tensioner ring) in order to maintain the drilling unit on the position. The linear weight of the riser is the difference between the linear weights of the joint in water minus the linear thrust exerted through the thrust collar by the buoyancy elements that are dressing it. The internal pressure generated locally by the mud column is equal to the mud specific gravity multiplied by the local column height. The external pressure generated locally by the sea water is equal to the sea water specific gravity multiplied by the local water depth. It has to be noted that what acts against the walls of the riser joints is the local difference in between the above two terms [2].

In the usual case of a riser string full of mud, the higher the mud weight & the water depth, the higher the differential pressure on the bottom that tends to "inflate" the joints generating hoop stress.

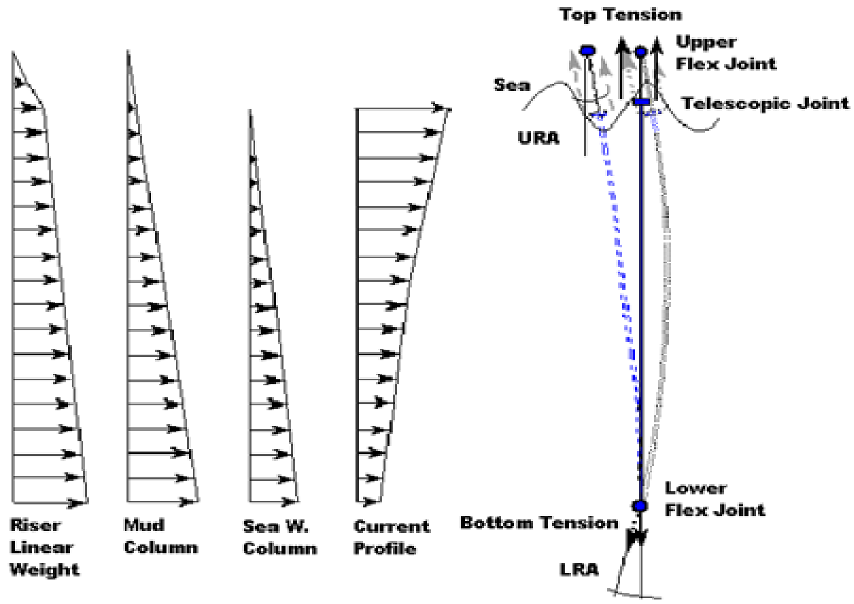

Figure 2: The action of different forces over the riser column

Should the riser for any reason be partially empty (mud heavy losses due to weak down hole formation), the riser wall would be subject to the external pressure only in the void zone.

The hydrodynamic forces of the waves will impact the riser column on the upper part and this is evaluated with MOJS equations (Morison, O'Brien, Johnson and Schaaf) [2]. The resistance of the riser column in to the water due to the oscillations is proportional with:

- A drag coefficient (friction, wake and added mass).
- The density of the sea water.
- The cross section of the riser string.

This approach is valid only if the current value is up to two knots. If this value is exceeded, the vortex phenomenon occurs, which generate vibrations in combination with the wave movement. The transversal vibrations are depending on the value of the tensions which are propagating along the riser column.

If those conditions are exceeding the acceptable operational limitations the tensioning system can be affected with consequences over the integrity of composed elements. A preventive measure is to reduce the top tension for a short period of time awaiting the normal operational parameters to be reinstalled.

However, the values exceeding two knots are not normal and therefore the solution of reducing the top tension for a short period of time can be adopted but such solution can overload the well head and may result in a fatigue rupture, as aforementioned, hence this measure should be correctly assessed.

In order to exemplify those forces we can imagine that a wave with a speed of two knots can generate a tension of 60-70 tones within the tensioning system for a water depth of 1 500 meters. Assuming a top tension of 350 tones and a lower flex joint tension of 150 tones an angle of 7 degrees deviation from vertical can be expected. Under these circumstances the acceptable operational limits are exceeded and the drilling process is suspended. The values mentioned are valid as long the top and lower tension values are not modified. The angle is modifying up to 3 degrees if the values mentioned are modified [1].

Another possibility to reduce the wave or currents influence is to modify the positioning of the drilling unit but keeping under control the lower angle of the riser column. The resulted position is meant to keep under control all parameters which may impact the vertical positioning of the riser column which is in fact the mission of the riser management system.

According with aforementioned it is obvious that old methods for keeping the drilling unit on position no long apply. Nowadays, it's unthinkable to run drilling operations in deep waters without the support of an advanced raiser management system which automatically adjust all operational parameters in order to maintain the integrity of the riser column as well as safety of the drilling operations. If the well head can be considered somehow rigid with regards to the BOP this no longer apply. Depending on the soil characteristics as well as the quality of the cement job for the upper section of the well, the BOP can oscillate with a range between 0-2 degrees during drilling operations which may cause damages to the drilling equipment as well as increasing the cyclic loads over the well head which will end up with the final fatigue rupture.

The design length of the raiser column is influenced by the environmental conditions by means of the horizontal movement of the drilling unit but also is related with the stroke of the telescopic joint [3].

During the design stage of the riser column for a given location, the worst case scenario has to be taken in to consideration. Also it is recommended to reduce as much as possible the lower flex joint angle trough the positioning system of the drilling unit. Any uncontrolled movement generated by the environmental conditions can generate additional stress over the riser column and finally will impact the well head which can be exposed for early fatigue rupture. Due to the fact that the lower and upper flex joint are not design to absorb the axial movement of the drilling unit these tensions, somehow will impact the tensioning ring and finally ,these excessive loads, will impact the tensioning system as well.

Finally, the best way to manage efficiently the riser column, is to keep the positioning of the drilling unit under control within the operational parameters established before starting the drilling program and especially design for a given location with an adequate top tension and this is the big challenge.

2 REFERENCES

References in the text should be numbers in square brackets [1], and then there should be a key to such numbers at the end, as shown below.Please use table in template; numbering is automatically. NOTE: You can sort second column with word alphabetically. These examples also show the expected reference format:

[1] Evans, J. T., McGrail, J., An evaluation of the fatigue performance of subsea wellhead systems and recommendations for fatigue enhancements, 2011

[2] Morison, J. R., Johnson, J., Schaaf, S., The force exerted by surface waves on piles, Journal of Petroleum Technology, vol. 2, 1950

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BENCHMARKING STRATEGY – EFFECTIVE INSTRUMENT FOR IMPROVING PERFORMANCES AND INCREASING THE ORGANISATIONS' EFFICIENCY

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ABSTRACT

In recent years Western companies have learnt, mostly due to the competition with Japan, the importance of cooperating with the others, using as criterion their performances. The comparison is often made with companies that have implemented the best practices and obtained the best results in the field, the principle being that only when you know where the "leaders" are situated you can set better the tasks and goals for your own company. This type of practice got the name of benchmarking, after the English word expressing the craftsman's habit to compare different sizes with a standard in his field. Between the alignment requirement to EU policies and the real difficulties caused by the current situation of the Romanian economy, research on the concept and techniques of benchmarking, including the applications made to an economic agent in difficulties, led to the conclusion that these comparisons could bring an important contribution to the recovery of lags, given that the Romanian industry and economy entered the globalization equation.

KEYWORDS

benchmarking, efficiency, performance, change

1. INTRODUCTION

Economic efficiency is a complex reality, which expresses in the most comprehensive manner, the results obtained from an economic activity, measured in terms of the resources used to carry out that activity. The relationship between the volume and quality of efforts is determined through it, as factors generating effects and the results obtained during a given period, as a consequence of achieving these efforts. The concept of sustainable development is goal-oriented, which means that resources should be used so as not to diminish their value and benefit can be achieved continuously, i.e. to rely on the rational exploitation of resources, but without being limited to it [1]. Economic efficiency is complex, which requires a detailed analysis of all efforts and effects obtained in terms of the volume and structure and social importance. Moreover, given the market economy, economic efficiency should be calculated both at microeconomic level and at the level of national and global economy.

Therefore, we initiated a benchmarking study, as a strategy aiming at improving performance, a better efficiency, a higher quality of services, all resulting from the acceptance of change [2]. Benchmarking aims to increase productivity and spending the money efficiently, better quality and services. To reach this goal, the full commitment of managers of those activities is required, or of those who make the policies at the decisional level, so that resistance to change is overcome and the necessary support for the right direction is provided. Benchmarking must be understood as an instrument to support those who make the development policies of a particular activity. It should be based on research, by using some quantitative indicators and qualitative analyses on the best practice. Benchmarking indicates the performance and also the target that needs to be reached. The presentation of the best practice will inspire those interested and may serve them as a model for learning how to improve their own activity or even to exceed the performances of the pattern.

2. BENCHMARKING TECHNIQUES AND INSTRUMENTS FOR IMPLEMENTING THE MODERN SYSTEMS OF INDUSTRIAL PRODUCTION MANAGEMENT IN AN ECONOMIC ORGANISATION

To get the desired effect from the investment effort devoted to improving the management methods and techniques, benchmarking provides information on the philosophy of „the most accurate manufacturing" which refers to the most intelligent and rational way of working, permanent improvement of products' and processes' quality, reducing costs, reducing manufacturing and delivery times and establishes a more responsible role for the employees, extending staff's skills in the production process; extending the importance given to team work; interest and thus increased staff involvement in the production process [4].

For testing the benchmarking techniques and instruments, we thought suitable to choose a company from Sibiu, which represents a complex, representative environment for a great number of economic agents in Romania. The chosen organisation is a highly integrated company in the machine manufacturing industry, with a wide variety of technological processes, from the manufacturing of semi-finished products to the general assembling process. The diversity of technological processes derives from the different dimension range of the parts that are operated in the company and the variety of materials that these parts are made from.

In order to substantiate the options regarding the strategic solutions to business restructuring of this organisation in the current period, the informational basis is its economic-financial statement, in which we first noticed the critical situation of profitability, generated by the accumulated action of several negative factors, such as: the critical decline in the volume of orders (due to the contraction of activity in the machine manufacturing industry); maintaining the surplus staff at a relatively high level; increased salary costs while there is lower production and failure to maintain the correlation between increasing the wage fund and the increase of work productivity; the increase of prices for materials, raw materials and energy and of the expenses with the depreciation of production costs by increasing consumption specific to hot manufacturing; financial blockage, etc. With regard to the analysis of applying the specific management methods and techniques (designed for solving some problems associated to the different management functions), we noticed that there are mainly used: extrapolation – used in elaborating short-term forecasts based on plans and programmes prepared on the basis of firm orders; meeting – widely spread in all organisational levels; delegation of authority – used more frequently in comparison with the delegation of competence; diagnosis found as the management report of the Board of Administration accompanying the financial balance sheet; cost calculation methods outlining the calculation articles for the products.

The diagnosis of managerial instruments shows, on one hand, the reduced number of management systems and methods used on a daily basis by the organisation and, on the other hand, the failure to comply with the methodological elements recommended by the management science in the implementation process.
Acknowledging the empirical character of the managerial processes conducted is reinforced by the lack of concern to develop new development strategies, based on realistic diagnoses, marketing studies and macroeconomic forecast. The consequences of this situation, the overstraining of the management's operational side by affecting the competitive potential and adaptability of the company's activity are enhanced by the inappropriate structural sizing of the organisation and human capital of some activities such as forecasting and budgeting.
By synthesizing the aspects of the management activity diagnosis at the chosen organisation, a management system with delimitations between components occurs (informational, organisational, methodological and decisional) and without establishing all the required connections between them. The implications of such inconsistency of the managerial body are directly reflected in the low level of performances of the scientific management valences in the process of making the company's activity more efficient.
All these disorders are currently generating additional costs, which have a negative impact on the company's profitability, adopting restructuring measures being necessary.
The economic objectives summarise and quantify the long-term goals envisaged by the owner, the higher management and major stakeholders.
The fundamental objectives of the organisation are: increasing the turnover; increasing market share; increasing work productivity; increasing product quality. The priorities given to increasing the turnover and increasing the market share are due to the fact that recently, the economic agent works long periods of time below the break-even rate. Increasing work productivity is a prerequisite for achieving a primary social objective, related to remuneration, but also of a future economic objective to make a entrance the profitable activities. Increasing the quality of products and services contributes to achieving a priority economic objective which is strengthening the market position of the products manufactured by the company but also to gain insight by making higher profit rate of resources.
Social objectives can, in time, have a major impact on the development and performance of the company. As for the chosen organisation, the main social objectives are: remuneration and working conditions of the employees; customer satisfaction through quality, sustainability and price of the offered products; cooperation with the authorities; environmental pollution control.
Among the approaches or strategic methods to be considered for the chosen economic organisation, we mention: renewal of products and technologies, creation of strategic alliances, entering new markets, company modernisation, redesigning the management system, computerisation of activities.
The company's management will be put in a position to combine several strategic options. To have an idea over the combination between the strategic options regarding modern management methods to be used and the market to be approached, the matrix market/management methods is used, shown in Table 1.
The economic organisation may create a competitive advantage by perceiving and discovering new and better ways to compete, this actually being an act of innovation. Innovation is defined here more broadly, including both technological improvements and modern management methods and techniques [5]. It can manifest in changing the products, new market approaches, new types of distribution and new concepts on the purpose. Internationally, innovations that bring competitive advantages anticipate both the national needs and those outside the national borders. In order for an organisation to get competitive advantage, the perception of new market demands and a more rapid and more aggressive movement to exploit opportunities are required.

Table 1: Market/management methods for the chosen economic organisation

	Traditional management methods	Less modernized management methods	Modern management methods and techniques
Unchanged market		**REFORMULATION** Requires the establishment of a new balance between effort and result	**REPLACEMENT** New management methods and techniques replace the previous ones
Enhanced market	**RESALE** Management methods are applied in a new way.	**UPGRADED METHODS** Due to the modernization of management methods and techniques, productivity increases. The further modernization of these methods and techniques is required.	**EXTENSION OF METHODS** Because of the extension of management methods and techniques, productivity increases and costs decrease, which result in increased profits (gain of competitive advantage)
New market	**NEW USE** The benefits created by new findings concerning the methods of management, attract new customers	**MODERNIZED PRODUCTS/NEW PRODUCTS** New customers require the further increase of competitive advantage.	**DIVERSIFICATION/NEW MANAGEMENT METHODS AND TECHNIQUES**

Therefore, information should play an important part in the innovation process. Benchmarking can give the chosen entity a series of data on the ability of some leaders in their field of activity to improve their management methods through a collective and continuous effort. As it could be noticed from the experience of some leaders, the most sustainable competitive advantages depend on the quality of human resources and on the internal technical ability.

In this respect, Kaizen philosophy finds fertile ground for affirmation in the field of modern management methods, where quite obvious and spectacular progresses have been made, and maintaining on the market requires an own permanent effort to pursuit and apply the best practices, but also to highlight its own creativity potential [6].

For the planning phase used in benchmarking, the diagnostic method was employed. Diagnostic-analysis was initiated as a method to improve the management of a company and it was focused on the classical concept of "function of the enterprise" [2]. The primary sources of information were the operational data of the analysed company, work reports, interviews, observations on the occasion of visits, and also table of data.

The next stage in the development of benchmarking is the partner search stage. For their search, the basic rule should be mentioned, according to which, all partners will have to learn from a benchmarking study [3]. This is guaranteed through the selection of benchmarking partners whose performances are not very different. This creates the condition that each partner can benefit from taking part in these studies. A very important moment in benchmarking is the confrontation with questions from outside its own process. In certain

situations, aspects that have not been given enough attention could be identified. Therefore, many new things can be discovered [2].
Thus, we proceeded to identifying new potential study partners the main characteristic envisaged being the implementation in different stages of some modern production management methods and techniques and also the development of production activities in the field of industrial production.
For the phase of data collection, necessary to the benchmarking study, we have chosen the questionnaire method, which provides the opportunity that the questions are clear and sufficient to obtain all desired information, in view of making a real image on the benefits that can be gained from the implementation of these modern production management systems [2].
Given the results of this benchmarking study, we have depicted some conclusions which might apply both to the organisation for which the study was made, but also for the whole industrial production in Romania.
Therefore, we can say that, after the visits to the selected organisation, we noticed that this organisation continues to have a layout of equipment based on the principle of processing workshops (turnery, milling workshop, drilling workshop, etc.), although there are no longer any large scale production processes, which, in certain outdated concepts, would require the organisation of production spaces according to this principle [6].
As known from theory, layout of production areas consists of the physical location of plant, machinery and equipment involved in the production process. Any plant layout project or rearrangement of production stands should have its own objectives, which differ depending on the managers' opinions, the company's policy, as well as the actual conditions of this project.
Based on these theoretical aspects, and given the current existing conditions of the chosen organisation, due to the production of small quantities of a great variety of products, we considered it appropriate that the processing workshops are straight-line, depending on the technological manufacturing process. Therefore, I believe that the cellular method must be applied, which consists of establishing the theoretical layout scheme of the jobs in relation to the links between jobs and the volume of materials or products to be transported between them. According to this method, jobs will be located so as to ensure the best rational technological flow possible, by minimizing the volume of internal and crossed transports, since it is well known that long and unnecessary movements are a waste of energy from the employees and a waste of time, which can also be found as costs in the final price of the products manufactured by the company.
Having established the order of machinery layout in the workshops, I believe it is necessary to analyse the possibility of positioning the machines in parallel lines, wanting that, through this arrangement, an operator can service multiple machines. To make the servicing of multiple machineries by a single operator, they need to have multiple qualifications, namely to service different types of machineries.
For the successful implementation of these modern production management systems, serious discussions with the suppliers of materials and raw materials need to take place, suppliers who should be aware of the fact that, without their help, there cannot be the best conditions to carry out the activities within their own company.
Therefore, if suppliers will not deliver in time the materials or raw materials necessary to the production process, the company is forced either to interrupt this technological process, for lack of materials, or to over-supply, and store them in special places, for whose planning space and staff is required.
In addition to storage areas for the surplus of materials or raw materials and staffing to handle and maintain them, they can be damaged either during handling, or due to the action of atmospheric factors from the storage areas. These issues have an impact on the final costs of the products manufactured by the company, costs that will be supported by the customers.
Once solved the problems listed below, depending on the financial resources of the company, we can move to the implementation stage of one of the modern organisation and management

methods of the industrial production from the enterprise (Kanban, Just in Time, MRP, etc.), and therefore a feedback system should be provided, through which the decision factors from this enterprise can intervene in the event of deviations from the initially established objectives or improve performances of the ongoing system.

3. CONCLUSIONS

We believe that efficiency – value added are the main performances of gaining market power of the company, since market competitiveness, in the context of change, with its basic, customer-oriented component, is the "life belt" of any economic organisation.

With such a role, the competitiveness of economic organisations on the market should become priority „0" in the management of organisations, especially in industrial organisations. The problem of ensuring market competitiveness, namely winning the customer, has become even more complicated, as a result of the devastating effects of this crisis, which destroyed even the fragile balances that have been made on the markets, but especially the global ones.

Recovering these balances and finding a new place on the market is not only an urgent, but fundamental problem for any organisation.

We also tried to emphasize the role of benchmarking in the process of continuous improvement. Therefore, we have tried to elaborate some new modular structures to make the production systems more flexible, in view of generalizing them. The managements of some organisations intend to start a process of continuous improvement and use benchmarking instruments and techniques, aimed at: researching, designing, developing new modular structures with higher performances for the construction of devices, tools and machinery modernization, developing highly complex technologies, developing and using calculation methods, mathematical methods, algorithms and computer aided design for technologies and equipment.

Given the results of the research regarding the ways in which manufacturing activities can be improved in some companies, I believe that this is a way to streamline the management of industrial production, and by extending the method to macroeconomic level, it could be an actual way to revive this segment of the national economy, especially given the current economic crisis in which the national and international economy is [6].

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THE INFLUENCE OF THE MAIN TAX CATEGORIES IN THE EAST EUROPEAN COUNTRIES

Ilie BANU[1], Anne-Marie BARTALIS[2], Madalina POMANA (CARAUS) [2], Mirela SOGLU (CALUGAREANU) [3] Mihai Aristotel UNGUREANU

ABSTRACT

Taxation serves to acquire the necessary funds for public expenditure, to redistribute income, to stabilize the economy, to address externalities (environmental taxes, taxes on alcohol and tobacco), to determine the allocation of resources, at the same time being support for sustainable growth. Starting from Myles surveys simulation models on the effects of different tax reforms on growth, in particular the effects of tax shifts, we subscribe using SAS software on finding relationships between the impact of indirect, direct and social contributions on the public budget deficit and public debt on East European Countries and Romania in a globalized world. The conclusions of the modelling in the countries considered are that fiscal pressure influences the public deficit and public debt in different levels.

KEYWORDS

tax shifts, public debt, budget deficit, sustainable, economic growth

1. INTRODUCTION

Taxation serves to acquire the necessary funds for public expenditure, to redistribute income (progressive income taxation), to stabilize the economy, to address externalities (environmental taxes, taxes on alcohol and tobacco), to determine the allocation of resources, at the same time being supportive to growth. Therefore, the quality of taxation is a concept with many dimensions. Quality of taxation is dealing with designing tax policies to achieve desired policy objectives (redistribution, allocation, stabilization, etc.) in the most effective way - that is by minimizing undesired distortions, promoting growth, and minimizing the cost of tax collection. The Commission underlined the crucial role that quality of taxation and particularly the tax structure plays for economic growth and fiscal consolidation.

Taxes on labor can affect the production factor human capital in three main ways, by altering: i) the allocation of time between labor and leisure, ii) human capital accumulation and iii) occupational and entrepreneurial behavior and choices.

High marginal tax rates can also affect entrepreneurial activity, due to changes in the after tax rewards for taking risk related to it.

Taxes on capital are the most damaging to growth, by their effect on theinter-temporal allocation decisions.

Myles (2009a) theoretical models show that the long-run optimal tax rate on capital should be zero. The corporate tax system can affect: (i) where firms choose to locate their investment, (ii) how much they invest, and (iii) where they choose to locate their profits.

Consumption taxes are often regarded as less distortionary than income taxes, as they do not distort inter-temporal decisions the way income taxes do.

In the case of environmental taxes the distortionary, rather the corrective effect of taxes is welcome, as they aim to influence consumers and producers via price incentives towards the desired, for example, less environmentally harmful behavior.

Taxation of immovable property is considered as least distortionary, because these taxes do not affect the decisions of economic agents to provide labor, to invest in human and physical capital as straight as other taxes do. Moreover, the immobility of the tax base is another attractive property.

Myles (2009a) surveys simulation models on the effects of different tax reforms on growth, in particular the effects of tax shifts. Despite widely varying effects for tax-reform simulations on growth (from zero to non-negligible), Myles concludes: "almost all the results support the claim that a move from income taxation to consumption taxation will raise the rate of growth even though the predicted effect may vary." (Myles (2009a), p.44). This conclusion is supported by the simulation with the European Commission's Quest III Model, which finds that a consolidation through an increase in property taxes and consumption taxes is most favorable of all tax based consolidations as regards long run GDP (EC 2010b). Using econometric estimations led Arnold (2008, OECD WP) and Johansson et al (2008 OECD WP) conclude similarly that corporate and personal income taxes are the most damaging to growth, while consumption, environment and property taxes are least toxic (Taxation trends in the EU, 2011).

When referring to the classification of taxes into direct and indirect, we summarize the first significant direct tax advantages: tax equity and providing relatively stable income to the state.

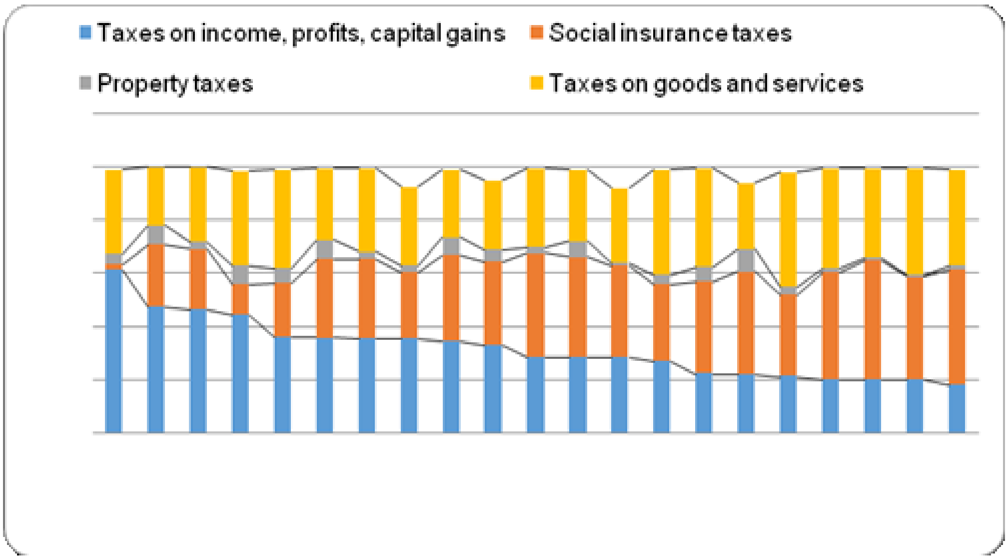
Direct taxation has, however, the major disadvantage of slow charging taxes at wide intervals of time. In addition, direct taxation is obvious and extremely irritable for taxpayers having a low yield. On the other hand, indirect taxes have a significantly higher yield, having also the advantage of higher speed of tax collection, while compliance costs required are lower. The great inconvenient of indirect taxation is tax inequity (due to the proportionality of the tax rate) and the fact that is not taking into account the particular situation of the payer. (Duma F.,2009)

In selected OECD countries, we outline the key trends in taxation between 1965-1999:

- taxes applied to income increased from about 7% of GDP in 1965 to almost 10% at the end of the period under review
- fees applied to companies have remained stable in the period around 3% of GDP
- compulsory social security contributions applied to both individuals and legal entities have nearly doubled (from 5.4 in 1965 to 10.3 in 1999)
- consumption fees remained stable in the analyzed period, being around 7% of GDP
- property tax burden has remained constant under 3% of GDP (Bailey S.,2004)

We emphasize that some taxes are less "harmful" than others in terms of the 4”E”. Considering this aspect, we consider that decision-makers are putting too much emphasis on consumption taxes (which actually are creating jobs) and insufficient attention on "negative" fees regarding negative externalities, for example, activities related to consumption of goods and services that pollute the environment).

Figure 1: Share of revenues by source from total taxes in 2010, in some OECD countries



Source: OECD (tax revenue by sector of total taxation), author's compilation

We selected some European countries from the OECD member states and ordered them descending, considering taxes on income, profit and capital gains. As shown in the above figure, Nordic countries are in the top, but another statement would be that both taxes (income taxes, profits and capital gains taxes and social security taxes) are constant in the countries analyzed, variations being small. For example, Slovakia, the country with the lowest rate applied to income, profits and capital gains (18.1%) has a 43.3% share of social security taxes, compared with Denmark which has the sum of the two rates by only 2 percentage points higher. Property taxes have a relatively low share in total and range from 1.1% in Estonia and 8.5% in France.

2. THE STRUCTURE OF TAX REVENUES

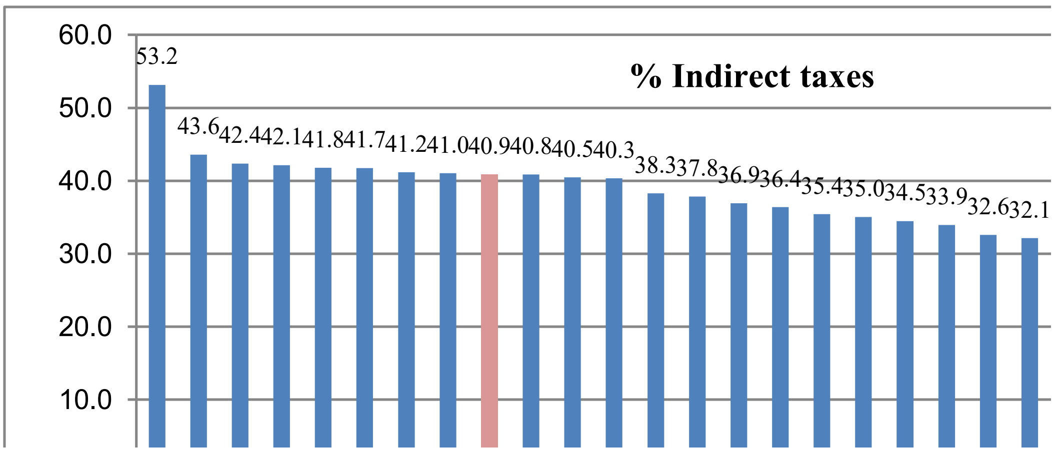


Figure 2: The structure of indirect taxes in total taxes in EU27 - 2009

In general, the structure of taxes in East European countries, characterized by a lower tax rate, differs. While most states have a structure of direct, indirect and social contributions quite balanced, Eastern European countries have a high rate of indirect taxes (Bulgaria - 53.2%, Estonia - 42.4%, Poland - 41.2%, Romania - 40.9%). Romania has a percentage of indirect taxes higher by 3.2 percentage points related to the EU average. If we consider the evolution of the share of indirect taxes in total tax rate, we can figure out that the share in Romania is relatively high. If Romania ranks 26 according to the pressure exerted by total taxes, it ranks 9 among the EU27 according to the share of indirect taxes in the total tax levy. Analyzing also the ranking of the 6 countries that joined the EU in 2004 we can see a high rate in Estonia (ranking 3rd place), Hungary (ranking 4th place), Poland (ranking 7th place) and a medium one in Slovenia (ranking 13th place) and Slovakia (ranking 15th place).

In the chart below, we have presented the evolution of indirect taxes compared with the EU27 average and the euro area.

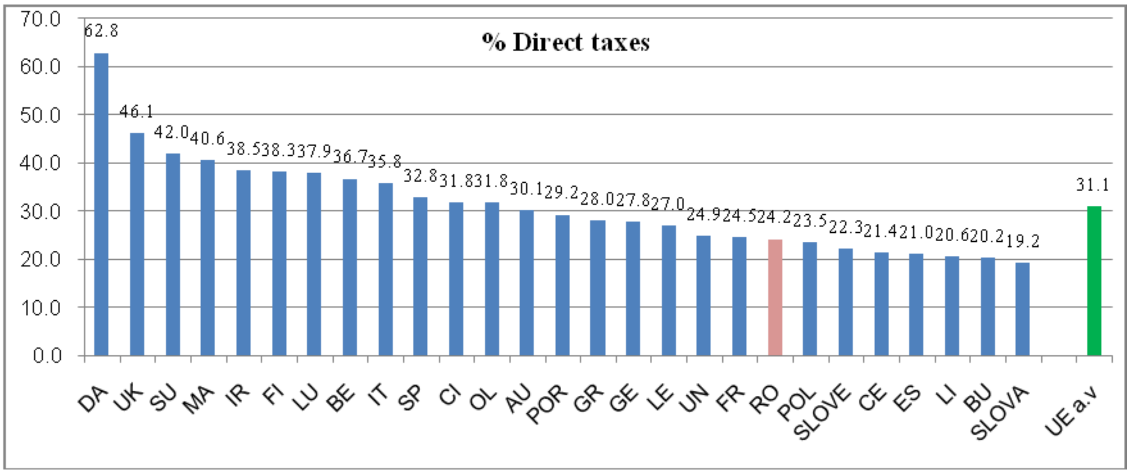


Figure 3: The structure of direct taxes in total taxin EU27 in 2009

Considering direct taxes, Romania has, on average, 6.9 percentage points less than the European Union, but the same trend applies also in the rest of Eastern European countries. The European average has the same value as countries like Netherlands, Austria and Portugal.

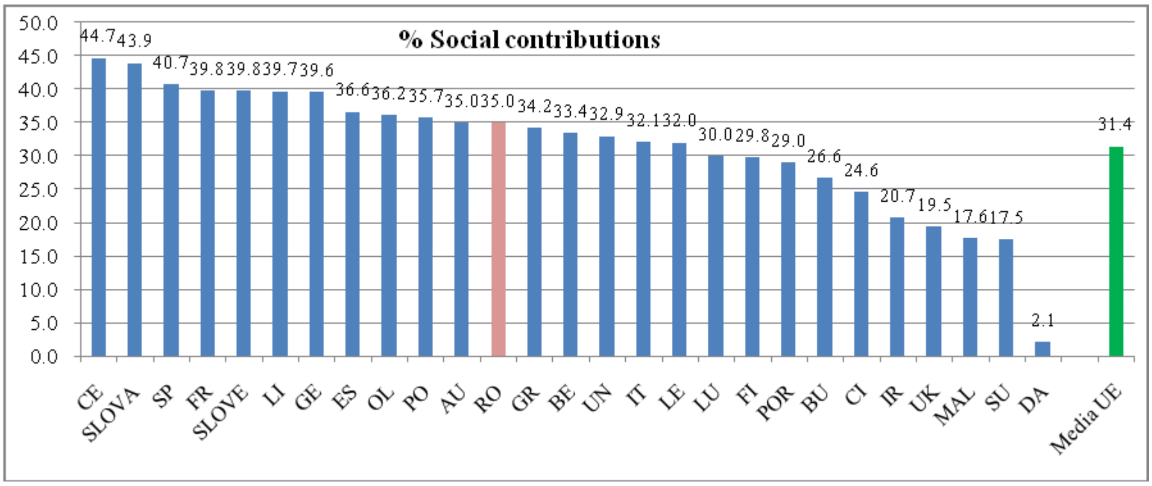


Figure 4: The structure of compulsory social contributions in total tax rate in EU27 in 2009

The low share of direct taxes in Eastern European countries is offset by high rates of indirect taxes and compulsory social contributions. Romania ranks 12th place with a percentage of social contributions in total tax levy of 35%, with3.6 percentage points higher than the EU27 average. Czech Republic and Slovakia occupy the first two places with the largest share of social contributions of the 27 countries analyzed, followed by Slovenia on the 5thplace, Estonia 8thplaceand Poland 10th place with 35.7%.

3. CASE STUDY: EMPIRICAL ANALYSIS OF THE IMPACT OF INDIRECT TAXES, DIRECT TAXES AND SOCIAL CONTRIBUTIONS ON THE SUSTAINABILITY OF PUBLIC FINANCE INDICATORS

This statistical analysis was performed by using EUROSTAT databases considering indirect, direct taxes and social contributions taxes rates in GDP, budget deficit to GDP ratio and public debt to GDP ratio.

The next step was processing data in SAS software and compiling a set of simulations.

- The impact of indirect, direct and social contributions tax rates to GDP on the budget deficit to GDP ratio at EU27 level

The regression equation in standard form is:

$$Y = a + b1 * X1 + b2 * X2 + b3 * X3$$

Given the performed simulation, the regression equation becomes:

Rdefbug / GDP= -39.54 + 2.45 * Rinto dialogue / GDP+ 2.01 * RIdir / GDP+ (-1.87) * Rcs / GDP

Parameter's values are summarized in the table below:

Table 1: Results generated for impact of indirect, direct and social contributions tax rates to GDP on the budget deficit

$R_{defbug/PIB}$	***Parameter***	***Value for t***	***Value for p(t)***	***Value for R coefficient***
a	-39.54826	-0.9	0.3859	
$R_{iind/PIB}$	2.4547	1.61	0.1352	0.701484473
$R_{idir/PIB}$	2.0104	2.09	0.0605	0.491624981
$R_{cs/PIB}$	-1.8734	-0.77	0.4556	-0.586349375

Source: author's compilation in SAS

Thus, from the analyzed data presented, we can conclude that the budget deficit to GDP ratio is influenced mainly by the independent variable, direct taxes to GDP ratio followed by indirect taxes to GDP ratio and social contributions to GDP ratio, these ago influencing indirectly and negatively the budget deficit to GDP ratio.

Analyzing the value of t = -0.9, and p (t) = 0.39 indicates a moderate influence (negative) to the rate of GDP budget deficit.

A correlation coefficient can range between [-1,1], and indicates the relationship between the two analyzed variables. In this case, the rate of the budget deficit to GDP ratio of indirect taxes in GDP is strongly correlated (R = 0.7). Regarding the budget deficit ratio to GDP correlated with the rate of indirect taxes in GDP, the value of R equals 0.49.

As a graphical representation of the period 1995-2009, we have chosen a PLOT (cloud scattering) generated with the GPLOT procedure and Bubble and Bubble2 option in which we have represented two vertical axis, on the left side being presented the indirect taxes to GDP ratio and on the right scale the social contribution to GDP ratio.

The impact of indirect tax to GDP ratio on the budget deficit ratio drawn in the graph with red bubbles with green text (dot represents the adjusted rates of direct taxes). The influence of social contributions to GDP ratio on the budget deficit to GDP ratio is indicated by blue bubbles with violet text (representing the adjusted size of debt ratio).

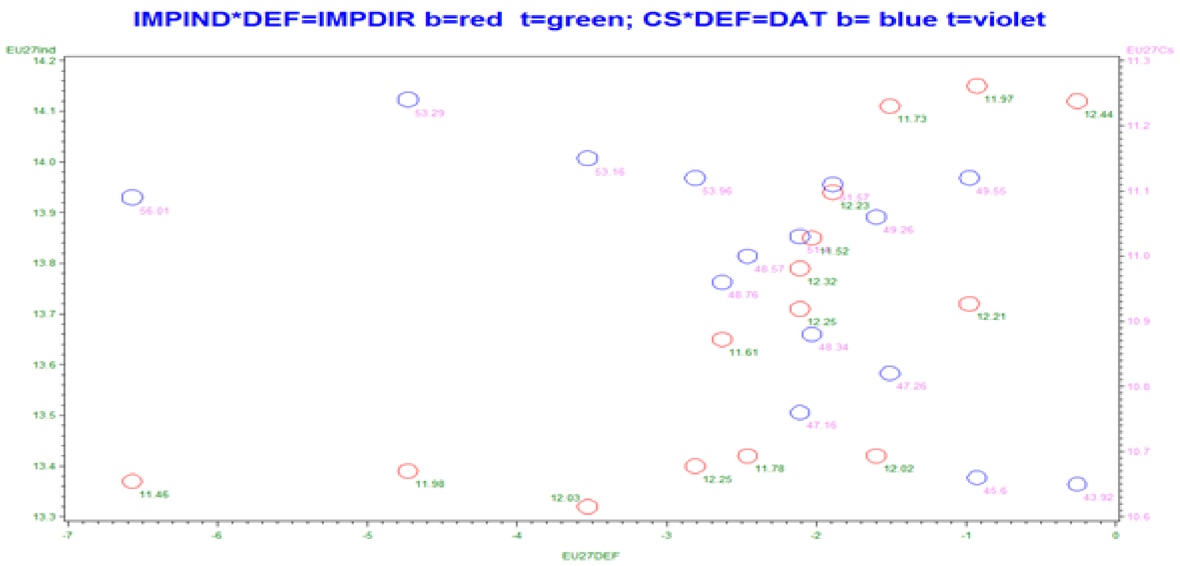


Figure 1: The impact of indirect tax to GDP ratio on the budget deficit ratio

Source: author's compilation in SAS software

For example, for an indirect taxes rate of 13,377 and the budget deficit to GDP ratio of -6.9 (effective values), the ratio of direct taxes to GDP corresponds to an adjusted value of 11.46.

4. THE IMPACT OF INDIRECT TAX RATES, DIRECT, SOCIAL CONTRIBUTIONS AND THE BUDGET DEFICIT TO GDP RATIO ON GOVERNMENT DEBT IN EASTERN EUROPE

The regression equation is:

$R_{datpb/PIB}$= -117.26 + (-1.36)*$R_{defbug/PIB}$ +(1.68)*$R_{iind/PIB}$ + (1.63)*$R_{idir/PIB}$+(-11.04)*$R_{cs/PIB}$

Parameter´s values are summarized in the table below:

Table 2: Results generated for impact of indirect tax rates, direct, social contributions and the budget deficit to GDP ratio on government debt

	Parameter	***Value for t***	***Value for p(t)***
a	*-117.26*	*-2.5*	*0.0314*
eu27def	*-1.363*	*-4.38*	*0.0014*
eu27ind	*1.6815*	*0.96*	*0.3578*
eu27dir	*1.63398*	*1.39*	*0.1941*
eu27cs	*11.038*	*4.3*	*0.0016*

Source: author's compilation in SAS

- The impact of indirect, direct and social contributions to GDP ratio on the budget deficit to GDP ratio in the 7 Eastern European Countries (Czech Republic, Estonia, Hungary, Poland, Romania, Slovenia and Slovakia)

Given the simulation performed, the regression equation becomes:

Rdefbug/PIB= 42.56 + 0.24*Riind/PIB + (-0.07)*Ridir/PIB+(-3.84)*Rcs/PIB

Where the parameter values are summarized in the table below:

Table 3: Results generated for the impact of indirect, direct and social contributions to GDP ratio on the budget deficit to GDP ratio

	Parameter	**Value for t**	**Value for p(t)**
a	*42.56424*	*2.31*	*0.0413*
$R_{iind/PIB}$	*0.24125*	*0.28*	*0.7829*
$R_{idir/PIB}$	*-0.07758*	*-0.25*	*0.8085*
$R_{cs/PIB}$	*-3.84492*	*-3.86*	*0.0027*

Source: author's compilation in SAS

Considering the results presented in the table above, which refers to the six countries which joined the EU in 2004 plus Romania, the budget deficit to GDP ratio is negative and significantly influenced by social contributions to GDP. The remaining variables do not have a significant influence on the rate of the budget deficit to GDP ratio. The chart below represents the impact of social contributions to GDP ratio on the budget deficit to GDP ratio.

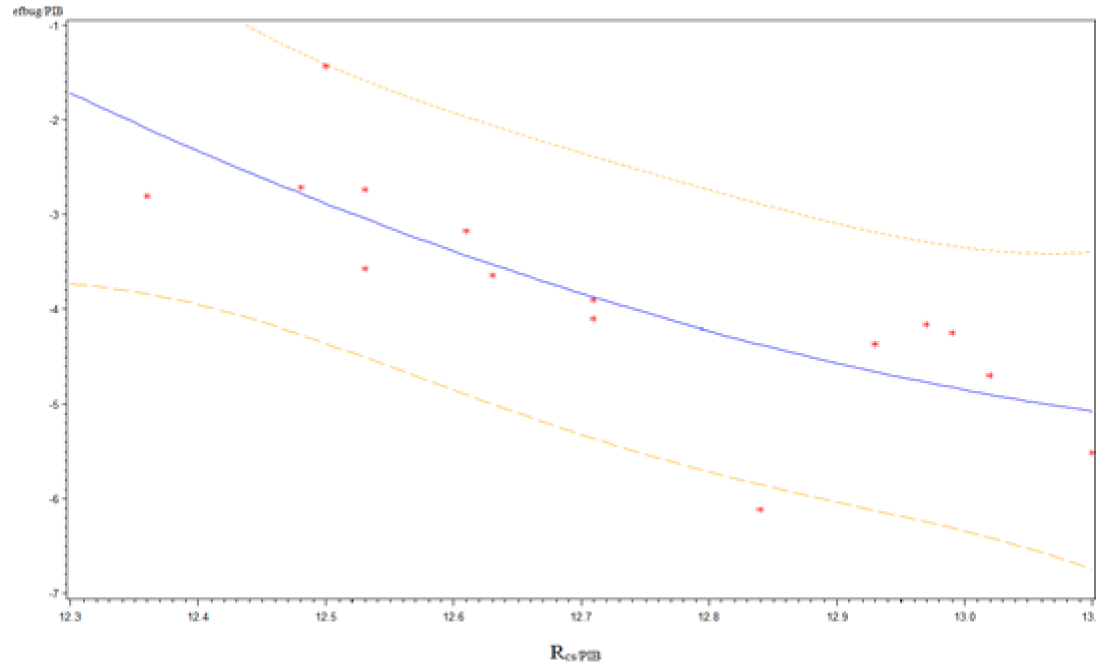


Figure 2: Impact of social contributions to GDP ratio on the budget deficit to GDP ratio

Source: author's compilation in SAS

5. THE EFFECT OF DIRECT TAXES, INDIRECT TAXES, SOCIAL CONTRIBUTIONS AND BUDGET DEFICIT TO GDP ON PUBLIC DEBT TO GDP RATIO IN EAST EUROPEAN COUNTRIES

Given the simulation performed the regression equation becomes:

Rdatpb/PIB= 74.90 + (-1.63)*Rdefbug/PIB +(0.92)*Riind/PIB + (-2,78)*Ridir/PIB+(-3.09)*Rcs/PIB

Where the parameter values are summarized in the table below:

Table 4: Results generated for the effect of fiscal pressure and budget deficit to GDP on public debt to GDP ratio

	Parameter	Value for t	Value for p(t)
a	74.8997	2.08	0.0646
eu27 $R_{defbug/PIB}$	-1.63793	-3.38	0.007
eu27 $R_{iind/PIB}$	0.91656	0.67	0.5209
eu27 $R_{idir/PIB}$	-2.7829	-5.53	0.0003
eu27 $R_{cs/PIB}$	-3.087	-1.26	0.2372

Source: author's compilation in SAS

The conclusions drawn from the results presented in the table above is that direct taxes to GDP ratio, budget deficit to GDP ratio and social contributions to GDP ratio have a negative and significant impact on public debt ratio to GDP. Indirect taxes to GDP ratio influence in a positive way the dependent variable, but not significantly.

6. THE INFLUENCE OF INDIRECT, DIRECT AND SOCIAL CONTRIBUTIONS RATIOS ON THE BUDGET DEFICIT TO GDP RATIO IN ROMANIA

Given the simulation performed, the regression equation becomes:
Rdefbug/PIB= -7,53 + 0,88*Riind/PIB + 0.07*Ridir/PIB+(-0.69)*Rcs/PIB
The parameter´s values are summarized in the table below:

Table 5: Results generated for the effect of fiscal pressure and budget deficit to GDP on public debt to GDP ratio

	Parameter	Valuefor t	Value for p(t)
a	-7.53854	-0.5	0.6298
RO $R_{iind/PIB}$	0.88251	0.92	0.3777
RO $R_{idir/PIB}$	0.0717	0.1	0.9215
RO $R_{cs/PIB}$	-0.68869	-0.96	0.3586

Source: author's compilation in SAS

Considering the following simulation regarding the evolution of the indicators analyzed in Romania, we found out that direct taxes to GDP do not affect the budget deficit ratio. Regarding social contributions to GDP ratio, the influence is moderate and negative. On the other hand, indirect taxes to GDP have a moderate but positive influence on the budget deficit to GDP.

7. THE IMPACT OF INDIRECT AND DIRECT TAXATION, SOCIAL CONTRIBUTIONS AND BUDGET DEFICIT TO GDP ON PUBLIC DEBT TO GDP IN ROMANIA

Given the simulation performed, the regression equation becomes:
Rdatpb/PIB= 43.13 + (-0,31)*Rdefbug/PIB +(-4.10)*Riind/PIB + (-2,46)*Ridir/PIB+(4.03)*Rcs/PIB

Where the parameter values are summarized in the table below:

Table 6: Impact of indirect, direct, social contributions and budget deficit to GDP on public debt to GDP

	Parameter	***Value for t***	***Value for p(t)***
a	43.12929	1.8	0.102
eu27def	-0.31344	-0.67	0.5209
eu27ind	-4.10057	-2.63	0.025
eu27dir	-2.45699	-2.21	0.0516
eu27cs	4.03429	3.45	0.062

Source: author's compilation in SAS

Regarding the results presented in the paper, we can observe a significant and negative influence of indirect and direct taxes to GDP on public debt to GDP ratio. Budget deficit to GDP ratio has a negative but not so significant influence on public debt to GDP ratio.

Social contributions to GDP ratio have a positive and significant effect on public debt to GDP ratio.

Table 7: Correlation coefficient of variables analyzed for Romania

	RODat	RODEF	ROInd	RODir	Rocs
RODat	1.00000	-0.23845 0.3921	0.36124 0.1859	-0.55732 0.0309	0.72080 0.0024
RODEF	-0.23845 0.3921	1.00000	0.18787 0.5025	-0.12017 0.6697	-0.03726 0.8951
ROInd	0.36124 0.1859	0.18787 0.5025	1.00000	-0.87076 <.0001	0.76874 0.0008
RODir	-0.55732 0.0309	-0.12017 0.6697	-0.87076 <.0001	1.00000	-0.73625 0.0017
Rocs	0.72080 0.0024	-0.03726 0.8951	0.76874 0.0008	-0.73625 0.0017	1.00000

Source: author's compilation in SAS software

The results obtained under PROCCORR procedure have the following understanding. Each variable is correlated with the other five variables. On the diagonal correlation variable with itself is always one, so the main diagonal is marked by the value 1, and correlation coefficients matrix is symmetrical to this diagonal. The first line of each box shows the strength of the link between the two variables, and the second row indicates the likelihood of the correlation coefficient between the two main variables in the community under the assumption the value of R = 0. For example, the correlation coefficient between variables RODat and Rocs is 0. So there is a strong positive connection.

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THE IMPACT ON THE ENVIRONMENT TRIGGERED BY THE INCREASED ENERGY CONSUMPTION IN CHINA – SOLUTIONS FOR A SUSTAINABLE DEVELOPMENT

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ABSTRACT

By this paper we aim to highlight the fact that the greatest pollution in the world today is produced by China, which uses over 60% coal in its energy mix. This aspect has very strong negative consequences on the environment on a local, regional and global level, by the important quantities of SO_2 and CO_2 reaching the atmosphere. At the same time, we wish to highlight the impact on the environment triggered by an excessive consumption of fossil fuels in China and what this country could do to use its primary resources to produce energy - efficiently. For its own economic growth, China needs energy, becoming dependent on the resources from other countries, such as: Russia, Middle East, and Africa. Therefore, by the research we have undertaken, we have tried to find solutions for a sustainable development of China. In our research, we started from the question: What solutions could be implemented in China for optimal energy consumption, in the context of sustainable development, knowing that, during the last thirty years, the annual GDP increase of China has been around 10% annually?, the market of China representing now 8% of the world goods and services trade, leaving behind even the United States of America. China needs to adopt a way of maintaining a solution to keep its GDP increase high, yet without endangering its own future and the future of the world. Today, increasingly more, pollution has become a serious problem leading to severe climate changes, which have been affecting the Earth's climate dramatically. The paper ends by the authors' conclusions concerning the environmental problems triggered by an uncontrolled energy production by China.

KEYWORDS

environment, energy, sustainable development, coal, pollution

1. INTRODUCTION

Today, one of the most important problems that the contemporary society is faced with is the issue of environmental quality and protection because pollution has been recording maximal levels.

Even since the oldest times, the issue of environmental quality has preoccupied man; yet, today, when mankind is faced with the aspects of industrialization, of the extension of the economic area, with the development of agriculture and the increase of the population number, the environmental quality constitutes one of the major concerns worldwide. One of the most significant world pollutants, following its rapid development during the last decennia, is China. The population of China, during the latest census of the year 2010, was of about 1,370,550,000 people. Although there are strict regulations in the environmental domain, such as the Environmental Protection Law of the year 1979, they are often ignored by the local communities and the governmental officials, in favor of a fast economic development, and a serious health problem in China is caused by its urban air pollution, given the fact that 16 out of the 20 most polluted cities worldwide are in China. Another serious problem of China, beside the massive carbon dioxide pollution is the pollution of more than 40% of the water resources, by industrial and agricultural wastes. Although in the year 2013 China has implemented a five-year plan, worth 277 billion USD, to reduce air pollution, especially in the north of the country, it has remained the greatest world pollutant in point of CO_2.Therefore, your full paper must comply with the format described here. The required text styles illustrated in this Microsoft WORD document must be used as a template for production of the full paper, by replacing the relevant text with your own. Please use word pre-defined styles in this template. The easiest way to use this paper form is by cutting and pasting unformatted text into each section to maintain the document's present format. The content should be compiled without changing the styles.

2. LITERATURE REVIEW

The issue of environmental pollution following the excessive consumption of primary energy resources by China and their impact on the environment has been studied by the Chinese specialists but especially by international European and world organisms such as the International Energy Agency, which publicized the results obtained both under the form of articles, and as ample analyses carried out on the level of each country in the world, in various publications such as: Energy Climate and Change, Tracking Clean Energy Progress 2015, China Daily – in English –, Science Ecology, Alternative Energy, Wind Energy, Solar Energy, Global Warming, Climate Changes, Reports of the Intergovernmental Panel on Climate Change / IPCC. According to the researchers, the emissions have grown faster between the years 2000 and 2010 than during the previous three decennia, and about half of the carbon dioxide emissions of the period 1750-2010 are due to the last 40 years, having a worrying effect on the planet, which determines the need that by the year 2100 the gas emissions worldwide should tend to zero for life to continue on Earth. Consequently, the importance of the global pollution issue triggered by China comes mainly from the concerns of different researchers in this respect, both on the level of China, and especially on the international level.

3. RESEACH METHODOLOGY

To gather the information necessary for our study we have used the theoretical documentary research – specific of any scientific approach, to acquire knowledge in the domain under analysis in order to start the empirical research process. To extract the theoretical information, the data were gathered from the databases of world publications in the domain of energy and industry of the International Agency for Energy. To analyze the various international reports, we have used the deductive and the statistical method, to understand their informational content and to arrange the material observations, quantified, clearly and concisely, for a good graphical representation of the data and for their correct interpretation. Practically, we consider that we have used a methodology merging fundamental and applicative research. The fundamental research undertaken has the advantage of putting together an important amount of data, offering, on the one hand, possible ways of reaching a consensus for all the existing debates on this topic and, on the other hand, highlighting future research directions relying on questions such as: What planet do we want to live on? What planet are we really going to live on· How long is life on Earth going to continue?

4. GENERAL APPROACHES REGARDING SUSTAINABLE DEVELOPMENT IN CHINA

The notion of sustainable development as it has been defined at different summits on this topic of the UN (Rio de Janeiro, Kyoto), refers to a model of socio-economic development that takes into account resource preservation and enviornmental protection. The most quoted definition of sustainable development is the one in the Brundtland Report of WCED: "sustainable development aims to meet the needs of the present without compromising the possibility of the future generations to meet their own needs". We consider that there are three key data in the appearance and development of the concept of sustainable development: - the first would be the year 1972, namely the moment of the Stockholm Conference; the second would be the year 1987, in the framework of the World Commission for Environment and Development, Department of Education (Western Cape) and the third would correspond to the year 1992, namely the Earth Summit. The concept has begun to be dealt with in a broader sense in the year 1987 as the Report "Our Common Future" was published, moment when the principles and laws of sustainable development were set. The Report pleaded for reconciling the economy with the environment, the accent falling on the development of the whole planet, present and future. As a development model in the urban areas, sustainable development has a number of peculiarities, given by the fact that, in the big cities, the environmental dimension, the economic and the social dimension condition one another the most strongly. The three domains refer to aspects such as: the economic domain - a certain level of revenues allowing a decent living for man; the social domain - covering a large array of topics such as child development, education, access to social care; these correspond to social, cultural and health needs, for a more equitable distribution of the revenues within and among the nations; the environmental domain - the future generations need to be able to breathe clean air and to benefit of the natural resources of the ground and underground having the role of maintaining the long-term viability of the ecosystems. Sustainable development appears only when the objectives of the three different zones (economic, environment and social) are met simultaneously. By attaining the objectives of two out of these three zones, the result is only a partial integration of sustainable development. In the large Chinese cities are concentrated the most numerous environmental problems, yet, at the same time, here are also concentrated most of the resources able to solve them: the most numerous economic operators, the most numerous investments, the most numerous human and financial resources. The latest act on sustainable development, the Kyoto Protocol, signed in 1997 and put into practice beginning with the year 2005 refers to the commitments of the international community on reducing greenhouse effect gases. The Popular Republic of China has not signed this agreement. The WHO Report highlights that only 31% of the Chinese cities meet the air quality standards. The cost of the damage triggered on the environment through pollution represents for China about10% of the GDP. These numbers highlight the fact that one of the greatest environmental problems in China is the pollution generated by burning fossil fuels. China holds the first position worldwide regarding carbon dioxide emission and the contribution to the annual global warming. China is the largest coal producer worldwide, with a continually growing production: from 2.226 billion tonnes in 2005 it reached 3.660 billion tonnes in 2013, which represents an increase of over 64%. By the end of the year 2006, the coal reserves of China were of 114 billion tonnes (black coal and lignite), situating it on the third place worldwide, after the USA and Russia. If the exploitation level remains on the level of the year 2012, China will exhaust its coal reserves in the next 31 years. The extraordinarily dynamic rhythm of the Chinese economy is likely not to decrease in the near future and, to maintain it, China introduces a new coal-based power plant every 7-10 days. In 2013, the power produced increased by 50 gigawatts compared to the previous year, which represents about seven times the annual power consumption of New York City. At the same time, China holds the record regarding the hidden costs involved by the power production. Regarding the coal use, it is necessary either to increase the GDP based on the continued exploitation and use of coal, or to generate power with a different intensity, produced using renewable energy resources. We can therefore ask ourselves the question: What policies should be put into operation to permit the implementation of a maximal sustainable development scenario? What could be done to decrease the emissions to a level that could be environmentally sustainable? To put China back on a sustainable track, we should rely on a price increase analysis to calculate the elasticity of the prices of the polluting emissions in China. To build such a price, it is not enough to throw a profit margin over the fixed and variable costs of the coal product or over the power provision service. Practically, we should test the market, how much it is willing to offer, in relation to the volume sold. The correct price is neither small nor great but exactly that amount of money which, covering the costs, maximizes the profit. Ideally, the provider should not remain with any unsold power quantity, and in order to do so, it should not produce only quantitatively, but also qualitatively, with as few gas emissions in the atmosphere as possible. Starting from the idea that when the price of a good or service decreases, the quantity demanded increases, next we shall discuss about how the optimal price for power can be set, as we wish the Chinese state to sell a cleaner and more affordable energy. The best known instrument for setting it is the "price elasticity", which shows how the volume of the demand is affected compared to the price modification. Let us take a concrete example, a Gcal produced by a mine in China for a price of 53 USD/Kwh, for which it has 100 consumers. Several months later, let us say that the respective mine increases the respective price to 60 USD/Kwh, yet it notices that it has fewer consumers, namely 80. We shall naturally ask ourselves the question: How should the provider proceed the following month? Decrease the price, or increase it a little more? Price elasticity

$$(PE) = (X - X)/X, (P - P)/P$$

where: X is the quantity and P is the price.

To interpret price elasticity, the minus sign is not taken into account.

PE > 1 Demand is elastic; a change of price triggers a major change in quantity;

PE = 1 Demand is unitary, a change of price triggers a proportional change of quantity;

PE < 1 demand is inelastic, a change of price triggers a minor change in quantity.

The last case is desirable, because a significant price increase will affect to a lesser extent the demand. PE = 0, the demand is perfectly inelastic, a major price change does not determine any quantity change. In our case, the demand is elastic; the provider will cash in less. The demand is very sensitive to price variation. In order to have had a unitary-elastic demand, it should have been of 100 consumers; therefore a modification by the same percentage of the price would have attracted the same number of consumers. Thus, the provider will decide to lower the price, waiting for larger sales. Supposing that the evolution would be proportional (often it is even exponential), one can calculate the form of the function, which is:

f(x) = - x + 75 (useful for price projections).

If the break even point (the moment when neither profit, nor loss is recorded) of the provider is 50 USD/kwh, then he can expect a number of 110 consumers for this price. If the production cost were lower, then it would be more profitable for the provider to choose the price variant of 50 USD/kwh. If, however, the real cost is 49 USD/kwh, the provider would earn the same amount of money, both for the price of 53 USD/kwh, and for that of 60 USD/kwh. It remains up to him to decide if he wants to win a market share including a larger number of consumers. Price is more often than not the first impression that a consumer associates to the service. The price segments the market and more often than not a too small price can be repulsive, while a big price can inspire trust, yet if the consumer does not receive the desired quality, he will reject the offer in the future. Why is demand elasticity smaller for certain goods, while for others it is bigger? The main factor is related to the existence or the inexistence of some alternative power sources. Coal could be substituted by wind, solar, hydro, nuclear power etc. An increase in the coal price will determine an increased demand for the substitutes enumerated above and a decrease of the number of consumers of the energy produced based on fossil fuels. Consequently, the services for which there is not a great number of substitutes tend to have an elastic demand, whereas a product for which there are no substitutes tends to have an inelastic demand. Yet, elasticity also depends very much on the weight of the service price in relation to the budget of a person or of a family. The elasticity of the demand also depends on the time horizon. A price increase does not trigger, in the short term, a decrease in the consumption, yet, in the long run, the consumers find solutions to diminish the expenses, such as isolating their homes. The price setting strategy can be everything. This can be the difference between impetus and collapse, between being the service that everyone will talk about or not. Thus, we can also state that sustainability in the energy sector can be considered by means of ***three approaches:***

- ✓ *Maintaining the revenues per capita.* The idea of maintaining the welfare standards is an essential component of sustainability – keeping the total capital constant in time;
- ✓ *Internalizing power externalities.* Power consumption or production is accompanied by emissions that are sometimes damaging for human health or for the environment. Pigou, a British economist, has shown that the negative externalities caused by pollution would be internalized by the market, if the pollutants were to pay a tax equal to the marginal social cost pertaining to the polluting emissions. Thus, during the last few years, an effort has been made to quantify these negative external costs related to power. Indeed, by evaluating the externalities of any power source and by internalizing them in the economic decisions of the power producers, it would be possible to have a more efficient power system;
- ✓ *Eliminating power subventions.* Subventioning the power sector has social, economic and environmental consequences. In reality, these subventions are not as attractive as people might expect. In poor countries, these subventions are meant to improve the fate of the population with average revenues, yet, however, they tend to practically improve the situation of a part of the population with large revenues because the poor population does not have access to the power network or cannot even afford to buy power benefting of subventions. Regarding the economic consequences, subventions reduce the price of fossil fuels, which will increase the coal quantity consumed and naturally will increase the quantity of polluting gases or greehouse gases reaching the atmosphere. Subventioning power, leads to global and local warming, thrugh an increase of the CO2, SO2, NOX and particulate matter emissions which are unfavorable for the environment.

There are very many discussions regarding the precise definition of subvention in the domain of energy and very little information regarding the level of the subventions in each country. In specialized terms, subvention means the payment, the funding by the State or by private persons – usually non-reimbursable – given to firms, private industrial groups, State groups, mixed groups or natural persons to cover the difference between the producer's cost and the sales price, in principle, when the price is smaller than the marginal cost, and in order to realize some specific actions and objectives. The power supply at accessible and reliable prices has a strong influence on economic sustainability, energy being vital for the economic development. Even though power subventions are very widely spread worldwide, it should be noticed that non-CEDO countries spend about twice as much as CEDO countries on power subventions. We actually consider that eliminating power subventions would support the three main goals of sustainable development, namely: social welfare, environmental protection and economic growth.

If power subventions were eliminated, the population would benefit from the perspective of the three domains as follows:

- *for the social component* the benefit would consist in the fact that the access to electricity improves the quality of life, by imprving public heealth, mobility and education;
- *for the economic component*, the benefit would consist in the elimination of this burden from the shoulders of the Chinese people, because practically this subvention granted by the government is public money, coming from the population from taxes and the money resulted from the elimination of this subvention could be used in the social domain – health, culture, education etc.;
- *for the environmental component,* the benefit would be immense, first of all for the environment and secondly for the health of the population.

The impact of the elimination of this subvention will depend on the circumstances specific of China, such as energy policies, the state of development of the power markets, the efficiency of the competition on the market, the power for which subventions are received and their level etc. Reducing (or eliminating) subventions permits to reduce the stimulation of the consumption or over-consumption of polluting energy sources. First of all, by removing a subvention, the Government would allow the energy prices to give correct signals to the consumers, consequently, the consumers would reduce the quantity of fossil fuels consumed, and the producers would decrease the coal production, promoting better technologies or at least less polluting than the fuels. The economic policies need to eliminate subventions for fossil fuels in order to protect the local and global environment, and then need to determine the producers to pay for the externalities they create by gas emissions, through carbon dioxide taxes, sulphur taxes etc.; this is how the Government can reduce the pollution. According to the specialists in this domain, over a billion domestic and industrial consumers of China do not pay bills equal to the real power price, adding 2,300 billion dollars to the burden of global subventions. The specialists consider that if the subventions for coal, oil and gas were eliminated, the level of CO2 emissions (contributing the most to the greenhouse effect) could go down by 20% worldwide**,** which will be much more efficient than any previous attempt to reduce pollution, while continuing to use fossil fuels. Consequently, several ***variants to reduce gas emissions in the atmosphere*** would be possible, namely:

- ✓ *eliminating subventions;*
- ✓ *increasing prices;*
- ✓ *making an increase use of alternate sources (solar, wind, hydro, nuclear, bio-mass energy);*
- ✓ *internalizing externalities (by applying a price to the gas emissions in the atmosphere) which is one of the most common ways of approaching pollution;*
- ✓ *reducing the number of cars etc.*

5. THE INFLUENCE OF COAL DEMAND ON POWER CONSUMPTION AND THE IMPACT OF THE LATTER ON THE ENVIRONMENT

China is the most populous country in the world and the second world economy after the USA. To support its economy, China needs huge quantitites of energy, especially electricity. For many scores of years, the coal consumption in China has had just one direction: up. China has huge coal reserves, being situated on the third place worldwide after Russia and the United States, the coal held by China representing approximately 12% of the world reserves. Since the basic energy mix produced by China could be characterized as "rich in coal and poor in oil and natural gas", China continues to rely on coal to generate energy. According to some of the research in this domain, the energy proportion obtained from coal rises to 72% of the total capacity installed and 80% of the total electricity generated. During the last few years, the proportion represented by coal in this mix increased because of the rise in the oil prices and because of its repeated absence. During the last 30 years the annual coal consumption in China went down only on two occasions, the most recently in 1997. Considering the political orientation of China towards diversifying the energy production system beyond coal and the great accent on air quality, the question is whether this tendency is going to stop soon, the result being a coal demand peak after the year 2019. The Chinese electricity market is the second in size worldwide, after that of the USA. Annually, 1950 billion Kwh are generated by the Chinese power plants. About three thirds of this quantity is produced by coal-based power plants. From here, one can deduce two important consequences: air pollution and increased CO2 emissions, leading to the amplification of man-made global warming. There is a possibility that both of these problems of the Chinese economy could be mitigated through the use of schyst gas. In the year 2015, about 65 % of the electricity generated has come from burning coal, around 15% from gas, about 15% from hydro resources and 1% from oil and around 4% from nuclear resources, namely uranium. From the perspective of consumption, most of the electricity generated by China is used in the industry, which represents over 75%. The rest is consumed by the dwelling sector 12%, trade sector 10% and agriculture 3%. The energy demand in the industry is given by the continual growth of the sectors of steel, cement and aluminium, which consume much energy. However, China, as a developing country, is not responsible for most of the bad things happening now in matters of pollution. It is responsible for the cumulated CO2 emissions of the period 1900-2015, along with the USA and the EU, which represent more than half of these emissions. It is true that, during the last few years, the emissions of China have suddenly increased, China taking the place of the USA as the first CO2 emitter worldwide, and in the year 2030, the Chinese emissions have been estimated to be 66% larger than those of the USA, which, at present, is situated on the 2nd place worldwide. This is a factor motivating this country to be interested in acting responsibly in this domain. Consequently, the following question emerges: What policies should be implemented to realize a maximally sustainable development scenario? What could be done to decrease the emissions to a sustainable level from the environmental perspective? The increase of the energy consumption is expected to have significant implications on the world energy market. China will be responsible for most of the demand for more coal.

For example, the coal consumption in the year 2030 will represent almost 60% of the energy production and around 40% of the world increase of the energy demand. The sectors with the greatest subventions are the greatest consumers of energy and the greatest producers of carbon such as coal and oil extraction and the electricity sector. An economy without these subventions would consume less energy and would produce less carbon dioxide, because only the best and the most efficient companies would survive. The specialists foresee that until the year 2030, coal will remain the dominant fuel for the production of energy, with a ratio varying between 52.6% and 63.2% of the entire energy produced in China, while the consumption of the other energy resources will increase less, an exception being the consumption of renewable energy resources, which will experience a certain impetus. The future of the Chinese coal depends very much on investments. If investments are made to improve productivity and transport, in order to protect the environment, China will remain a strong coal user. If not, because of the local, regional and global pollution, it might have to reduce its dependence on coal. However, according to most studies, China will continue to use over 50% coal in its energy mix, even in the year 2030.

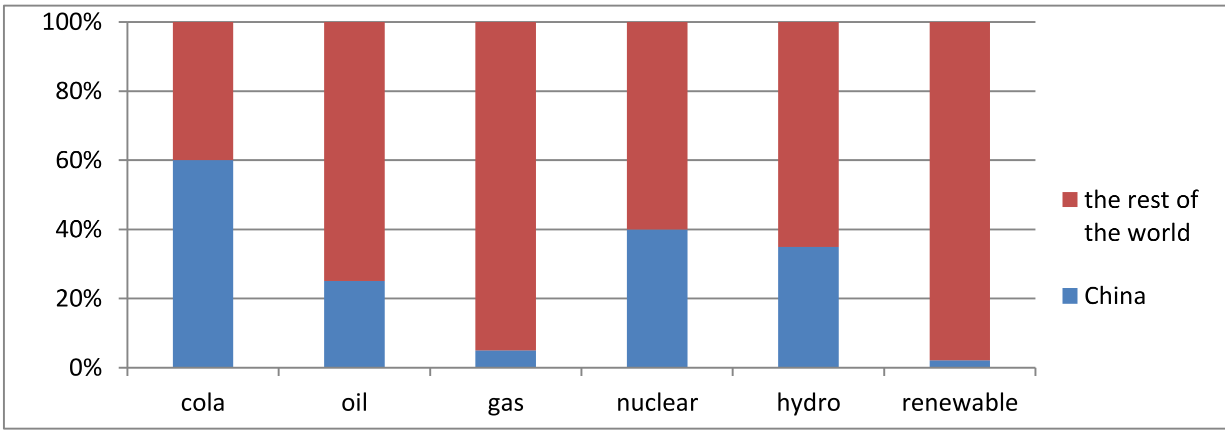

Figure 1: Energy production forecast, on the level of the year 2030 based on primary resources
Source: World Energy Outlook, International Energy Agency
http://www.worldenergyoutlook.org/media/weowebsite/2008-1994/weo2008.pdf

The main coal user remains the energy sector, and represents two thirds of the energy demand. China consumes today 40% of the world coal and this ratio coud go up to 50% until 2030. Its demand is forecast to grow to 3487 Mtec in the year 2030 (IEA, 2008). Regarding the production it is expected to grow to 3.399 Mtec in the year 2030, an aspect that might trigger extraordinary consequences on the environment. The decline of the Chinese emissions can be attributed to the decreasing coal consumption on the level of the country, the last year's decrease being the first of this kind in this century. The Greenpeace/Energydesk China analysis announced that the coal use in China decreased by 8%, and the CO2 emmissions decreased by 5% during the four months of the year, compared to the same period of the year 2014, and the process has been going on. As part of a reform of this sector, China has decided to close over 1,000 coal mines and the use of this resource has been decreasing, its percentage of reduction being set at 7.4% per year. An analysis of these data by Greenpeace/Energydesk, regarding the coal consumption in China, suggests that it has decreased by about 8%, and the CO2 emissions by about 5% during the first four months of the year, compared to the same period of the year 2014. If the reduction in the coal use continues until the end of the year, it will be the greatest recorded from year to year and also the greatest reduction of the CO2 emissions. At the same time, for the first time in the last 40 years, a stagnation of the CO2 emissions in the energy sector has been recorded, to the level of those of the year 2014, an all the more important aspect as it is not due to the economic decline of China.

Table 1: Coal consumption - million tonnes

Name of indicator	January-April 2014	January-April 2015	Difference
Coal production	1225	1150	-6,1%
Coal imports	111	69	-37,71%
Stocks	-9	-22	

Source: data by Greenpeace/Energydesk, 2014 and 2015

The calculation relies on a variety of sources, mainly on data regarding the industrial production of China for the month of April of the year 2015, which revealed a reduction of 6.1% of the coal production, during its first four months. This has been combined to a reduction of about 38% of the coal imports, and a reduction of the coal stocks. This calculation relies on the fact that each tonne of coal produced or imported needs to be consumed, stocked or exported. The data regarding the production come from the National Statistics Office of China while those regarding the stocks are from the National Energy Administration.

Table 2: Decrease of CO2 emissions, during the first four months of the year 2015 following the use of energy resources t/TCE (IPCC)Coal

Resource	Growth	Primary energy ratio	CO2 factor, t/tce (IPCC)
Coal	-7.7%	66%	2.77
Oil	4%	17.2%	2.15
Gas	6.6%	5.5%	1.64
CO_2	-5.2%		

Source: National Energy Administration 2015

One can notice a growth in the use of oil and gas of respectively 4% and 6.6% and a decrease in the use of coal of 7.7% triggering a decrease of carbon emissions of 5.2%, on the background of a growing use of solar and wind energy.

6. CONCLUSIONS

During the last decennia, China has suffered because of the pollution and of the serious deterioration of the environment. While regulations such as the Environmental Protection Law of 1979 are quite strict, they are nevertheless badly applied, being often ignored by the local communities and the governmental officials, in favor of a rapid economic development. The urban air pollution triggers serious health problems in the country, the World Bank estimating that in the year 2013, 16 out of the 20 most polluted cities in the world were situated in China. The country also has problems related to potable water. About 298 million Chinese, from the rural areas, have no access to drinkable water; until the end of the year 2011, 40% of the rivers of China were polluted by industrial and agricultural wastes. Despite the efforts made, the global greenhouse emissions have grown to unprecedented values. At present, China is doing its best to change the actual state of the atmosphere, which has become unbreathable on the Chinese territory. These changes could occur at reasonable costs, through a good collaboration of the world states regarding the world climate policy and through China's own development mechanisms. With the money that could be saved by suppressing the subventions and with the money gathered from the internalization of externalities (the pollution price), the Chinese government would be able to fund new infrastructures, and also to implement policies meant to improve the fate of the most underprivileged population. The realization of this desideratum of sustainable development and implicitly the fight against pollution can only be achieved by changing the present production and consumption patterns, unfriendly to the environment, by giving up on short-term approaches and visions, by correlating the sectorial, local, regional, national and international strategies and by counteracting some inertial forces that go against the sustainable development criteria and principles. What has turned China into a world leader in the industrial production is due to the low labor force costs, high productivity and relatively good infrastructure.

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STRATEGII DE MANAGEMENT ÎN ECONOMIA MINIERĂ

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ABSTRACT

Situația actuală a exploatărilor miniere din România ne prezintă o exprimare a deciziilor manageriale a acestui domeniu care dacă nu va fi îmbunătațit poate duce în viitor la o stopare a exploatărilor miniere nu datorită neprofitabilității acestui sistem ci datorită slabei gestionări a resurselor, a oportunitaților și a punctelor tari din acest sector industrial. Prezentăm în această lucrare câteva strategii de management care pot ajuta în armonizarea profitabilității minelor cu impactul economic, social dar și cu influența în mediului înconjurător. Transparența minelor și organizarea acestora într-un sistem eficient poate fi o binecuvântare ci nu o povară pentru România.

KEYWORDS

Management, mining, strategy

1. INTRODUCERE

Sectorul industriei miniere din România reprezintă un segment deosebit de important menit să susțină activ dezvoltarea economică a țării prin furnizarea unei game variate de produse minerale, utilizate ca atare sau ca materii prime.

Gestionarea eficientă şi utilizarea durabilă a resurselor minerale pentru a asigura aprovizionarea pe termen lung cu materii prime la nivel naţional, creând în acelaşi timp condiţiile prealabile pentru dezvoltarea economică într-un mediu global cu oportunităţi pentru activităţi generatoare de afaceri internaţionale.

Factorii implicați:

- mediul de afaceri;
- autorităţile responsabile ale statului (MECMA, ANRM, ARDDZI, etc.);
- învăţământul şi educaţia;
- institutele de cercetare-dezvoltare-inovare;
- organizaţiile profesionale, sindicale, asociaţii patronale, ONG-uri,etc..

În prezent, în Uniunea Europeana, cât și pe plan mondial, cererea de produse miniere, în special pe sectorul non-energetic este în creștere, același lucru manifestându-se şi în România.

Inițiativa Comisiei Europene privind materiile prime este esențială pentru funcționarea durabilă a societății moderne. Asigurarea unui acces fiabil și constant la materii prime constituie un factor din ce în ce mai important pentru competitivitatea UE și prin urmare un element esențial pentru creșterea economică și a locurilor de muncă în Europa.

În noiembrie 2008, Comisia Europeană a adoptat *"Inițiativa privind materiile prime – satisfacerea celor mai importante necesități ale noastre privind dezvoltarea și locurile de muncă în Europa" (Raw Materials Initiative)* care a propus o strategie integrată a Uniunii Europene ca răspuns la diferitele provocări legate de accesul la materiile prime ne-energetice. Aceasta a unit diferite politici ale Uniunii Europene, atât externe (ex. relații externe, comerț, dezvoltare), cât și interne (ex. mediu, competitivitate, inovare) și a promovat o mai strânsă cooperare între statele membre, acolo unde este cazul. Strategia se bazează pe trei piloni:

1. garantarea accesului la materii prime pe piețele internaționale în aceleași condiții ca și ceilalți concurenți industriali;
2. determinarea condițiilor la nivel comunitar, capabile de a favoriza o aprovizionare durabilă cu materii prime din surse europene;
3. dinamizarea eficacității globale a resurselor și promovarea reciclării în scopul de a reduce consumul de materii prime principale în Uniunea Europeană și de a reduce dependența față de importuri.

2. OBIECTIVE STRATEGICE ALE INDUSTRIEI

2.1. Obiective strategice generale:

- asigurarea resurselor minerale necesare dezvoltării durabile a țării, cu prioritate din producţia internă;
- armonizarea interesului naţional cu necesitatea atragerii de capital de investiţii şi cu incadrarea în cerinţele de sustenabilitate;
- atragerea în circuitul economic a unui număr cât mai mare și variat de resurse minerale;
- reducerea dependenţei de importurile de resurse de energie primară şi de materii prime minerale.

2.2. Obiective strategice specifice și directii prioritare privind cercetarea şi dezvoltarea tehnologică

Atingerea obiectivelor strategiei necesită pe lângă expertiza acumulată și formarea profesională şi recrutarea unei noi generaţii de specialişti practicieni şi cercetători. Mediul de afaceri are de asemenea, o contribuţie importantă în acest domeniu alături de administrația centrală din România, Ministerul Economiei, Comerțului şi Mediului de Afaceri, Ministerul Educaţiei şi Cercetării şi Autoritatea Naţională de Cercetare Ştiinţifică - ANCS.

ANCS va trebui să investească în programe de cercetare în sectorul resurselor minerale. Trebuie pus în aplicare un program de cercetare în sectorul resurselor minerale, cu scopul de a dezvolta produse noi şi inovative, procese şi servicii care să cuprindă toate aspectele legate de lanţul de utilizare al resurselor minerale.

O colaborare mai strânsă între grupurile de lucru din cercetare şi din industria extractivă (și cele conexe) poate fi sursa unor noi oportunităţi. Alături de alte state membre, România va milita pentru includerea vizibilă de propuneri din sectorul resurselor minerale în cadrul Programului (2014-2020), astfel încât acesta trebuie să devină un obiectiv cheie.

2.3. Obiective prioritare pentru cercetare-dezvoltare:

- minerit invizibil și inteligent;
- procese tehnologice, automatizare și optimizare inovativă;
- utilizare eficientă a materialelor, energiei și a apei;
- minimalizarea emisiilor de gaze;
- procese chimice şi biologice de îmbogățire;
- sisteme de date geodezice și modelare multi-dimensionale;
- tehnologii de explorare inovative;
- extragere și îmbogățire bazate pe high-tech a metalelor;
- reciclare, materiale noi și alternative;
- cuantificarea și managementul impactului asupra mediului.

Programul de cercetare generală trebuie să stea la baza fundamentării şi susţinerii politicilor şi strategiilor naționale de dezvoltare a sectorului minier, identificării tendinţelor noi, a direcțiilor critice în domeniul consumului, extracției, valorificării resurselor miniere și aspectelor sociale. În acest scop sunt necesare:

- studii economice privind dimensiunea cererii de materii prime minerale, dinamica achizițiilor și tendințele pieței care vor sta la baza elaborării strategiilor, modelelor alternative şi metodologiilor pentru susţinerea politicilor de dezvoltare națională;
- studii pentru diversificarea, protejarea şi punerea în valoare a bazei de materii prime minerale, fezabile și adaptabile la conjuncura de piață;
- studii interdisciplinare privind capacitatea de producție corelată cu impactul social și gradul de epuizare a rezervelor;
- studiul impactului de mediu asupra ariilor afectate în contextul modului și principiilor de exploatare a unui zăcământ prin opțiunea, în subteran sau la suprafață;

Programul de cercetare geologică trebue să conducă la constituirea bazei naționale de date cu privire la resursele minerale, să clarifice asupra perspectivelor de identificare a noilor zăcăminte să conducă la finalizarea lucrărilor geologice în zonele cu perspective de conturare a unor rezerve valorificabile.

Cercetarea geologică poate fi structurată astfel:

- studii de reevaluare și valorificare a fondului de date acumulate în ultimii ani, sistematizarea și interpretarea acestuia, in corelare cu datele existente anterior, în scopul evaluării gradului de cunoaștere a teritoriului și a perspectivelor de punere în evidență a unor zăcăminte noi;
- studii de reevaluare a fondului național de rezerve de substanțe minerale utile, ținând seama atât de conjunctura actuală și tendințele pieței cât și de evoluția tehnologiilor de extracție și prelucrare;
- studii de sinteză pentru evaluarea gradului de cunoaștere a condițiilor de geneză, metalogeneză și dezvoltare a faciesurilor purtătoare de mineralizații, în vederea localizării ariilor de perspectivă și fundamentărea programelor de cercetare viitoare.
- studii în vederea evaluării, din punct de vedere cantitativ și calitativ, a depozitelor antropogene (tehnogene) rezultate din activitatea de extracție și preparare a minereurilor (iazuri de decantare, halde de steril);

Cercetarea sectorială trebuie să conducă la diversificarea și perfecționarea opțiunilor tehnologice de producție și valorificare a produsului minier, să promoveze recuperarea substanțelor minerale utile din toate sursele disponibile (inclusiv zăcăminte izolate, depozite antropogene, deșeuri sau ape uzate), să detalieze cadrul tehnic atât la scară macro, pentru operatori mari cât și la scară micro pentru IMM-uri.

Arii tematice de cercetare ştiinţifică, dezvoltare şi inovare tehnologică:

- cercetări privind elaborarea de noi tehnologii în scopul valorificării superioare a substanţelor minerale utile şi utilizarea metodelor biotehnologice pentru tratarea deșeurilor și epurarea apelor reziduale;

- optimizarea fluxurilor de producție din punct de vedere al asigurării utilităților de bază: energie, microclimat, transport;

- adaptarea metodelor de deschidere, pregătire și exploatare, în condițiile reevaluării rezervelor din zăcământ și ținând seama de schimbările intervenite pe piața producătorilor de mașini și utilaje miniere;

- analiza stabilității fizice și chimice a perimetrelor miniere și depozitelor de steril şi studierea comportării în timp a reabilitării perimetrelor miniere și depozitelor de steril ținând cont de condițiile meteorologice și a potențialului local;

- studii şi cercetări privind realizarea la nivel naţional a hărţilor specifice privind

emanaţiilor de gaze din lucrările miniere subterane şi a zonelor de influenţă asupra comunităţilor locale, stabilirea cadrului legislativ necesar clasificării;

- dezvoltarea de tehnici, proceduri, tehnologii noi în scopul creşterii gradului de securitate şi sănătate în muncă, creşterii randamentului la lucrările de împuşcare şi reducerii pierderilor de substanţe minerale utile;

- cercetări noi asupra cauzelor apariţiei fenomenelor tranzitorii specifică atmosferei subterane, metode de prevenire şi combatere a lor în cazul exploatării subterane a substanţelor minerale utile; profilaxia şi combaterea fenomenelor de combustie spontană a substanţelor minerale utile (cărbune, sulfuri, etc.), cu proprietăţi de oxidare din subteran, suprafaţă şi depozite;

- optimizarea reţelelor de ventilaţie în care sunt prezente atmosferele potenţial explozive şi/sau toxice în scopul prevenirii, limitării şi combaterii fenomenelor de explozie care pot să apară la exploatarea în subteran a substanţelor minerale utile;

- dezvoltarea şi aplicarea unor tehnici noi (inclusiv gazeificare) în ceea ce priveşte extragerea şi valorificarea gazului metan din cărbune, din straturile de roci şi substanţe minerale utile purtătoare, inclusiv cercetări privind metode noi de valorificare a gazelor combustibil la concentraţii mici din curenţii de evacuare din subteran, la minele de cărbune şi petrol la nivelul staţiilor principale de ventilaţie;

- cercetări privind dezvoltarea unor metode neconvenţionale de recuperare a energiei termice din subteran, respectiv a energiei geotermice;

- cercetări privind identificarea unor destinaţii noi a reţelelor de lucrări miniere subterane (de exemplu: depozite subterane, fitoculturi, etc.);

- cercetări privind dezvoltarea de tehnici şi metode noi privind depozitarea de CO_2;

- cercetări privind valorificarea substanţelor minerale utile pentru reluarea exploatării în perimetrele aferente minelor închise sau în conservare, utilizând metode de exploatare cu un randament crescut și cu costuri investiționale minime.

2.4. Obiective prioritare pentru Substanţele Minerale Utile

2.4.1. Obiectivele prioritare pentru lignit

- concentrarea activităţii în perimetrele miniere cu potenţial de eficienţă economică;

- extinderea perimetrelor existente în vederea exploatării raţionale și valorificării superioare a zăcământului în concordanţă cu cererea de lignit la nivel naţional pentru perioada strategiei;

- asigurarea bazei materiale pe termen lung prin deschiderea unor noi perimetre în condiţii de eficienţă economică;
- masuri legislative pentru achiziționarea proprietăţilor imobiliare (terenuri, gospodării) necesare dezvoltării exploatării în cel mai scurt termen, după o justă despăgubire;
- continuarea programului de reabilitare, retehnologizare și modernizare a fluxurilor tehnologice mijloacelor de producţie corelat cu asigurarea bazei materiale pe termen lung;
- atragerea de surse de finanţare de pe piaţa de capital;
- refacerea mediului în cel mai scurt timp în zonele care nu mai sunt afectate de

activitatea minieră și diminuarea maximă a impactului asupra mediului natural în zona de activitate;

- atenuarea problemelor sociale determinate de încetarea activităţii ca urmare a

epuizării rezervelor în anumite perimetre sau din alte cauze;

- perspectiva repoziţionării cărbunelui ca sursa primara de energie strategică.

2.4.2. Obiectivele prioritare pentru huilă

- restructurarea activității de exploatare în entităţi separate viabile/neviabile, cu

afilierea celor viabile la structuri noi care să permită funcţionarea în condiţii de

rentabilitate;

-retehnologizarea exploatarilor miniere viabile în vederea eficientizarii activității de extracție;

- măsuri legislative pentru încurajarea exploatării gazului metan din cărbune în

perimetrele concesionate (CBM);

- prelungirea termenului de operare a concedierilor colective până în anul 2018;
- perspectiva repoziţionării cărbunelui ca sursă primară de energie strategică.

aper should include the following sections: Introduction, Methods, Results, Discussion, and References.

3. COMUNITATE LOCALĂ ȘI IMPACT SOCIALFIGURES / PICTURES / REFERENCES

3.1. Maximizarea beneficiului social

Se va promova conceptul de cooperare între comunităţile locale, companiile miniere şi autorităţile de reglementare, pe parcursul întregului ciclu de viaţă al activităţii miniere.

Companiile trebuie să adopte o responsabilitate socială corporativă, dezvoltându-și performantele economice într-o manieră etică (respect față de oameni și comunităţile locale).

Acţiunile întreprinse pentru atingerea acestui obiectiv trebuie să:

- țină cont de necesitatea de a respecta şi de a promova protecţia drepturilor omului;
- susțină responsabilitatea socială corporativă a întreprinderilor (CSR);
- practice politici de împărțire a veniturilor, asigurându-se că o parte rezonabilă a acestora merge la comunităţile în cadrul cărora se desfășoară activitatea de exploatare, echilibrând conflictele și sprijinind interesele locale.
- sprijine echitabil mediul de afaceri local, comunităţile, asociațiile de femei şi alte părţi interesate sau afectate de activităţile miniere.

3.2. Protecţia vieţii şi sănătăţii lucrătorilor din domeniul industriei miniere

Pentru protecţia vieţii şi sănătăţii lucrătorilor din domeniul industriei miniere – subteran, suprafaţă şi activităţi conexe- se va aplica şi pe mai departe abordarea naţională de cooperare între Ministerul Muncii Familiei si Protectiei Sociale (prin departamentele specializate de securitate şi sănătate în muncă), Inspecţia Muncii (prin Inspectoratele teritoriale de Muncă) şi Institul National de Cercetare Dezvoltare pentru Securitate Minieră și Protecție la Explozie-INSEMEX Petroşani, instituţie abilitată pentru efectuarea expertizelor

tehnice a evenimentelor generate de explozii şi incendii soldate cu victime sau pagube materiale, protejarea lucrătorilor, evaluarea şi atestarea tehnologiilor, instalaţiilor, echipamentelor, articolelor pirotehnice, explozivilor (inclusiv capse detonante, mijloace şi dispozitive de iniţiere sau control) şi personalului implicat în activităţi în legătură cu atmosferele potenţial explozive şi/sau toxice, caracterizarea proprietăţilor şi carcateristicilor amestecurilor explozive (salvatori, energeticieni, mecanici, operatori şi/sau responsabili).

Se va elabora un sistem dinamic de gestionare a riscurilor profesionale din industria minieră care să cuprindă cel puțin următoarele:

- definirea politicii de securitate și sănătate în muncă a angajatorilor care să

cuprindă: enunțarea obiectivelor de S.S.M, angajamentul angajatorului (efectele financiare), indicarea responsabilităților și a responsabililor pentru fiecare obiectiv, organizarea serviciului de prevenire și protecție, serviciul de medicină a muncii, pilotarea demersului de gestionare a riscurilor, identificarea pericolelor, evaluarea și caracterul riscurilor;

- planificarea prevenirii riscurilor: planul de prevenire și protecție, aprobarea

planului în cadrul Comitetului de Securitate și Sănătate în Muncă al fiecărui Angajator.

3.3. Asigurarea Resursei Umane- Personal competent, specializat în domeniul resurselor minerale

Sectorul resurselor minerale se confruntă cu o situaţie grea datorită numărului redus de specialiști. Media de vârsta a acestora este ridicată în tot sectorul și datorita perspectivelor de extindere și dezvoltare, necesarul de specialiști va crește cu siguranţă. Pregătirea personalului în România ultimelor două decenii a fost slab coordonată în acest sector, programele de pregătire fiind reduse, iar profesorii pensionați. În plus, sectorul resurselor minerale nu este

atractiv pentru tineri, datorită imaginii generale a sectorului. Industria minieră cere însă forță de muncă profesional calificată, antrenată în tehnici miniere moderne şi domenii hightech emergente, lucru care necesită programe adecvate în universitățiii de științe aplicate, colegii tehnice și școli profesionale.

Conceptul de durabilitate cu privire la utilizarea resurselor naturale trebuie să devină o parte integrantă acceptată a sistemului de învăţământ, în scopul de a promova o înţelegere mai largă a importanţei materiilor prime, alături de alte activitati didactice în stiintele naturii, încă din primii ani de școală. Acest lucru este important pentru planul de învăţământ general, şi în studiile economie şi studiile comerciale. Programe de formare în sectorul resurselor minerale trebuie să fie promovate în continuare pe termen mediu şi lung, cu eforturile de a consolida şi legăturile internaţionale. Statul va asigura o finanțare preferențială programelor de studii în domeniul resurselor minerale.

Aceste obiective trebuie aliniate cu cele ale „tinerilor în mişcare”, proiecte emblematice ale planului de dezvoltare Europa 2020, care are drept scop îmbunătăţirea rezultatelor sistemului de educaţie şi facilitarea accesului tinerilor pe piaţa muncii. Astfel, România trebuie să promoveze activ includerea obiectivelor de educaţie în sectorul minier și geologic în cadrul programelor de formare ale Uniunii Europene.

Statul va încuraja prin măsuri specifice (prin acordarea de burse, contracte privind integrarea în mediul economic la absolvire, etc.) dezvoltarea învăţământului vocaţional pentru minerit şi geologie. Acest lucru se va realiza prin parteneriate cu administraţiile publice locale şi agenţii economici interesaţi.

Formarea personalului competent din domeniul minier şi geologic prin:

-şcoli profesionale,

-cursuri postliceale,

-cursuri de calificare,

-colegii tehnice,

- învăţământul superior tehnic,

- cursuri universitare,

- cursuri postuniversitare,

- masterate,

- stagii doctorale şi postdoctorale,

- specializări, în scopul menţinerii şi dezvoltării expertizei tehnice a geologiei miniere.

Pentru acele categorii profesionale şi meserii care vor fi necesare ca urmare a evoluţiei tehnologice în domeniul exploatării resurselor minerale se vor propune noi standarde ocupaţionale, respectiv se vor actualiza cele existente, respectându-se prevederile legale referitoare la formarea profesională a adulţilor.

3.4. Impactul industriei miniere asupra mediului

- includerea prevederilor privind conservarea biodiversităţii în proiectele miniere;

- minimizarea deşeurilor generate, prin modele de producţie şi de consum modificate, contribuind la prevenirea generării deşeurilor și la reutilizarea, reciclarea şi transformarea deşeurilor în produse;

- creşterea reciclării şi reutilizării apei şi a altor resurse naturale, protecţia împotriva contaminării a apelor de suprafaţă şi subterane şi reducerea la minimum a energiei folosite pentru a produce materii prime şi produse derivate;

- implementarea la nivel naţional a cadrului legislativ european pentru industria minieră pentru proiectarea iniţială a instalaţiilor de depozitare, de decantare şi de gestionare a deşeurilor, de închidere, post-închidere şi remediere a siturilor miniere abandonate în aşa fel încât să prezinte risc neglijabil pentru sănătatea publică, pentru mediu, şi un impact social și de mediu redus în timpul funcţionării şi după închidere.

4. Domeniul finanțelor

Este esenţial ca industria minieră să contribuie semnificativ prin chirii, redevenţe şi alte forme transparente de plăţi, la o distribuire echitabilă între veniturile companiilor, cele ale autoritatilor locale și ale statului român.

Activităţile miniere contribuie la dezvoltarea durabilă în cazul în care generează venituri adecvate şi echitabile. Reprezentantii industriei miniere și statul, vor milita împreună pentru un regim fiscal solid şi echilibrat, precum şi pentru o bună gestionare a resurselor financiare, necesare pentru a garanta beneficiile pe termen lung.

CONCLUZII

- Trebuie avută în vedere maximizarea beneficiilor sociale ale zonei de exploatare minieră dar și a zonelor laturalnice atunci când se implementează o strategie pe termen lung cu privire la deciziile managementului si administrării bazelor miniere.
- Asigurarea resurselor minerale necesare dezvoltării durabile a țării, cu prioritate din producţia internă;
- Armonizarea interesului naţional cu necesitatea atragerii de capital de investiţii şi cu incadrarea în cerinţele de sustenabilitate;
- Atragerea în circuitul economic a unui număr cât mai mare și variat de resurse minerale;
- Reducerea dependenţei de importurile de resurse de energie primară şi de materii prime minerale.

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CUANTIFICAREA EFECTULUI REDUCERII ACTIVITATII EXTRACTIVE IN VALEA JIULUI. SCENARII ENERGETICE POSIBILE

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ABSTRACT

The future of the Jiu Valley coal mining is acutely hardened by a multitude of factors, arising from the interference of force lines of different decision centers, which effects – often exposing a cumulative and în some cases even antagonist manner- may lead to irreparable consequences. Avoiding to take into account all the economic, socio-geographic, technogenic and anthropogenic aspects în their embedment have not allowed until now the delivery of realist and viable scenarios which cut the Gordian knot of the multilevel challenge which this socio-industrial complex is facing with, scenarios which fundaments a coherent and consequent strategy, challenges which unsolved may produce irreversible an dramatic effects not only at area level, but also on a national scale. The paper intend to offer – at least as a methodological frame- an assessment based on scenarios of the achievements/losses which may occur by ignoring or no-taking into a fair account of the role of this industrial complex in the future picture of Romanian energy producing industry.

KEYWORDS

Scenariu, energetică, huilă, Valea Jiului

Motto: " Daca exista hotărâre, soluţiile pot fi găsite" spunea George Samuel Clason (1874-1957)

1. CONSIDERAŢII TEHNICO-ECONOMICE

O analiză, am putea zice acum superficială a deciziei de înfiinţare a Complexul Energetic Hunedoara (CEH) în noiembrie 2012, demonstrează că aceasta s-a bazat în primul rând pe criterii legate în principal de interdependenţa accentuată dintre furnizorul de resursă energetică (producătorul intern de huilă energetică, fostul CNH-SA Petroşani, divizat în anul 2012 în două entităţi independente, SNH respectiv SNIMVJ), şi cei doi producători de energie electrică şi termică existenţi în zonă, respectiv termocentralele Mintia si Paroşeni, şi în al doilea rând, dar poate cel mai important, pe criterii de natură socială, legate de caracterul cvasi-monoindustrial al zonei.

Cele două termocentrale incluse în structură sunt diferite din mai multe puncte de vedere:

- Termocentrala Mintia are o capacitate instalată teoretică de 1285 MWh, în 6 grupuri (5 grupuri de 210 MWh, din care unul retras din exploatare în 2012, şi unul retehnologizat de 235 MWh), dar care se confruntă cu probleme deloc de neglijat, şi anume:
  - Retragerea din exploatare a două grupuri deoarece nu îndeplinesc normele europene în ceea ce priveşte cerinţele de mediu;
  - Dezafectarea totală a unui grup care este propus la casare;
  - Investiţii în retehnologizare şi instalaţii de desulfurare şi şlam dens pentru celelalte două grupuri rămase care se estimează la aproximativ 203,5 milioane euro.
- Termocentrala Paroşeni dispune de un singur grup retehnologizat (respectiv grupul IV), cu o capacitate de 150 MWh, dat în exploatare comercială în august 2007. Cerinţele de mediu sunt îndeplinite parţial, investiţia în desulfurare şi şlam dens începând la mijlocul anului 2013, cu termen de finalizare estimat la 31 de luni de la demararea investiţiei.

Aşa cum s-a precizat principalul punct comun al celor două termocentrale îl reprezintă combustibilul cu care funcționează, respectiv huila energetică extrasă în bazinul minier Valea Jiului. Teoretic corectă, integrarea minelor viabile (aflate în subordinea SNH, devenită ulterior Divizie Minieră în cadrul CEH), în acest complex a fost făcută fără o analiză economică profundă şi fără a avea la bază un program coerent de restructurare şi retehnologizare. Necesitatea unui astfel de program este demonstrată de costurile de extracţie ale huilei, costuri care variază de la 92 lei/Gcal în cazul minei Vulcan şi 157 lei/Gcal în cazul minei Livezeni, cu o medie la nivelul diviziei miniere de 130 lei/Gcal.

Barometrul viabilităţii întregului complex gravitează în jurul preţului de vânzare a energiei electrice pe piaţa concurenţială, preţ mediu situat la nivelul lunii august 2015 la 180 lei/MWh (PZU) şi la 163,47 lei/MWh pe PCCB –LE . Ca bază de comparaţie, costul producerii unui MWh se situează la nivelul de 330 lei în condiţiile în care huila era partial achiziţionată la 52 lei/Gcal de la SNIM VJ.

În condiţiile în care peste 70 % din costul unui MWh îl reprezintă huila, iar acesta ar fi fost asigurata doar din explotarile miniere ale complexului ar rezulta un cost de producţie de 456 lei/MWh.

În aceste condiţii, Complexul Energetic Hunedoara trebuie sa rezolve probleme care nu au fost rezolvate din 1990 până în prezent.

2. SCENARII POSIBILE PRIVIND VIITORUL COMPLEXULUI ENERGETIC HUNEDOARA

Pornind de la cele prezentate mai sus, putem formula câteva scenarii cu privire la viitorul Complexului Energetic Hunedoara, şi anume:

A. <u>Scenariul 1- foarte pesimist :</u>

a. insolvenţa,

b. eşecul privatizării,

c. falimentul Complexului Energetic Hunedoara,

d. disponibilizarea şi trimiterea în şomaj a tuturor angajaţilor complexului.

B. <u>Scenariul 2 – pesimist moderat</u>

a. insolvenţa,

b. externalizarea componentelor actual viabile, respectiv Electrocentrale Paroşeni şi a maxim două exploatări miniere,

c. închiderea activităţilor neviabile, adică a Electrocentrale Mintia şi a celorlalte mine,

d. Disponibilizarea şi trimiterea în şomaj a 2/3 din angajaţii complexului.

C. <u>Scenariul 3 – pesimist moderat</u>

a. insolvenţa,

b. externalizarea grupurilor energetice viabile (Grup IV Paroşeni şi grupurile 3 şi 4 Mintia),

c. închiderea totală a activităţii extractive,

d. casarea şi valorificarea grupurilor rămase de la Mintia, import de cărbune şi achiziţie parţială de la SNIM Valea Jiului.

D. <u>Scenariul 4 – optimist</u>

a. evitarea insolvenţei

b. realizarea investiţiilor,

c. triplarea productivităţii extractive,

d. încadrarea în costuri,

e. supravieţuirea şi consolidarea complexului

În cazul scenariului 1, în care dispariţia industriei extractive a huilei în judeţul Hunedoara va deveni efectivă, efectele socio-economice vor fi atât imediate cât şi pe termen lung. Aceste afirmaţii sunt susţinute de o serie de date prezentate în continuare.

Ameninţarea asupra industriei extractive a huilei în judeţul Hunedoara se poate măsura atât în efecte imediate cât şi în efecte în timp. Totuşi, considerăm că cele două societăţi constituite la sfârşitul anului 2012, care divizează exploatările miniere în "mine viabile" şi "mine neviabile" trebuie să reprezinte doar o etapă în drumul spre revigorare a activităţii în bazinul carbonifer al Văii Jiului.

Pe de o parte Societatea Naţională de Închideri Mine Valea Jiului, care înglobează exploatările miniere Petrila, Paroşeni şi Uricani are că orizont de timp anul 2018. în cifre însă acesta societate înseamnă cheltuieli cu bunuri şi servicii de 57.052 mii lei, cheltuieli cu impozitele, taxele şi alte vărsăminte asimilate de 7.799 mii lei şi alte cheltuieli de exploatare de 9.609 mii lei. La acestea se mai adaugă cheltuieli cu salariile, bonusurile şi alte cheltuieli cu personalul, inclusiv cheltuieli de mandat de 82.241 mii lei şi cheltuieli cu asigurările şi protecţia socială (inclusiv platile compensatorii) de 47.475 mii lei. Cheltuieli pentru investiţii au fost estimate la 12.800 mii lei . La finele anului 2014 societatea avea un efectiv de 1.856 persoane şi un câştig salarial inclusiv bonusurile de 3.964 lei.

De cealaltă parte Societatea Complexul Energetic Hunedoara, compusa din fosta SocietateNaţională a Huilei (incorporata în urma unui proces de fuziune prin absorbţie în Complexul Energetic Hunedoara la mijlocul anului 2013) înglobează minele Lonea, Vulcan, Livezeni şi Lupeni, Exploatarea de preparare a cărbunelui şi Staţia de salvare miniera precum si Termocentralele Mintia si Paroseni. In cifre acesta societate înseamnă cheltuieli cu bunuri şi servicii de 309.877 mii lei, cheltuieli cu impozitele, taxele şi alte vărsăminte asimilate de 35.002 mii lei şi alte cheltuieli de exploatare de 183.251 mii lei. La acestea se mai adaugă cheltuieli cu salariile, bonusurile şi alte cheltuieli cu personalul, inclusiv cheltuieli de mandat de 309.194 mii lei, cheltuieli cu asigurările şi protecţia socială de 109.325 mii lei şi cheltuieli financiare 33.950 mii lei. Cheltuielile pentru investiţii au fost estimate la 115.360 mii lei. La finele anului 2014 societatea avea efectiv de 6.597 persoane şi un câştig salarial inclusiv bonusurile de 3.906 lei.

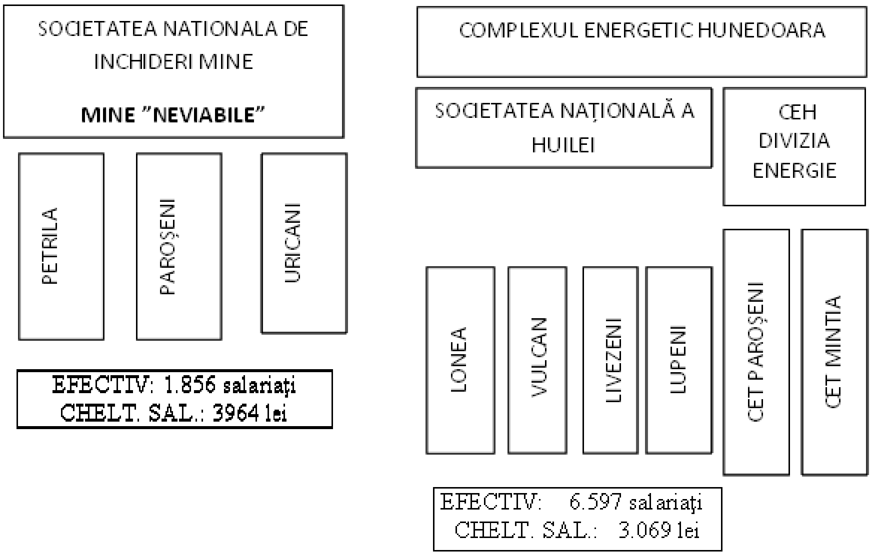

Figura:1. Structura organizatorică a industriei miniere în Valea Jiului

Efectivele de personal ale celor două societăţi reprezintă 7.68 % din efectivul salariaţilor înregistrat la sfârşitul lunii decembrie 2014 la nivelul judeţului, cca. 30% la nivelul Văii Jiului (n.a. estimat din lipsa de date statistice) respectiv (0.16% la nivel naţional) iar câştigul salarial al personalului din cele două unităţi reprezintă o influenţă importantă asupra nivelului salarial mediu brut de 1.888 lei înregistrat în judeţ la sfârşitul aceleaşi luni.

Contribuţiile salariaţilor la bugetul consolidat al statului, reprezentând CAS , CASS, SOMAJ, Impozit salarii s-ar situa anual la aproximativ 127.219 mii lei, iar din salariile nete principalele destinaţii sunt cheltuielile băneşti pentru cumpărarea de alimente şi băuturi aproximativ 78.473 mii lei, cumpărarea de mărfuri nealimentare 71.286 mii lei, plata serviciilor 58.207 mii lei, impozite contribuţii cotizaţii şi taxe 56.252 mii lei.

Pentru anul 2015 Societatea Naţională de Închideri Mine si-a propus venituri totale în sumă de 217.256 mii lei iar Societatea Complexul Energetic Hunedoara venituri totale în suma de 563.824 mii lei.

Pornind de la scenariile formulate cu privire la viitorul complexului putem estima pierderile suferite de statul roman :

A. **Scenariul 1- foarte pesimist :**

Statul român că urmare a încetării activităţilor de extractive a huilei pierde anual în mod direct aproximativ 199.601 mii lei din contribuţii la bugetul de stat şi bugetele locale la care se adaugă ajutoarele de şomaj care trebuie plătite foştilor sau potenţialilor viitori angajaţi. Şomajul la nivel judeţean ar urma să crească în mod direct cu peste 7.68 puncte procentuale.

In mod direct cifra de afaceri a societăţilor comerciale partenere şi conexe industriei extractive ar scădea cu aproximativ 366.929 mii lei anual, iar pierderea din contribuţia salariaţilor la cifra de afaceri/veniturile societăţile/instituţiile publice care produc si/ sau comercializează bunuri alimentare, mărfuri nealimentare, servicii, contribuţii, taxe, cotizaţii, etc. ar fi de 264.219 mii lei anual.

B. **Scenariul 2 – pesimist moderat:**

Statul roman că urmare a diminuării activităţilor de extractive a huilei pierde anual în mod direct aproximativ 133.733 mii lei din contribuţii la bugetul de stat şi bugetele locale la care se adaugă ajutoarele de şomaj care trebuie plătite foştilor sau potenţialilor viitori angajaţi. Şomajul la nivel judeţean ar urma sa crească în mod direct cu peste 5.15 puncte procentuale.

In mod direct cifra de afaceri a societăţilor comerciale partenere şi conexe industriei extractive ar scădea cu aproximativ 245.842 mii lei anual, iar pierderea din contribuţia salariaţilor la cifra de afaceri/veniturile societăţile/instituţiile publice care produc si/ sau comercializează bunuri alimentare, mărfuri nealimentare, servicii, contribuţii, taxe, cotizaţii, etc. ar fi de 177.026 mii lei anual.

C. **Scenariul 3 – pesimist moderat**

Statul roman, că urmare a stopării activităţilor de extractive a huilei, pierde anual în mod direct aproximativ 107.148 mii lei din contribuţii la bugetul de stat şi bugetele locale la care se adaugă ajutoarele de şomaj care trebuie plătite foştilor sau potenţialilor viitori angajaţi. şomajul la nivel judeţean ar urma să crească în mod direct cu peste 4.45 puncte procentuale.

In mod direct cifra de afaceri ale societăţilor comerciale partenere şi conexe industriei extractive ar scădea cu aproximativ 230.114 mii lei anual, iar pierderea din contribuţia salariaţilor la cifra de afaceri/veniturile societăţile/instituţiile publice care produc si/ sau comercializează bunuri alimentare, mărfuri nealimentare, servicii, contribuţii, taxe, cotizaţii, etc. ar fi de 154.923 mii lei anual.

D. **Scenariul 4 – optimist**

Nu ar exista pierderi, veniturile la stat s-ar ridica la un nivel de aproximativ 199.601 mii lei din contribuţii la bugetul de stat şi bugetele locale, contribuţia la cifra de afaceri ale societăţilor comerciale partenere şi conexe industriei extractive ar fi de aproximativ 366.929 mii lei anual, iar contribuţia salariaţilor la cifra de afaceri/veniturile societăţile/instituţiile publice care produc si/ sau comercializează bunuri alimentare, mărfuri nealimentare, servicii, contribuţii, taxe, cotizaţii, etc. ar fi de 264.219 mii lei anual.

3. ANALIZA SWOT PENTRU VALORIFICAREA HUILEI

Puncte tari:

✓ Existenţa unei rezerve industriale de circa 260 milioane de tone, în cele şapte perimetre active aflate în concesiunea celor două societăţi miniere, din care circa 94 milioane tone rezervă exploatabilă cu actuala reţea de lucrări miniere. Această rezervă poate asigurarea producţia de energie pe bază de huilă la actualul nivel pentru circa 100 de ani;

✓ Infrastructura existentă, la suprafaţă şi subteran, pentru extracţia huilei şi pentru transportul ei, pe calea ferată, la beneficiari;

✓ Concentrarea teritorială a exploatărilor miniere într-o zonă relativ restrânsă;

✓ Distanţa redusă faţă de beneficiari;

✓ Existenţa personalului calificat în activitatea minieră, tradiţie şi expertiză profesională la toate nivelurile;

✓ Necesarul de personal de specialitate este acoperit atât din punct de vedere calitativ cât şi numeric;

✓ Contribuţia esenţială la securitatea energetică naţională în situaţii de criză a altor resurse;

✓ Parametrii produselor realizate cu actualele tehnologii de exploatare şi preparare compatibile cu instalaţiile de ardere a cărbunelui, existente la beneficiari;

✓ Instalaţiile de preparare deţinute pot realiza produse cu un conţinut energetic mărit;

✓ Termocentralele româneşti sunt concepute să funcţioneze cu combustibil solid având parametrii calitativi ai huilei din Valea Jiului, ceea ce le crează o anumită dependenţă de exploatările miniere;

✓ Beneficiarilor li se pot asigura cantităţile necesare de cărbune energetic, la calitatea adecvată nevoilor proprii şi la un preţ mai mic decât cel al cărbunelui din import;

✓ Rezervele strategice de huilă pot juca un rol antispeculativ, fapt subliniat de Uniunea Europeana în contextual incapacităţii Uniunii de a negocia preţurile resurselor energetic şi de a exercita presiuni pe aceste pieţe;

✓ Ponderea ridicată a costurilor pentru transport în preţurile cărbunelui importat (circa 50%

din preţul cărbunilor energetici importaţi din Europa şi Japonia), fapt care pledează pentru utilizarea huilei din ţară.

Puncte slabe:

✓ Condiţiile geologo-miniere dificile de exploatare concretizate prin: adâncimea mare de exploatare, tectonica complicată, prezenţa gazului metan,s.a. ;

✓ Puterea calorică scăzută a cărbunelui din Valea Jiului, comparativ cu oferta de pe pieţele externe şi conţinutul mare de sulf din cărbune;

✓ Posibilităţile reduse de îmbunătăţire semnificativă a calităţii producţiei, cu actuala tehnologie de exploatare;

✓ Gradul scăzut de mecanizare a exploatării, utilaje şi echipamente miniere uzate fizic şi moral (complexe mecanizate pentru exploatarea cărbunelui, combine de înaintare şi de abataj, echipamente pentru perforare, echipamente de transport subteran a cărbunelui, echipamente pentru evacuarea apelor subterane, instalaţii de aeraj, instalaţii de extracţie, echipamente pentru automatizare şi dispecerizare);

✓ Lipsa unor tehnologii performante adaptabile condiţiilor de zăcământ, insuficienta dotare cu echipamente performante pentru tăierea cărbunelui, susţinerea abatajelor, perforarea găurilor, tăierea rocilor în lucrările de pregătire şi deschidere a câmpurilor miniere şi pentru forajul sondelor;

✓ Dificultăţi în exploatarea selectivă a cărbunelui;

✓ Cost de producţie ridicat;

✓ Productivitatea muncii la nivelul exploatărilor, sub 300 t/persoană/an, situată mult sub nivelul mondial;

✓ Riscul crescut de producere a accidentelor miniere favorizat şi de lipsa mijloacelor de monitorizare a spaţiului din abataje;

✓ Neexecutarea la timp a lucrărilor de investiţii, necesare pentru punerea în exploatare a noilor capacităţi de producţie, la majoritatea exploatărilor miniere;

✓ Rămâneri în urmă în executarea lucrărilor de cercetare geologică, pentru identificarea unor porţiuni de zăcământ care oferă condiţii bune de exploatare, cu implicaţii directe asupra dezvoltării capacităţilor de producţie viabile;

✓ Construcţiile industriale dezafectate în incintele minelor, că urmare a restrângerii activităţii şi neutilizate în alte scopuri.

Oportunităţi

✓ Necesarul crescând de surse de energie primară;

✓ Piaţa de desfacere relativ stabilă;

✓ Posibilităţile de creştere a veniturilor prin îmbunătățirea calităţii produselor;

✓ Creşterea ponderii cărbunelui în producţia termoenergetică pe plan mondial;

✓ Costurile încă ridicate ale producerii energiei electrice din surse regenerabile;

✓ Înființarea Complexului Energetic Hunedoara.

✓ Menţinerea unei infrastructuri miniere adecvată exploatării huilei astfel încât să fie asigurată continuitatea producţiei pe o perioadă mare de timp;

✓ Posibilitatea implementării proiectelor de captare a metanului din cărbune şi a emisiilor de metan din zăcămintele aflate în exploatare.

✓ Îmbunătăţirea calităţii cărbunelui vândut, cu mici investiţii în retehnologizarea sortării de la fiecare exploatare minieră;

Ameninţări

✓ Agravarea crizei economice mondiale;

✓ Vulnerabilitatea exploatării cărbunelui faţă de caracteristicile şi condiţiile geo-miniere;

✓ Creşterea costurilor de producţie generată de obligativitatea asigurării unor condiţii suplimentare de securitate şi sănătate în muncă şi de protecţie a mediului;

✓ Vulnerabilitatea socială mare datorată caracterului monoindustrial al zonei, a deteriorării situaţiei financiare;

✓ Reducerea numărului locurilor de muncă din Valea Jiului prin restrângerea activităţii miniere în condiţiile lipsei unei alternative economice reale;

✓ Dependenţa producţiei de cărbune de funcţionarea celor două termocentrale;

✓ Lipsa unui preţ reglementat al cărbunelui, apropiat de costul de producţie;

✓ Lipsa fondurilor pentru dezvoltarea extensivă a exploatării;

✓ Şanse reduse de asigurare a necesarului investiţional pentru rentabilizarea minelor viabile în condiţiile actualei forme de organizare;

4. PROPUNERI TEHNICO ECONOMICE PENTRU VALORIFICAREA HUILEI

Propunerile elaborate pleacă de la adevărul verificat în practică, că „Fără investiţii orice activitate este sortită inevitabil eşecului”.

1. Stabilirea rolului huilei în balanta energetica a Romaniei si dimensionarea reala a productiei
2. Realizarea unui program de investiţii în tehnologii şi utilaje care să determine reducerea costului de producţie a cărbunelui;
3. Investiţie într-un nou bloc energetic de 200 MWh cu parametrii supracritici la Paroşeni;
4. Realizarea investiţiilor de retehnologizare, desulfurare şi şlam dens la grupurile 3 şi 4 de la Mintia;
5. Implementarea proiectelor de captare a metanului din cărbune şi a emisiilor de metan din zăcămintele aflate în exploatare;
6. Investiţii în instalaţii de producţie auxiliare instalațiilor de desulfurare şi şlam dens;
7. Retragerea din exploatare şi casarea treptată a grupurilor 2, 5 si 6 de la Mintia
8. Realizarea unui nou grup de 400 MWh la Mintia ciclu combinat cu turbine cu gaze;
9. Realizarea unui depozit central în Valea Jiului, pentru omogenizarea şi livrarea cărbunelui spre beneficiari.

CONCLUZII

Pentru evitarea insolvenţei este extrem de importanta viabilizarea unor exploatări miniere, valorificarea metanului care însoţeşte zăcământul de cărbune din Valea Jiului precum şi gestionarea deşeurilor. In acest mod se contribuie la asigurarea independenţei energetice si totodată se pot rezolva şi alte probleme comune acestei zone geografice care vizează şi asigurarea viitorului CEH. CEH se afla intr-o situaţie delicata generată de dificultăţile prin care trece Sistemul Energetic Naţional, şi anume un excedent de energie electrică din surse regenerabile şi hidro pe fondul scăderii dramatice a consumului în România precum şi Acordurile semnate de Guvernul României cu creditorii externi FMI – BM - CE privind viitorul Complexului Energetic Hunedoara - privatizare şi în caz de eşec, insolvenţă .

Se apreciază că acţiunea de privatizare este sortită eşecului, iar intrarea în insolvenţă, convenită prin Scrisoarea de intenţie cu FMI - BM – CE, se va solda cu intrarea în faliment atât a minelor viabile cât şi a Termocentralei Paroşeni.

Dacă privatizarea va eşua, pentru a nu se ajunge în situaţia de a se decide administrarea judiciară, moment din care este practic imposibil de evitat falimentul , se propun următoarele:

a) - Elaborarea, de către specialiştii din cadrul CEH – Sucursala Paroşeni, Divizia miniera, SNMVJ, Universitatea din Petroşani şi Administraţia Locala, a unui proiect pentru identificarea tuturor potenţialilor consumatori de energie electrică şi termică, furnizată de Termocentrala Paroşeni, pe fondul scumpirii gazelor naturale. Principalele măsuri propuse pentru acest document strategic sunt:

- Dezvoltarea sistemului de termoficare în toată Valea Jiului prin lucrări de reabilitare a conductei magistrale , extinderea conductei magistrale în Uricani şi Petrila;

- Reabilitarea reţelelor de distribuţie a agentului termic şi a punctelor termice existente şi construirea unor reţele noi în Uricani şi Petrila;

- Furnizarea energiei electrice de la Termocentrala Paroşeni pentru toate administraţiile locale, populaţie si agenţi economici prin practicarea unor tarife concurenţiale;

- Demararea de investiţii colaterale care să folosească infrastructura energetica existentă;

- Achiziţionarea unei instalaţii ecologice de ardere a deşeurilor menajere şi valorificarea agentului termic în reţeaua de termoficare.

b)- Eficientizarea minelor din Valea Jiului. Se apreciază că necesarul de cărbune, corespunzător consumului de energie al Văii Jiului, nu depăşeşte cca. 1,5 milioane de tone pe an, dacă ţinem seama şi de energia suplimentară produsă din arderea deşeurilor şi din arderea gazului metan recuperat din zăcământ. Această producție se poate obţine cu 2.500 – 3.000 de angajaţi. Pentru exploatare trebuie selectate, după criterii tehnico-economice bine fundamentate, porţiunile de zăcământ care oferă cele mai favorabile condiţii de aplicare a tehnologiilor moderne de lucru.

Rentabilizarea activităţii în Valea Jiului se poate face numai prin identificarea unor noi consumatori şi creşterea cererii de energie termică şi electrică şi prin realizarea investiţiilor propuse.

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UN MODEL DE MARKETING INDUSTRIAL PENTRU PIAȚA ECHIPAMENTELOR MINIERE BAZAT PE ECONOMIA SPAȚIALĂ

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ABSTRACT

Față de caracteristica generală a piețelor industriale în general, piața echipamentelor pentru industria extractivă se caracterizează în primul rând prin numărul redus de furnizori - ca rezultat al mergingului și achizițiilor-, numărul redus de clienți - companii miniere multinaționale sau de stat puternice, și din acest motiv caracterul concurențial al pieței nu este determinant, iar studiile de piață bazate pe date statistice nu sunt relevante. Există produse cu caracter monopolist, caracter care se accentuează mereu prin fuziuni și achiziții, sau oligopol relativ echilibrat, iar fluiditatea pieței este redusă – piață mai degrabă vâscoasă – în special datorită specificității produselor și omogenității ofertei. Piața produselor industriale care face obiectul marketingului B2B este o piață dispersă, în sensul că producătorii (furnizorii) și consumatorii (clienții) sunt distribuiți teritorial în spațiu. Procesul de vânzare-cumpărare-achiziție- furnizare se derulează în timp și spațiu. Metodele de stabilire a echilibrului ofertă-cerere ignoră spațialitatea și presupun derularea procesului de marketing în mod instantaneu, iar aspectele legate de costurile de transport sunt eventual tratate separat. Modelele de echilibru spațial sunt cele care studiază comportamentul în spațiu al agenților economici, iar procesele economice sunt analizate din punctul de vedere al dispunerii lor spațiale.

KEYWORDS

B2B Marketing, Spatial economics , Mining Equipment, Field theory

1 Specificitatea Utilajelor (Echipamentelor) Miniere din Punct de Vedere al Marketingului Industrial. Caracterizarea Pieței

Față de caracteristica generală a piețelor industriale care caracterizează mai ales produsele high-tech (mobilitate structurală rapidă, durată de viață din ce în ce mai redusă a produselor, concurența indusă în special de scarcitatea materiilor prime și a energiei), cea a echipamentelor miniere se caracterizează prin impactul puternic al caracterului derivat al cererii – cererea depinde de cererea pieței din aval în care evoluează clientul – prin caracterul variabilității geografice determinat de mutarea centrului de greutate al activității miniere către zone geografice îndepărtate de locația furnizorilor, la care se adaugă o durată de viață relativ ridicată a produselor – inclusiv posibilitatea de reabilitare tehnică a dotării existente, datorită în special valorii lor reziduale ridicate – eterogenitatea cererii – atât pentru produse complexe cât și pentru componente – importanță redusă – rigiditate – față de modificarea prețurilor, etc.

Durata de livrare ridicată de ordinul lunilor, sau chiar anilor este de asemenea o trăsătură a acestor produse.Clienții sunt informați, fiind profesioniști cunosc foarte bine produsele, tendințele, au așteptări fundamentate rațional. Inexistența verigilor intermediare în lanțul de furnizare, predominanța vânzării directe, reprezintă o altă trăsătură. Existența leasingului ca alternativă la cumpărare este o tendință care se manifestă continuu.

Tendințele identificate într-o recentă analiză [1] arată că în domeniul mașinilor de săpat galerii (tuneluri) RH (Roadheaders) și cele de extragere continuă CM (Continuous Miners) respectiv cele ce realizează în plus și susținerea cu ancore BM (Bolt Miners) s-au înregistrat în ultimii ani (2012 față de 2008, n.a.) următoarele tendințe, interesând atât furnizorii (OEM) cât și clienții (Companii miniere):

- Piețele noi(ex. Rusia) nu s-au dezvoltat pe măsura așteptărilor, în timp ce în Asia se remarcă un progres important în extinderea utilizării acestor utilaje parțial automatizate[2];
- Comparația cu 2008 arată că piețe tradiționale, aparent dinamice (ex. SUA), înregistrează relative regrese și diminuări, în timp ce piețele noi (Australia, India) indică un potențial accentuat de creștere;
- Piețele în general cunoscute ca preferențiale (core markets) ca SUA, Africa de Sud, Australia, rămân saturate (saturarea pieței) și rata de reînnoire nu va depăși 100 de unități datorită presiunii tehnologice a minelor mici care preferă tehnologia cu front lung (LW) Long Wall, – unde utilajele definitorii sunt susținerile mecanizate și combinele de abataj – în locul tehnologiei cu camere și pilieri R&P (Room & Pillar) care utilizează CM, tehnologie tradițională în minele americane;
- Cu toate acestea, metodele INOVATIVE care folosesc CM, și deci cererea de astfel de utilaje va înregistra o creștere continuă (de exemplu pentru lucrări de pregătire în cadrul tehnologiei LW (LongWall), atât în mineritul carbonifer cât și în cel necarbonifer.

2 Segmentarea de Pieței de Utilaj Minier

Schimbarea generală a pieței din SUA afectează împărțirea pieței mai ales că SUA reprezintă piața domestică a firmei JOY GLOBAL. Scăderea ponderii SUA în populația CM a adus firmei JOY o pierdere de cca. 4% din cota de piață. Câștigătorul este aparent SANDVIK deoarece produsele lor pot cuceri piața non carboniferă. SANY a avut o intrare furtunoasă pe piață, dar aceasta a fost încurajată de o piață domestică puternică, până acum aproape nu este înregistrată prezența sa pe piața din afara Chinei.

Aflată mult în urma liderului de piață, Africa de Sud arată o corelație între aplicațiile majore și diferiții producători specializați. Piața clasică de R&P definește o cerere matură de CM și se întrevede o creștere în viitor a flotei. Cererea internă continuu crescândă și necesitățile de export a cărbunelui australian stau la baza acestei prezumții.

Condițiile geologice și proprietățile cărbunelui australian impun construcții mai robuste de CM decât în alte țări. Este de așteptat ca, în situația în care condițiile geologice vor deveni mai dificile, iar cererea de cărbune va rămâne cel puțin la același nivel, necesarul de mașini va crește. În aceste circumstanțe, scăderea în comparație cu piața CM și BM din SUA și Republica Sud-Africană, cea australiană este diferită. Lucrările de pregătire pentru tehnologia LW utilizează cca. 100 de unități din cele 130 aflate în flotă.

Avantajul comparativ al SANDVIK, specializat în aceste mașini, se manifestă printr-o cotă de piață de 31%.Scăderea cotei JOY pe piața Sud-Africană se explică doar prin accentuarea competiției. Aplicațiile CM și BM vor continua să rămână importante în mineritul carbonifer și al rocilor moi și pe viitor.

Piața este diversă și complexă, dar rămâne o provocare și o sursă de avantaje pentru OEM, cu diferențe variabile între regiuni și tipuri de aplicații.

Conform unui studiu efectuat de The Freedonia Group Inc., creșterea anuală a cererii globale de echipamente miniere, în expresie valorică, va fi de 8.6% până în anul 2017, ajungând la 135 miliarde USD. Această creștere va fi realizată în pofida unor scăderi ușoare a vânzărilor pe termen scurt.(Fig.2)

"Creșterea (cererii de echipamente) va fi stimulată de o cerere din ce în ce mai accentuată de materii prime minerale în China, India și alte țări cu industrie în curs de dezvoltare", arată Matt Raskind, analist la Freedonia. Creșterea cea mai rapidă se întrevede în piețele mari, aflate în dezvoltare(Brazilia, India, și în mod special China). Exprimat în termeni cantitativi, ponderea producției miniere de minereuri metalice va fi mai redusă decât nemetalicele și cărbunele, dar segmentul cel mai important al pieței globale a echipamentelor este tocmai cel metalifer. Aceasta în special datorită scăderii continui a conținuturilor acestor zăcăminte, care implică o masă minieră mai mare de extras.

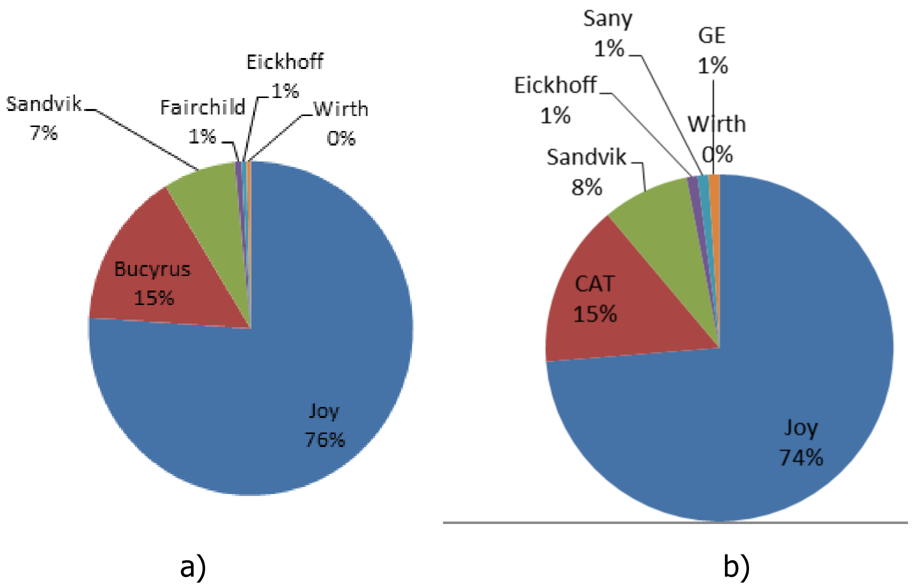


Fig. 1. Distribuția ponderii pieței principalilor furnizori la nivel mondial în anul 2008 (a) față de 2012 (b)

De aceea creșterea cererii de echipamente miniere pentru acest sector va înregistra cel mai înalt ritm până în anul 2017, stimulată de cererea de oțel și aluminiu.

Creșterea continuă a populației va stimula de asemenea o expansiune a investițiilor în agricultură și construcții, ceea ce va atrage creșterea corespunzătoare a vânzărilor de echipamente pentru extragerea materialelor de construcție(agregate) și de îngrășăminte chimice minerale(fosfați).

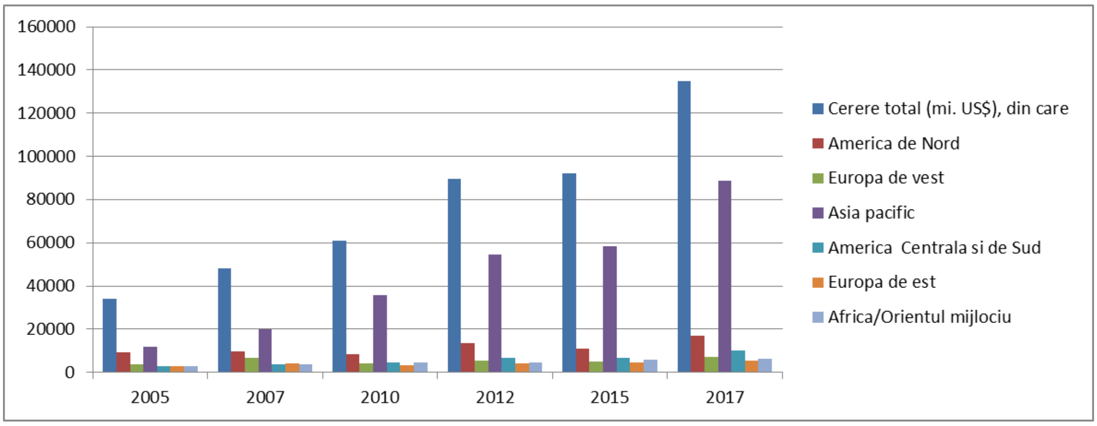


Fig.2 Evoluția și prognoza cererii de echipamente miniere

Cea mai mare creștere a vânzărilor de echipamente va fi în regiunea Asia/Pacific, determinată de creșterea așteptată a investițiilor în noi capacități miniere. O creștere a cererii se va înregistra în America de Sud, ca urmare a extinderii exploatării de noi rezerve de bauxită, cupru și minereu feros.

Saturarea pieței de cupru, observată în anii 2012-2013 se va calma, producând o revenire a prețurilor și conducând la o creștere a cererii de echipamente specifice în țările bogate în minereu de cupru, cum sunt Chile și Peru. Africa/Orientul mijlociu, Europa de Est și de Vest, precum și America de Nord, vor înregistra o creștere mai lentă a cererii de echipamente, reducerea cererii de cărbune energetic fiind parțial compensată de creșterea cererii de material de construcție, mai ales în țările în curs de dezvoltare. Aceasta va atrage o modificare în tipologia echipamentelor miniere cerute.

3 Model de marketing bazat pe teoria economiei spațiale

Globalizarea piețelor industriale ridică noi provocări teoretice și operaționale în știința și practica marketingului. Coagularea producătorilor în câteva centre de influență și concentrarea clienților în companii multinaționale dar dispersate geografic în zone de interes, readuce în actualitate modelele economie spațiale – apărute în perioada extinderii producției agricole de mare amploare în condițiile congestionării transportului și lipsei accesibilității prelucrătorilor.

Dacă primele lucrări se refereau la binomul fermă-moară, astăzi se poate aplica teoria localizării la relația producător concentrat – în arii geografice puternice economic și clienți care operează în zone îndepărtate, în locații disperse.

Acesta este cazul producătorilor de echipamente miniere care s-au concentrat în țările dezvoltate economic în zone ca America de Nord, America de Sud, Uniunea Europeană, Australia, dar și India, China, Federația Rusă. Clienții sunt în general marile corporații miniere multinaționale, cu unitățile productive amplasate în zonele cu potențial mineral (includem aici și cărbunele și excludem petrolul și gazele).

În aceste condiții, pe baza studiului de caz referitoare la piața echipamentelor pentru industria minieră, se pot aplica metodele economiei spațiale și teoriei localizării**.** Piața produselor industriale care face obiectul marketingului B2B este o piață dispersă, în sensul că producătorii (furnizorii) și consumatorii (clienții) sunt distribuiți teritorial în spațiu. Procesul de vânzare-cumpărare- achiziție- furnizare se derulează în timp și spațiu. Metodele de stabilire a echilibrului ofertă-cerere ignoră spațialitatea și presupun derularea procesului de marketing în mod instantaneu, iar aspectele legate de costurile de transport sunt eventual tratate separat.

Modelele de echilibru spațial sunt cele care studiază comportamentul în spațiu al agenților economici, iar procesele economice sunt analizate din punctul de vedere al dispunerii lor spațiale.

Modelele clasice se bazează pe ipoteza 'punctualității' economiei și ignoră, de obicei, aspectul situării geografice a agenților și piețelor. Problemele esențiale ale analizei economice ca, de exemplu, ce trebuie produs, cum trebuie produs, pentru cine trebuie produs, sunt studiate fără a lua in calcul distanțele, costurile de transport sau alte neajunsuri generate de dimensiunea spațială a pieței. Aceste imperfecțiuni sunt înlăturate de modelele economiei spațiale.

Având in vedere că activitățile economice sunt derulate nu doar în timp, ci și în spațiu, aceste modele introduc conceptul de regiune,care definește astfel un subsistem spațial al unei economii.

Primele încercări în domeniu sugerau formularea unor probleme de optimizare si echilibru pentru piețe separate spațial, care pot fi privite ca noduri ale unei rețele în care costurile de transport sunt luate în mod explicit în considerare, aceste modele fiind de fapt o generalizare a problemei clasice de transport.

Există două abordări în modelarea economiei spațiale: abordarea discretă sau continuă. Abordarea discretă domină literatura de specialitate, deoarece aplicațiile practice operează cu mulțimi finite de date.

În această abordare, spațiul este considerat ca o mulțime finită de noduri, în care se derulează activități economice (producție și/sau consum), noduri interconectate prin arce sau legături de comunicare. Toate atributele legăturilor ca: incidență, costuri de transport, fluxuri, pot fi reprezentate prin matrici.

Această structură algebrică însă nu are semnificație geometrică de ”spațialitate” cu atribute specifice ca: dimensiune, mărime, formă.

Alternativ, spațiul poate fi considerat ca un spațiu geografic bidimensional,continuu, proiectat pe o oarecare hartă, cu activitățile economice posibil de a fi amplasate oriunde, iar fluxurile de produse sunt descrise ca fiind câmpuri vectoriale în plan, cu mărime și direcție variabile în spațiu. Aceasta a fost de altfel poziția clasicilor economiei spațiale. *(von Thünen* (1826), *Launhardt* (1885), *Lösch* (1940)).

Avantajul punctului de vedere continuu, mai mult sau mai puțin neglijat în ultimii ani este acela că oferă o imagine realistă a spațiului geografic, pe care se proiectează elementele specifice pieței - producția, consumul, schimburile, prețuri etc.

Punctul de vedere discret are avantajul formalizării, prin doi indici de poziție (est-vest) sau (nord-sud). Un motiv pentru care acest avantaj nu a fost exploatat este că în analizele spațiale aria este discretizată în elemente finite de suprafață, de tip triunghiular mai degrabă decât rectangular, din motive de facilitate computațională.

Trecerea la spațialitatea continuă, a relevat dificultatea tratării în două dimensiuni, ceea ce a condus la majoritatea abordărilor, la analiza unidimensională, (duopolul arhicunoscut al lui Hotelling, 1929).

Simplificarea a fost binevenită pentru validarea metodei, dar modelul unidimensional și-a atins limitele atunci când s-a dorit a se lua în calcul și o variabilă temporală.

Analizele spațio-temporale ulterioare nu au putut evita capcana bidimensională, deoarece, timpul și spațiul, chiar reduse la o dimensiune nu sunt același lucru. Dacă între stânga și dreapta nu e nici o diferență, intre trecut și viitor, este. De aceea pentru studiul spațialității sistemelor liniare necesită a doua derivată, în timp ce pentru procesele temporale este suficientă prima derivată. Reducerea spațialității la o singură dimensiune poate da naștere la înțelegeri greșite.

Altă cale de a reduce dimensionalitatea spațiului este să consideri o simetrie circulară a sa cu comunicare pe direcția radială, ca în teoria clasică a lui *von Thunen*. Aceste cazuri sunt așa numitele abordări *pseudo-bidimensionale.*

Beckmann (1952) a făcut primul pas în direcția abordării bidimensionale în cunoscuta sa teorie a spațiului continuu al pieței pentru cazul unui singur produs sau bun. Modelul său folosește câmpuri scalare și câmpuri vectoriale. Notând coordonatele spațiului euclidian $x1$, $x2$, se consideră distribuția prețului în acest spațiu ca $\lambda(x1, x2)$. Notația λ introdusă de Beckmann provine de la multiplicatorul Lagrange al minimizării costurilor.

Din punct de vedere geometric, aceasta este o suprafață definită pe spațiul bidimensional (planul) x_1, x_2. Din punct de vedere matematic este un câmp scalar.

Modelul lui Beckmann mai utilizează încă două câmpuri scalare, și anume excesul local de cerere $z(x1,x2)$ care reprezintă excesul de consum al producției locale, aici considerat dependent doar de amplasare, dar care în general depinde și de preț, $z(x_1, x_2, \lambda)$ și costurile locale de transport $k\ (x_1,\ x_2)$. Scris în acest fel, costul de transport este izotrop, adică independent de direcţie. Un mod mai general, este $k\ (x_1,\ x_2,\ \theta)$, unde θ este direcţia în care are loc transportul. După cum s-a menţionat deja, neregularitatea de reţelelor rutiere reale tinde să uniformizeze neregularitățile direcţionale, astfel că izotropia devine o simplificare rezonabilă.

Variabilitatea costului transportului între locații depinde doar de proprietăţi locale ca densitatea reţelei (influenţând necesitatea de ocoluri, care se abat de la linia euclidiană), sau intensitatea traficului față de capacitatea de trecere (ca un factor determinant de al întârzierilor datorate congestiei în trafic).

Pe lângă câmpurile scalare menționate, se introduc și câmpuri vectoriale. Acestea din urmă sunt vectori de bidimensionali a cărui lungime și direcţie variază în funcţie de amplasarea punctului considerat al originii . Un astfel de câmp vectorial poate obține imediat din câmpul scalar al preţului prin gradientul său, adică:

$$\nabla\lambda = (\frac{\partial\lambda}{\partial x_1}, \frac{\partial\lambda}{\partial x_2}) \tag{1}$$

Unde ∇ este notația obișnuită pentru gradient. Câmpul vectorial $\nabla\lambda$ este gradientul preţului, a cărui direcţie indică direcția creşterii celei mai abrupte a pantei suprafeţei distribuției preţului din locația data spre celelalte zone ale regiunii studiate, şi a cărui normă (mărime absolută), este :

$$|\nabla\lambda| = \sqrt{\left(\frac{\partial\lambda}{\partial x_1}\right)^2 + \left(\frac{\partial\lambda}{\partial x_2}\right)^2} \tag{2}$$

reprezintă creșterea prețului pe unitate de distanță euclidiană în această direcție abruptă de creștere.

Pe lângă acest câmp derivat din gradient, mai avem nevoie de un câmp vectorial general pentru a reprezenta fluxul de mărfuri tranzacţionate.

$$\boldsymbol{\Phi = (\Phi1\ (x1, x2), \Phi2\ (x1, x2))} \tag{3}$$

a cărui normă,

$$|\Phi| = \sqrt{(\phi_1)^2 + (\phi_2)^2} \tag{4}$$

reprezintă volumul fluxului de mărfuri care traversează locația (x_1, x_2) Împărțind vectorul flux prin norma sa, obținem vectorul de lungime unitară (versor)

$$\frac{\Phi}{|\phi|} = \left(\frac{\phi_1}{\sqrt{(\phi_1)^2 + (\phi_2)^2}}, \frac{\phi_1}{\sqrt{(\phi_1)^2 + (\phi_2)^2}}\right) = (\cos\theta, \sin\theta) \tag{5}$$

Evident, $|\Phi|$, θ, sunt coordonatele polare pentru $\varphi1, \varphi2$, unde $|\Phi|$ este volumul de marfă iar θ este direcția fluxului in fiecare locație . Ambele variază cu coordonatele (x_1, x_2) ale punctului considerat. Modificarea volumului fluxului de-a lungul unui parcurs trebuie pusă în relație cu excesul de cerere local, $z(x_1,x_2)$

Pentru aceasta este nevoie de operatorul diferențial divergență, argumentat de următorul raționament euristic: să considerăm fluxul care trece printr-un pătrat mic cu laturile dx1 și dx2 in plan. Fluxul poate fi considerat ca având componentele φ_1 in direcția coordonatei (orizontale) x_1 și φ_2 in direcția coordonatei (verticale) x_2 .

Trecând prin acest dreptunghi infinitezimal, componenta orizontală $\varphi1$ se modifică cu $(\partial\varphi_1/\partial x_1).dx_1 .dx_2$, în timp ce componenta vertical ă $\varphi2$ se modifică cu $(\partial\varphi2/\partial x2)\ dx2\ .\ dx1$. Prin însumare, obținem schimbarea totală

$$\nabla.\phi = \left(\frac{\partial\phi_1}{\partial x_1} + \frac{\partial\phi_2}{\partial x_2}\right) dx_1 dx_2 \tag{6}$$

Sau, normalizând pentru unitatea de suprafață

$$\nabla.\phi = \left(\frac{\partial \phi_1}{\partial x_1} + \frac{\partial \phi_2}{\partial x_2}\right) \quad (7)$$

Operatorul ∇ · (de remarcat semnul . care indică produsul scalar) pentru divergență nu trebuie confundat cu operatorul ∇ pentru gradient, primul aplicându-se unui câmp vectorial având ca rezultat un câmp scalar, iar al doilea unui câmp scalar având ca rezultat un câmp vectorial. In accepțiunea noastră, divergența are semnificația de modificarea volumului fluxului datorat unei surse (densități) in cazul excesului de ofertă – care adaugă o cantitate de produs fluxului imergent sau a unui puț (excesul de cerere), atunci când ea este negativă, care reduce cantitatea fluxului emergent.

Excesul de cerere (cerere minus producție), q , poate fi definit ca o funcție de poziție in plan $q=q\ (x_1, x_2)$

Acesta poate fi considerat ca un câmp scalar in spațiul bidimensional, având coordonatele spațiale x_1 și x_2, in care se delimitează o regiune închisă, A.

Condiția de echilibru al pieței este ca in toată regiunea A sa avem

$$\iint_A q(x_1, x_2)\,dx_1 dx_2 = 0 \quad (8)$$

Exceptând cazul trivial al absentei comerțului local, când $q\ (x_1, x_2)=0$, în orice punct, condiția (1) impune existența unor puncte cu exces de cerere pozitiv, respectiv negativ (exces de ofertă). Mișcarea produselor se face de regulă de la punctele cu exces de ofertă către cele cu exces de cerere. Mișcarea produselor este descrisă ca un flux al unui câmp.

In fiecare punct, câmpul are o direcție și o mărime, care împreună definesc fluxul vectorului $\Phi(x_1, x_2)$.

În punctele unde nu există nici producție și nici consum, ori unde local cererea și oferta sunt echilibrate, fluxul este inexistent. In punctele singulare - în care de exemplu avem centre de producție sau de consum, la frontiera domeniului etc. , există mai multe direcții simultane ale fluxului. Aceste puncte de regulă sunt omise din integralele care determină influxuri sau ieșiri.

Relația dintre fluxuri și valorile locale ale excesului de cerere sunt analoage relației între fluxul unui fluid și surse respectiv puțuri, studiate in hidrodinamică, sau fluxul termic în relație cu sursele calde și reci, studiate termodinamica transferului de căldură.

Această relație are forma binecunoscuta a ecuației lui Laplace:

$$\nabla.\phi = \left(\frac{\partial x_1}{\partial x_1} + \frac{\partial x_2}{\partial x_2}\right) = -q(x_1, x_2)$$

Unde $\Phi(\Phi_1,\Phi_2)$ este fluxul vectorial.

Se presupune ca fluxul normal care traversează frontiera domeniului este nul. Daca $\lambda(x)$ este prețul produsului în locația x și k(x) costul specific al transportului (costul transportului unității de produs pe unitatea de distanță de la locația x, rezultă $|\text{grad}\ \lambda| = k$ sau $k\Phi/|\Phi| = \text{grad}\ \lambda$. Aceasta este cunoscută ca ecuația lui Beckmann.

Soluția ecuației **$k\ \varphi/|\varphi| = \text{grad}\ \lambda$** minimizează expresia costului **$\iint_A k\ |\varphi|\ dx\ dy$** cu îndeplinirea restricției **$\text{div}\ \varphi + q\ (x, y) = 0$.**

Dacă considerăm o funcție de utilitate **u** în concordanță cu cele de mai sus putem scrie

$\Delta u = \text{div}(\text{grad}\ u) = -q\ \nabla\lambda/k$

Simbolul Δ se numește laplacian și are expresia $\Delta u = \frac{\partial^2 u}{\partial {x_1}^2} + \frac{\partial^2 u}{\partial {x_2}^2}$ iar ecuația anterioară este o variantă a ecuației lui Poisson.

Dacă cunoaștem distribuția regională a prețurilor $\lambda(x_1,x_2)$, a costurilor de transport k (x1,x_2) și excesul de cerere (cerere minus ofertă), q (x_1, y_2), care se consideră o densitate a cantității deci este punctual distribuită prin surse - producători respectiv puțuri – consumatori, ecuația de mai sus este clasica ecuație a lui Poisson, în două dimensiuni, similară cu ecuația transferului de căldură pe o placă conductoare cu surse de căldură respectiv pierderi de căldură concentrate, membrul drept având semnificația densității (puterii sursei) iar membrul drept (sub semnul *Laplacianului*, Δ, este temperatura.

În cazul nostru, cu notațiile cunoscute și adoptate, u este o funcție de utilitate, a cărui gradient este fluxul de produse Φ, un câmp vectorial cu componentele Φ x și Φy, sau mărimea | Φ | și direcția θ.

$$\Phi = Grad(u)=\nabla u$$

După rezolvarea ecuației Laplace, care în forma dată îmbină ecuația de minim a costului de transport min $\left(\int\int_A k\ |\varphi|\ dx\ dy\right)$ prin $k\ \varphi/|\varphi| = grad\ \lambda$ și condiția de echilibru productie consum flux, $div\ \varphi + q\ (x, y) = 0$, obținem funcția de utilitate, u, al cărui gradient ne dă fluxul (câmp vectorial).

Integrarea de arie a fluxului ne dă volumul de produse care traversează frontiera ariei.

In modelul nostru, am înlocuit pentru fiecare regiune intensitatea (densitatea) mărimii exces de cerere cu un dipol, format din cerere și ofertă, separate, distanțate cu o oarecare valoare , care reprezintă similarul unui dipol electric.

Constând dintr-o sarcină negativă și una pozitivă, respectiv o cerere și o oferta (excesul de cerere nefiind util pentru a pune în evidență și fluxul intra-regional), mai ales în zonele in care oferta locală satisface parțial cererea locală într-o oarecare cotă valorică, restul cererii locale fiind asigurată de furnizori externi, respectiv excesul de ofertă fiind redirecționat spre consumatori externi.

Desigur, această îmbunătățire a modelului crește acuratețea, dar o analiză mai aprofundată ar trebui făcută pentru produse sortimental variate, cu un mix diferit de ofertă și cerere.

Această analiză este complicată, dar nu imposibilă. Pentru lucrarea de față ne-am limitat la a analiza un grup de utilaje tratate în studiul de cay anterior care sunt ca destinație și funcționalitate asemănătoare, comercializate la prețuri relativ egale, rezultate dintr-o echilibrare naturală de lungă durată, dar mixul producției și consumului pe zone geografice este diferit.

Cele 6 Zone geografice care caracterizează piața globală de utilaje sunt prezentate în figura 3.

Fig. 3 Zonarea geografică a consumatorilor și furnizorilor

Semnificația notațiilor este dată în tabelul de mai jos:

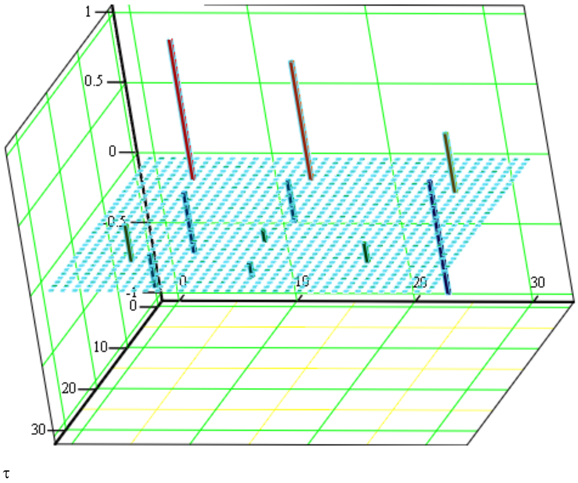
	Regiunea	Cerere	OFERTA	Exces de Cerere
1 NV	America de Nord (SUA+CANADA)	0,12	0,40	-0,28
2 SV	America centrala și de Sud	0,10	0,11	-0,01
3 NC	Europa (UE)	0,12	0,30	-0,18
4 SC	Africa	0,06	0,05	0,01
5 NE	China+Rusia	0,20	0,11	0,09
6 SE	Australia & Asia Pacific+ India	0,40	0,03	0,37
	Total	1,00	1,00	0,00

În tabelul de mai jos am prezentat fluxurile globale ale produselor –echipamente pentru industria extractivă între furnizorii și consumatorii din cele 6 regiuni

		2	3	4	5	6
1				x	x	x
2				x	x	x
3				x	x	x
4	x	x	x			
5	x	x	x			
6	x	x	x			

Folosind datele din tabele, obținem distribuția surselor și a puțurilor ca în figură (am utilizat MathCad pentru generarea graficelor). Se observă că practic fiecare regiune este dezechilibrată din punct de vedere al cererii și ofertei, dar piața globală este echilibrată. Excesul de ofertă are o tendință globală de scădere de la Vest spre Est iar cel de cerere o tendință crescătoare de la Nord la Sud. Este deci de așteptat ca fluxul principal să fie orientat NORD VEST spre SUD EST, ceea ce este evidențiat și în sursele de studii de piață analizate.

Continuarea studiului prin metoda propusă va detalia și demonstra acest trend, și va justifica oportunitatea metodei pentru analiza globală a piețelor produselor de înaltă specificitate de la regiunile dezvoltate industrial spre zonele emergente în care tehnologia ”occidentală” își păstrează atractivitatea. Cum consumatorii sunt –in cazul mineritului – endemic legați de zonele cu resurse minerale bogate, iar producătorii de echipamente tradițional implantați în arii cu tradiție industrială, acest fapt este evident.



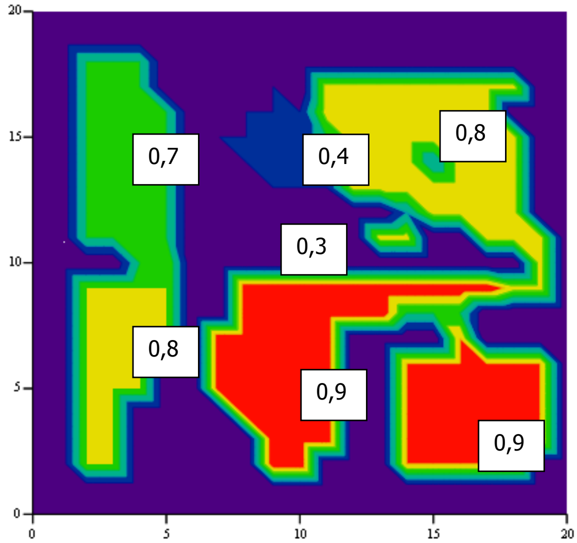


Fig. 4 Distribuția spațială a cererii și ofertei *Fig.5 Costurile de transport pe zone*

Diagrama de variație spațială a ofertei și cererii respectiv distribuția teritorială a prețurilor sunt prezentate în figurile 4 respectiv 5

În continuare s-a determinat gradientul prețului, Fig.6 necesar pentru calculul coeficienților div(λ)/k din ecuația Poisson.

Prin mediere se obține in final pentru cele 6 regiuni matricea coeficienților de corecție ai densității div(λ)/k .

$$\mathbf{div(\lambda)/k} = \begin{pmatrix} coefNE & coefNC & coefNV \\ coefSE & coefSC & coefSV \end{pmatrix} = \begin{pmatrix} 0.808 & 1.12 & 1.582 \\ 0.895 & 0.995 & 0.527 \end{pmatrix}$$

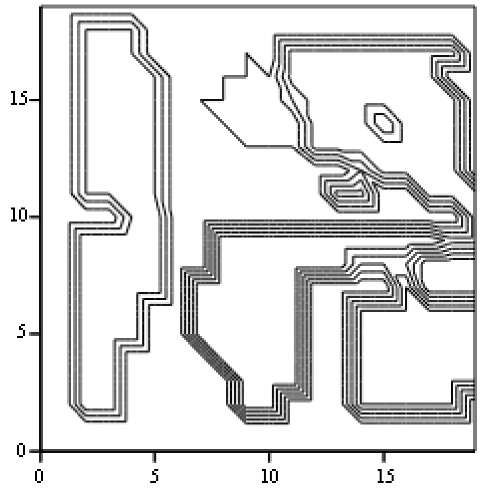
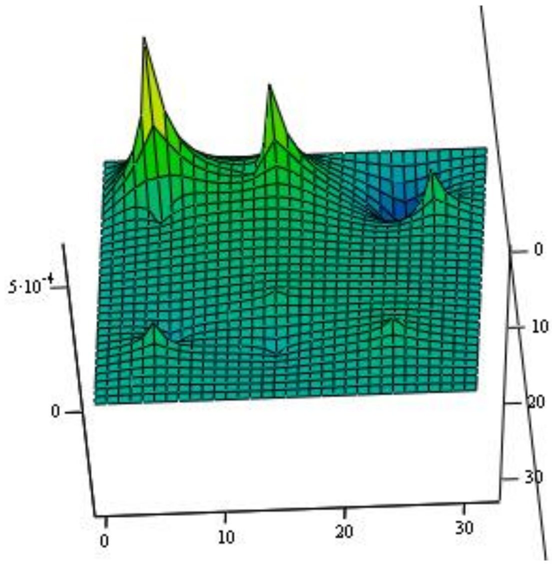


Fig. 6. Gradientul prețului

Prin rezolvarea ecuației Laplace, folosind procedura din ***Mathcad,*** se obține funcția de utilitate, u. Vârfurile sunt zonele de exces de ofertă, iar adânciturile cele cu exces de cerere.

Ca o interpretare intuitivă, se poate asimila oferta/ cererea ca altitudine într-un spațiu tridimensional, sub acțiunea unui câmp gravitațional, iar mișcarea produselor ca traiectorie a unei particule cu masă unitară sub efectul acestui câmp de forțe. Particula se va deplasa de la vârfuri spre puțuri, pe traiectoria cu consum minim de energie, către puțul cel mai atractiv, de-a lungul liniilor de câmp, cu o viteză proporțională cu aceasta.

Alăturat s-a reprezentat linia valorilor izo-utilitate in valori normalizate. Aceste curbe pot fi interpretate ca limite de influență ale unui anumit producător, respectiv limitele economice ale influenței sale în spațiul pieței.



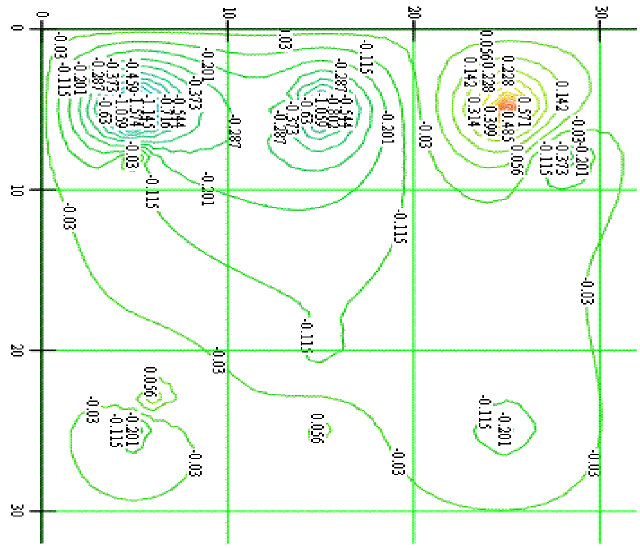


Fig. 7. Diagrama spațială a utilității și liniile echipotențiale

Geometria lor reflectă zonarea presupusă în ipoteză, iar densitatea lor spațială indică intensitatea fluxului de produse.

Liniile de curent (directiile fluxului), prezentate mai jos, confirmă prezumpția anterioară, și poate indica preponderența fluxului de produse pe regiuni (de exemplu zona NV este preponderent exportatoare, iar zona SE preponderent consumatoare.

Aceste fluxuri concordă în bună măsură cu cele reale. Volumul de produse care circulă se poate determina din fluxurile parțiale care pornesc (sau aflueazǎ) din (în) centrele regiunilor. Determinând divergența fluxului, găsim liniile de separație între zonele achizitoare (divergența pozitivă) și cele furnizoare (divergența negativă, separate prin liniile div=0, care reprezintă zonele în care transportul este scump sau prețul este mic și nu acoperă cheltuielile de transport, respectiv în interiorul cărora avem un echilibru între cerere și ofertă.

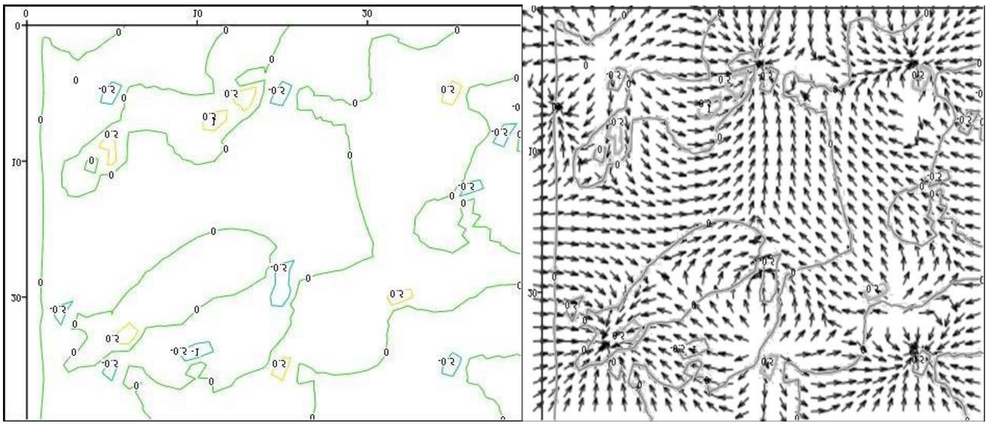


Fig.8. Diagrama divergenței fluxului și vectorii de flux

Suprapunând cele două diagrame – ale fluxului și ale divergenței ca în figura de mai sus - cele arătate se confirmă și mai elocvent.

Volumul intrat prin schimb este de 9,85 unități valorice (UV), volumul ieșit în schimbul interzonal este 5,42 UV iar diferența 4,43 UV este volumul folosit intern în toate zonele.

Divergenta fluxului este 0,9 (pe tot spațiul pieței) ceea ce reprezintă o abatere de cca 12% față de valoarea 0, abatere rezonabilă având in vedere nivelul de precizie al calculelor.

Se remarcă delimitarea în 6 sectoare NV, NC, NE și SV, SC, SE

CONCLUZII

Analiza prezentată este utilă, relevantă și oportună din mai multe puncte de vedere.

Din punct de vedere metodologic, este o primă încercare de a transpune și aplica metodele economiei spațiale în studiul piețelor produselor industriale destinate mineritului care fac obiectul marketingului B2B, produse industriale care ocupă o pondere importantă în schimburile economice (cca 100 miliarde $ în 2015 cu o rată de creștere estimată de cca 8-10% pe an).

Din punct de vedere operațional, metoda poate fi utilizată în prognozele de piață – având în vedere dinamica schimbărilor în structura furnizorilor și consumatorilor - dinamică care este așteptat să devină mai rapidă în următorii ani.

Din punct de vedere al cunoașterii – poate fi un element de legătură între ceea ce numim marketing operațional și abordarea scientologică – reprezentând un pas înainte ca domenii de aplicare a teoriei spațialității care a rămas captivă în domeniul economiei dezvoltării regionale și al piețelor produselor naturale către domenii actuale, specifice și cu dinamică revigorată.

Constituind un început, extinderea cercetării poate – pe baza unor date și fapte mai detaliate și cu un aparat matematic computațional mai puternic să conducă la elaborarea unui sistem expert de analiză-previziune care să inducă un suflu nou în domeniul B2B marketingului, rămas, încă, în remorca marketingului de consum.

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TECHNOLOGICAL OPTION FOR THE RECOVERY OF THE COAL FRACTION FROM FLOTATION TAILINGS STORED IN PONDS

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ABSTRACT

After processing coal by hidrogravitational and flotation methods, there were released considerable amounts of tailings, generally under 3 mm, with a 30 percent content of coal fraction. These were stockpiled in ponds and were considered secondary sources of solid fuel.

The technology for the recovery of the coal fraction from flotation tailings stored in ponds consists in the combination of attrition-sizing, primary concentration in centrifugal field in a special apparatus called centrifugal concentration apparatus connected at the overflow with a conventional hydrocyclones battery, obtaining in the downflow a coal-bearing product, which is drained through screening, and the overflow of the cleaning hydrocyclones, with a considerable content of argillaceous fraction is drained through centrifugation.

The waste waters are totally recirculated in the installation and in order to obtain the right dilution, to sprinkle the riddles and to cool off the installation there is used technological water. The argillaceous tailing is deposited in authorized landfills. This technology has the advantage that, on one hand it helps discharging the ponds in order to be used for their primary purpose and on the other hand permits the exploitation of a secondary energy source.

KEYWORDS

tailings, coal, hydrocyclones, secondary energy source …

1. INTRODUCTION

This paper is about a technology and a processing plant used for sterile raw tailings with a variable content of coal fraction. The raw sterile tailings are stock-piled in ponds that contain millions of cubic meters of tailing and extend for tens of hectares. The purpose of processing these tailings in centrifugal field in a special apparatus called centrifugal concentration apparatus connected at the overflow with a conventional hydrocyclones battery is to recover the coal fraction that has proper characteristics to be burnt in steam power plants or other power installation.

2. TECHNOLOGY DESCRIPTION

The main characteristic of the proposed technology is that after cleaning the material in a scrubber, the coal fraction, separated from the argillaceous compound, regains its natural shine. The next step is a sizing below 14 mm on a rotating screen, trommel type, part of the scrubber. The screenings are mainly foreign material from the ponds' shore, that represents about 1 to 3 % from the inlet and are removed from the plant like a course material. The sifting is the inlet of the processing plant in centrifugal field, obtaining the coal fraction as a finite product in the downflow, and the argillaceous fraction in the overflow. The final products are stock-piled on special platforms.

Figure 1 shows the technological flux of the processing of raw sterile tailings extracted from the ponds through mechanical and/or hydraulic methods. The extracted raw sterile tailing is transported in the mixing tank (1), where water is added, in order to obtain a minimum dilution of 3m3/t.

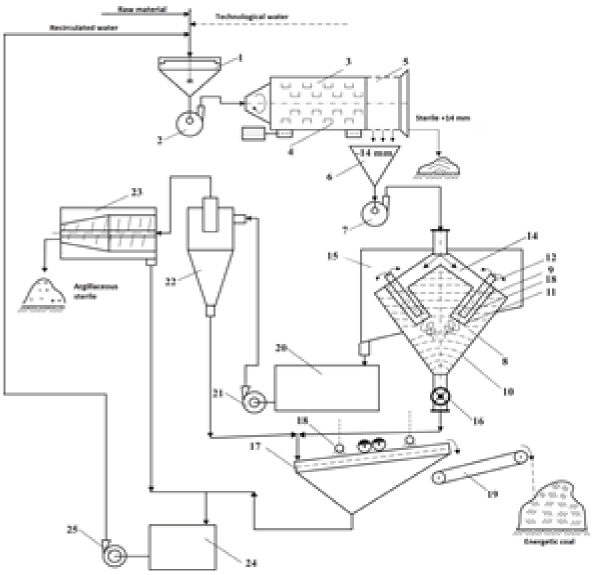

Figure 1: Technological flux of the processing of raw sterile tailings with coal fraction 1. Mixing tank; 2. Centrifugal pump; 3. Attrition scrubber; 4. radial palettes ; 5. Trommel screen 6. Receiving tank ; 7. Centrifugal pump; 8. Centrifugal concentration apparatus; 9. Special hydrocyclone 10. Conic drum ; 11. Cylindrical part; 12. Siphon pipe 13. Fix spiral; 14. Pressure chamber ; 15. Gutter ; 16. Rotating discharger ; 17. Vibrating screen ; 18. Sprinkler; 19. Belt-type carrier 20. Transfer tank ; 21. Centrifugal pump; 22. Hydrocyclons battery; 23. Sedimentation centrifuge; 24. Transfer tank; 25 Centrifugal pump.

From tank (1) the homogenized slurry is transferred with the centrifugal pump (2) to a rotating scrubber (3) which has inside radial palettes (4) that raise the material to a certain height above the water mirror. Afterwards the material falls again in cascades in the slurry current thus accomplishing attrition which consists in the scaling of the argillaceous minerals from the coal grains. Next the slurry is separated through a rotating trommel type screen (5), with the 14 mm meshes. The raw material is discarded from the plant and deposited on the ponds' shore; the sifting passes to the receiving tank (6) and that through the centrifugal pump (7) gets to the centrifugal concentration apparatus (8), which consists in a battery of 6 ÷ 8 special hydrocyclones (9) installed into a conic drum (10).

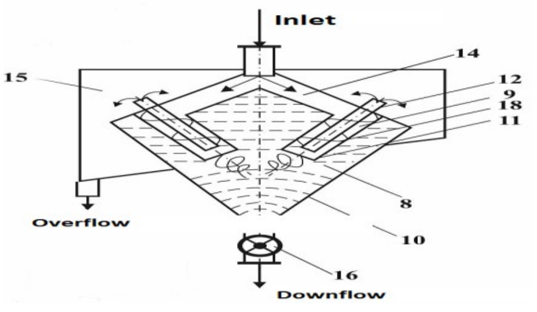

Figure 2. Centrifugal concentration apparatus – functioning scheme

A hydrocyclone from the battery consists in a cylindrical part (11) in which there is installed the

siphon pipe (12). In the space between the two cylinders there is a fix spiral (13) with a constant declivity angle, that takes into account, on one hand the separation dimension and density, and on the other hand the resultant force created by centrifugal, centripetal and gravitational forces, giving a descending helicoidally movement to the mineral particles.
The inlet to the 6 ÷ 8 hydrocyclones is achieved through the pressure chamber (14). The raw material leaves the hydrocyclones and settles at the top of the conic drum (10) from where it is continuously removed with the rotating discharger (16). The fine product leaves the apparatus through the siphon pipes and it is collected in the gutter (15). Without the conical part of the hydrocyclones they have to work underwater in order to achieve the separation density and the right thickness. The usage of the rotating discharger is compulsory because it achieves the consolidation of the apparatus and the humidity of the evacuated product. The overflow collected into the gutter passes to the transfer tank (20) from where through the centrifugal pump (21) it supplies the hydrocyclones battery (22), which retains the fine coal fraction in the downflow and the sterile material in the overflow. The downflow material obtained from both hydrocyclones batteries 8 and (22) goes on the vibrating screen (17), which has clear water sprinklers (18) where the downflow is drained. the drained product is transported with a belt-type carrier (19) in a warehouse. The overflow containing mainly argillaceous minerals -0,063mm, it's drained through a sedimentation centrifuge (23) with flocculant agents. The drained material is deposited on a special platform while the fugat (clear water) with the sifting (17) are collected in a tank (24), from where with the pump (25) it is recirculated in tank (1). Waste waters are totally recirculated in the installation and in order to obtain the right dilution, to sprinkle the screens and to cool off the installation there is used technological water. The technological indicators obtained using this method, are shown in table 1.

Table 1: Technological indicators

Indicator	**Material**	**Value**
Weight Rate A, [t/h]		150
Flow Q, [m^3/h]		450
Ash content, [%]	Raw	58.13
	Coal	27.70
	Sterile	69.52
Calorific power, [kcal/kg]	Raw	1720
	Coal	4100
	Sterile	780
Coal recovery, [%]		28.32
Water recycling degree, [%]		75

3. CONCLUSIONS

The presented technology is good for all the sterile deposits with coal content, below 3 mm, from tailing ponds or alluvial areas.
It is known that when the fine fraction, usually under 63 micrometers, has a high percent, the gravitational methods of separation are inefficient therefore there are needed higher forces (10 -100) g. These forces can be obtained only in centrifugal field.
The presented technology is innovative, at least nationally, and it is based on coal fraction separation in centrifugal field using hydrocyclonig in two stages:
- A harsh stage - separating the fraction over 250 micrometers, into a special constructed hydrocyclones battery;
- A fine stage - separating the fraction below 63 micrometers, in conventional hydrocyclones.

Generally the over 63 micrometers fractions consist mainly of merchantable coal, while the under 63 micrometers fraction is composed of argillaceous minerals, representing tailings.

The proposed technology is flexible depending on the characteristics of processed raw material and is suitable for automation responding to the requirements of modern mineral and environmental engineering.

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THE MAGNESIUM LIMESTONES – UNIVERSAL PANACEA FOR THE ENVIRONMENTAL HEALTH

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ABSTRACT

The magnesium limestone or dolomitic limestone represents varieties with high content of magnesium carbonate, which can reach 20-25%. They have a wide range of uses, for having imposed a limit levels of $CaCO_3$ and $MgCO_3$. In many areas of use, the largest share (about 60%) is destined for environmental protection (water, air, soil) with extremely beneficial effect in terms of economic profitability record. Based on these findings, the work contains the results of research that shows the possibility of using these outstanding properties in an integrated system: for advanced treatment of municipal sewage and to reduce soil acidity, taking into account that in Romania, about 2 million hectares (23% of the agricultural area of the country) are acid soils. These are presented in the form of a case study, all the stages of the extraction, processing, purification of domestic waste water and in the end the use of obtained fertilizer in agriculture.

KEY WORDS

magnesium limestone, waste water treatment, fertilizer

1. INTRODUCTION

Lately though, it has highlighted the importance and effect of magnesium oxide presence of different materials containing limestone. Thus, since 1997, at the Kyoto Conference, when 161 countries – including Romania- have completed an agreement that establishes the terms and rules of the emanations of gases causing the greenhouse effect, it stressed the

high ability of magnesium oxide to retain CO_2, functioning as a "Lung" of the Earth, even when it is in the composition of building materials.
In many areas of use, the largest share (about 60%) is destined for environmental protection (water, air, soil) with extremely beneficial effects in terms of economic profitability record. Based on these findings, the work contains the results of research that shows the possibility of using these outstanding properties in an integrated system: for advanced treatment of municipal sewage and to reduce soil acidity, taking into account that in Romania, about 2 million hectares (23% of the agricultural area of the country) are acid soils. These are presented in the form of a case study, all the stages of the extraction, processing, purification of domestic wastewater and in the end the use of obtained fertilizer in agriculture. Research results have highlighted the possibility of achieving the two aims:

- extremely effective reduction of harmful ions content in waste waters from 200 mg/l at 1 mg/l for the NO^3 ion and at 50 mg/l in the 5 mg/l for the PO_4^{3-} ion, the permissible values for the discharge of domestic waste water in the emissaries
- getting a usable precipitate as fertilizer of acidic soils in agriculture, in particular for greenhouse crops, grapevines, fruit trees, potatoes, sugar beets, alfalfa, and clover.

2. PHYSICAL AND CHEMICAL CHARACTERISTICS OF DOLOMITIC LIMESTONE DEPOSITS FROM ROMANIA AND THEIR AREAS OF USE

The presence on our country of some significant deposits of limestone magnesium leads to the idea of their complex capitalization in the field of environmental protection, quality of materials in many deposits being very good for this direction of use, but not only.
The most valuable deposits are dolomitic limestone with brucite $(MgOH)_2$ because through calcination at relatively low temperatures (650° C) it highlights reactive magnesium oxide that has a tendency to get into reaction with carbon dioxide in the water or in the air, but also with other free ions from the environment in which they are located.
Deposits of dolomitic limestone with brucite on the territory of Romania are those in the Bihor mountains, area Budureasa - Pietroasa. Main content thereof, evidenced by the chemical analyses are presented in table 1.

Table 1: Average contents of limestone deposits with brucite from Romania [3]

Substance	***Average content , %***		
	Budureasa-Valea Mare	***Budureasa-Valea Sârca***	***Pietroasa***
MgO	21,73	20,53	19,13
CaO	34,40	34,36	34,55
$Mg(OH)_2$	11,12	9,86	7,55
CO_2	36,18	37,42	37,54
Al_2O3	1,14	1,39	1,53
Fe_2O_3	0,46	0,60	0,87
SiO_2	2,57	2,48	3,80

Other major deposits of dolomitic limestone from Romania are those in Poiana Rusca Mountains, Ovidiu (Constanta) and Voşlobeni (jud. Harghita). Their quality parameters are presented in table 2.

Table 2: Average contents of dolomitic limestone deposits from Romania [4]

Substance	***Average content , %***		
	Poiana Ruscă Hunedoara	***Ovidiu Constanţa***	***Voşlobeni Harghita***
MgO	21,5-20,47	18-20	20,56-21,7
CaO	31,2-32,13	31,5-32,14	30,56-32,97
Al_2O3	0,33-1,47	0,5	0,01-0,06
Fe_2O_3	0,46-1,47	1-2	0,01-0,08
SiO_2	0,25-1,39	1-2	1-2

In addition to the field of environmental protection (wastewater treatment for extraction of nutrients and heavy metals, SO_2 and CO_2 extraction from industrial gases in agriculture to feed the soil and fertilization), magnesium limestone may have many other areas of use such as:
- basic refractory products manufacture;
- preparation of magnesium electrolytic;
- obtaining magnesium alloys used in machine construction, in aerospace, consumer goods industry;
-obtaining magnesium oxide used in the chemical industry (to manufacture melting pots resistant to high temperature, electrical heating elements, in the manufacture of synthetic rubber, the various catalysts in the manufacture of fading, the manufacture of solvents as well as in the preparation of pharmaceutical and cosmetic products;
- soda ash with Mg is used in producing artificial silk (get magnesium acetate used to neutralize the artificial silk fibres);
- pigment for objects of polyvinyl chloride and fillers for paints;
- fillers in the composition of boards for footwear and miscellaneous duroflex categories of rubber;
- coating material for paper;
- the mixture constitutes the raw material for obtaining fine ceramics in faience, frit as a table for glazes, in the composition of the glass;
-admixture in construction materials (replaces 50% of the lime mortar brickwork and plaster, is a good addition in concrete as cement substitute in the manufacture of cellular concrete.

3. POSSIBILITIES OF MAGNESIUM LIMESTONE USING IN DOMESTIC WASTE WATERS TREATMENT

The most reliable procedure of nutrient contaminated waste water purging proved to be the precipitation as ammonia and magnesium double phosphate, a compound known as struvite. The formed compound has such a low solubility in water so that it is used in analytical chemistry to determine the magnesium concentration [8], [9]

The precipitation reaction is:

$$Mg^{2+} + NH_4^+ + PO_4^{3-} = MgNH_4PO_4 \quad (1)$$

The conditions necessary for the precipitation are also enhancing the partial removal of a lot of other chemical elements such as Hg, Ag, Pb, Al, Fe, Mn, Zn either by co-precipitation or adsorption from the polluted waste water. Arsenic ions precipitate as AsO_4^{3-} under the same conditions as well. The solubility product also indicates the low solubility of the residual ammonia and phosphate ions remained in solution:

$$Ps = [Mg^{2+}]\cdot[NH_4^{+}]\cdot[PO_4^{3-}] = 2{,}5\cdot10^{-13} \qquad (2)$$

The residual concentration of ammonia and phosphate ions is about $1\cdot10^{-5}$ mol/l, but under industrial conditions the outcome residual concentrations were not less than 0.1mg/l.
The ration between the ammonia and phosphate must be 18:95 according to the precipitation reaction stoichiometry as well. Any deviation from this ratio will cause an unwanted excess of reagent in water. In order to achieve the lab scaled research, an experimental installation was set up to provide the household water conditioning with different kinds of magnesium mineral substances.
In order to conduct the experiments two types of waste waters sampled from a household waters purging station were reacted with the following mineral purging materials: raw dolomite, roasted dolomite and concentrate enriched in MgO, obtained by dissolution of dolomite in CO_2 supersaturated solution.
The solution conditioning with each one of the mineral magnesium component was done during 10 minutes, then after the filtration two products resulted: treated water and the solid phase. Figure 1 shows the flow sheet of the applied lab research method and the resulted products. The results of chemical analysis of the obtained products are synthetically presented in table 3.

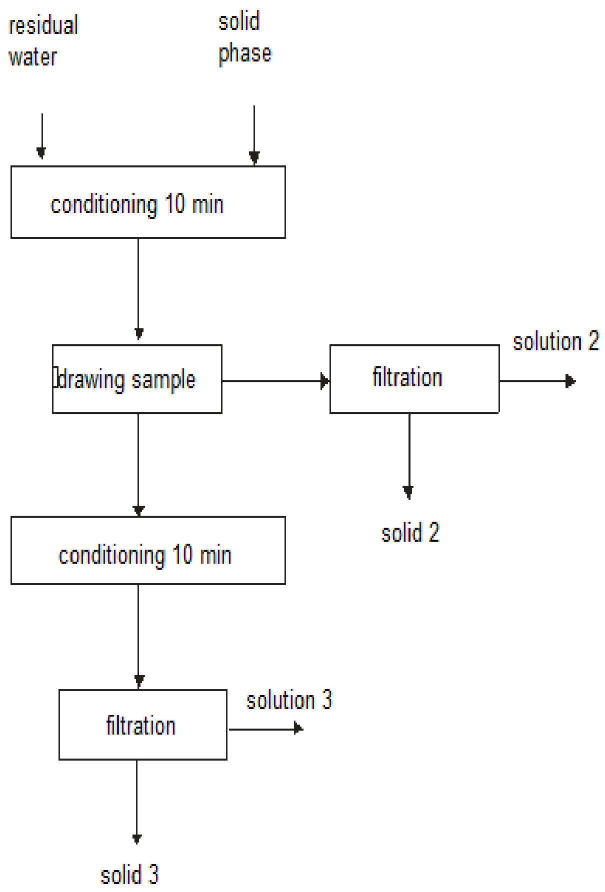

Figure 1 - The flow sheet of the laboratory research

The existent ammonia and phosphate ions contents of the raw household water sharply declines after 10 minutes of solution (2) conditioning with the purging magnesium products as it can be observed in figure 2.

Table 3: Results using raw, roasted dolomite and magnesia

	Mineral: raw dolomite				Mineral: roasted dolomite				Mineral: magnesia			
Solutions	Contents, mg/l				Contents, mg/l				Contents, mg/l			
	Mg^{2+}	Ca^{2+}	NO_3^-	PO_4^{3-}	Mg^{2+}	Ca^{2+}	NO_3^-	PO_4^{3-}	Mg^{2+}	Ca^{2+}	NO_3^-	PO_4^{3-}
Sol.1 (feed)	2.12	39.83	1.2	23.77	2.12	39.83	1.2	23.77	2,12	39,83	1,2	23,77
Sol.2	19.5	29.1	uld*	9.1	24.85	17.17	uld*	6.8	0,03	130,5	uld*	4,13
Sol.3	22.4	22.84	uld	7.85	7.1	16.1	uld	3.1	0,13	13,63	uld	2,78
	Mg	MgO	Ca	CaO	Mg	MgO	Ca	CaO	Mg	MgO	Ca	CaO
Solid 1 (feed)	6.83	11.32	25.46	35.62	8.03	13.31	28.13	39.36	14,9	24,7	20,65	28,89
Solid 2	19.92	33.02	15.9	22.24	18.45	30.58	16.26	22.75	15,08	25	17,28	24,18
Solid 3	18.87	31.28	16.38	22.91	18.25	30.25	15.87	22.20	10,53	17,45	20	27,98

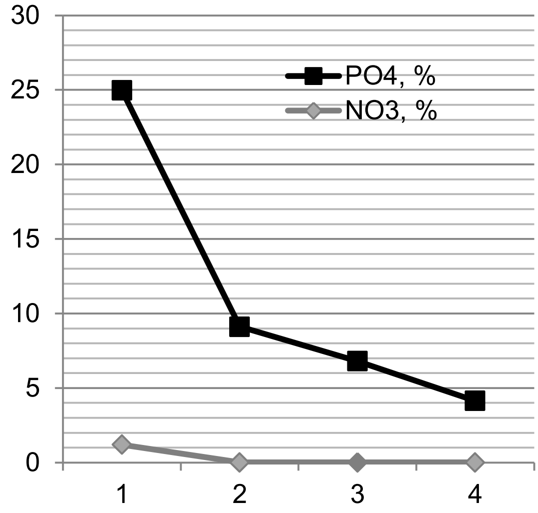

Figure 2 - The variation of PO_4^{3-} and NO_3^- ions (1-residual water; 2-limestone; 3-roasted limestone; 4-MgO concentrate)

The most simple technological alternative for dolomite processing and its' use in the waste water cleaning process is presented in figure 3. It consists in a dolomite processing and preparation installation and the nutrient removal apparatus that basically represents a fluidized bed reactor to assure the direct formation of struvite and its' exhaustion from the apparatus as marketable end product. The Installation for the product obtaining consists in a subset (A) to process the activated concentrate of brucite limestones, which includes two jaw crushers joined together by an inclined chute, one vibrating sieve whose reject is redirected to a feeding chute of the posterior crasher, the sieved phase is conducted towards a hammer mill and the crushed material is taken over and introduced in a silo. From this silo the material can be introduced in an inclined calcinations furnace and the resulted activated concentrate is conducted toward another silo. The subset (A) to process the activated brucite limestone concentrate activated is linked to a subset (B) to fabricate the struvite, which includes a vibrant dispenser which assures the feeding with pre-established flow rates of one or more than one cylinder-conic fluidized bed reaction vats where the activated concentrate is contacted with the household water.

This technology is easy to be implemented at all household water purging station, which allows the subsequently recovery of these nutrients. The magnesium limestone use to obtain the fertilizer and soil amendment represents a viable solution.

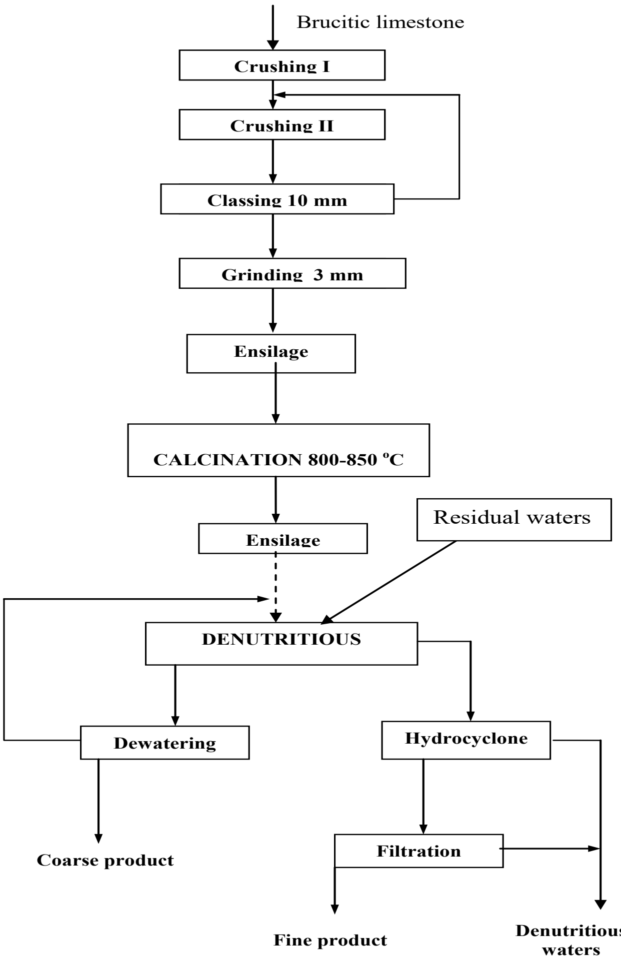

Figure 5 -Technological flow sheet for dolomite processing

4. POSSIBILITIES OF UTILIZATION OF MAGNESIUM IN LIMESTONE IN ACID SOIL FERTILIZATION

Romania currently has more of the magnesium limestone deposits estimated at over 100 million tons, which can be used effectively in this type of use and beyond. The U.S. currently use in environmental activities and in agriculture, over 40% of the production of magnesium oxide produced or imported, with special benefits.

In the composition of chemical elements enter the following plants: carbon (45%), oxygen (42%), hydrogen (6.5%), nitrogen (0.5-5%), phosphorus (0.2-1,74%), potassium (0.2-5%), silicon, magnesium, sulfur and sodium in proportion of 99.95%, and chlorine, aluminium, iron, manganese, boron, copper, strontium, titanium, zinc, bismuth, lead, nickel, etc. at the rate of about 0.05% [10].

Plants take water and minerals from the soil, and the oxygen and carbon dioxide (CO2) from the air.

In the soil are found large quantities of the nutritious substances. Calculated per hectare on a depth of 1 m, nitrogen accounts for 10-40 t/ha phosphorus 5-25 t/ha and potassium 220-375 t/ha. Compared with the quantities lost harvest (100 kg/ha), soil reserves are very large.

In the soil the plants consume more nitrogen, phosphorus and potassium. For plant growth substances must be in a form readily conduct amounts to. If the ground substances assimilated easily are insufficient or lacking, plants suffer from growing.
The necessary nutrients to plants that are not found in sufficient quantities in the soil can be supplemented by fertilizer. Therefore, nutrients, fertilizers respectively, have an important role in plant life.
The use of fertilizers in relation to the needs of their enrichment plant ensures the items concerned, obtaining an increase in production and a qualitative improvement.
Proper use of mineral fertilizers increases crop yields for all crops by 40-50%, and in some specific cases and more. Used to animal feed crops, improve quality and various products (milk, eggs, meat, etc.). This will ensure an increase in production of agricultural products.
Application of Mg fertilizers are recommended when the arable soils cultivated with crops from the field content of exchangeable Mg drops below 80 ppm Mg on sandy soils, under 120 ppm on soils with medium texture and below 200 ppm on the clay.
Draycott and others (2006) considered that the use of fertilizers with Mg becames efficient when the contents Mg in soil drops below 35 ppm. After English researchers applying is required under 25 ppm Mg to all cultures. Over these thresholds, the application is required only when the soil has a high content of K or when it comes to greenhouse crops or fruit trees.
It is recommended that the following indicative dosages depending on the crop and the soil content in Mg: 30-40 kg/ha of MgO in the form of water-soluble salts to grasses, 30-60 kg in legumes and 80-100 kg/ha to potato. Foliar splashing must be repeated 3-4 times with magnesium sulphate solution (2%) can be effective in preventing the manifestation of Mg deficiency at the vines and fruit trees. However, fertilizing the ground is most recommended.
Starting from scientific considerations summarized, it can be concluded that in any areas affected by large emissions of sulfur dioxide and carbon dioxide, 1970s brucitice that contain on average 19-25% MgO can be used as a soil improver and fertilizer affected by acid rain formed in polluted areas.
The active components of brucitic limestone, magnesium hydroxide, respectively (brucite) and calcium carbonate, in contact with soils and under the effects of acid rain, give rise to magnesium sulfate (soluble component) and calcium sulfate (component insoluble). Magnesium sulfate frees the magnesium ions which conducts to a beneficial growth of all types of crop plants.

CONCLUSIONS

- The aim of this paper was to present some new solutions and effective wastewater treatment plant, in close correlation with the opportunity to improve the soils acidic. The connection between these two areas, the product can be obtained from the advanced treatment of wastewater, called struvite, which is an ammonium and magnesium phosphate that can be used as fertilizer of acidic soils with very good results. It can be obtained by using the process of magnesium limestone. The magnesium oxide determines the phosphate and ammonium ions retention from waste water, which currently can be found in wastewaters discharged to the envoys.
- The technologies applied of waste water treatment station in Romania eliminate phosphate only partially and oxidize the ammonia to nitrate ion. The old technologies of nutrients elimination were based only on the phosphate precipitation as calcium phosphate or hydroxyapatite.
- A simple technology was elaborated that it easy to be implemented at all household water cleaning station, which allows the subsequently recovery of these nutrients. The magnesium limestone use to obtain the fertilizer and soil amendment represents

a viable solution and is possible to be applied within a program involving three economic fundamental fields : mineral resources exploitation – environment – agriculture.

- The results obtained at laboratory scale on household water using three different types of mineral magnesium materials pointed out the possibility to decrease the contents of phosphate and ammonia ions under the safety limit enforced by the law for the waste water discharged in the emissary.
- There is a possibility to revitalize two important fields in the global economic circuit, which are tightly related with the environment, respectively the household waters purging and the increase of agricultural potential of acid lands by simply use of the dolomite from the ore deposits in Romania in a chain process.

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COMPUTATIONAL MODELING OF STRUCTURE AND PROPRIETIES OF THE FLOTATION REAGENTS

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ABSTRACT

Science the inception of it using to the present, flotation was the broadest application process for mineral separation, worldwide.
Although in Romania, the numerous flotation plants which produced large quantities of concentrates, closed their activity, flotation is still in topicality; it is applicable for useful compounds recovery from huge amounts of waste produced over the decades, in order greening areas strong affected of their presence.
The main way of routing, control and adjustment of flotation process, in order to achieve higher economic and technological indicators is to ensure the most adequate reagent regime. For more efficiency of collectors action, lately is used computational modeling technique of their structure, considering the existence of a strong interdependence between the structural construction of molecule of collector and its chemical activity.
Quantum chemical research methods assures the determination of indicators of possible reactions of the cations from mineral surface with collector – even before its synthesizing.

KEY WORDS

Collector, computational modeling , flotation, mineral cluster

1. INTRODUCTION

The main way of routing, control and adjustment of flotation process, in order to achieve higher economic and technological indicators is to ensure the most adequate reagent regime, especially the most effective collector for each mineral.

Establishing the stereochemical representation of reagents is considered to be fairly important for the study of flotation. In order to be realized, the strong dependence between the spatial structure of the molecules and the chemical activity of the compound needs to be considered. Soloviev M.E. and Soloviev M.M. demonstrated the efficiency of the research using computer technology and chemistry software.

One of the key roles in using the dependence between the spatial structure of the collector molecules and the chemical activity of the compound rests with the quantum-mechanical researches which have been proven to be the necessary instruments for studying the geometry of the molecular structure, in the study of the particularities of molecules interactions, when analyzing the structure of different origins substances.

Tens of millions of compounds having a different chemical structure have been synthesized nowadays, only tens of thousands being considered to have a practical use.

Each compound has its own physical-chemical characteristics. Therefore, it is quite important to determine the quantitative correlations of the dependence between the structure and the chemical characteristics of the compound. This determination, not only does it allow rapidly choosing between the existent compounds, but also, choosing the most appropriate one, in order to ensure the required synthesizing properties of new compounds.

Experimental determination of the physical-chemical properties often implies important difficulties related both to the measurement technique as well as to obtaining, and purifying the substances, their possible stability, toxicity and aggressiveness. These types of determinations require large material expenses, a lot of qualified work and a lot of time.

The existence of quantum-chemical determination methods allows for the indicators of the binding capacity of metallic cations to collector reagents (before the synthesized reagents the properties of which are measured) be established, and respectively allows the selection, from a series of unresearched compounds – even more note yet synthesized – of those which according to the forecast, shall accomplish superior requirements.

Contemporary science disposes of a considerable number of technical methods which are able to study in detail the structure of molecules, their reaction capacities the mechanisms of these reactions.

India has carried out important computer modeling researches on oxydrylic reagents under the attentive leadership of Pradip and Rai Beena. They have managed to realize a molecular modeling study of oleate monolayers adsorbed at the surface of calcium minerals (Beena, Pradip, 2003; 2008).

Pradip, Rai Beena and Rao T.K. (Pradip, Beena, Rao et al, 2002; Pradip, Beena, 2002; Pradip, Beena, 2003) studied the interaction of alkyl hydroxamates with calcium minerals, using for the research complex software: MOPAC 6.0, CERIUS version 4.0 as well as Materials Studio.

Solozhenkin Peter M. and Solozhenkin Oleg I. have studied in detail the 3D models of sulphydric collectors, of diaryl dithio-phosphonic acids, of mercapto compounds (Solozhenkin, Solozhenkin, 2010a, 2010b, 2011).

Using the computer modelling method as well Kurkov A.V. and Pastukhova I.V. (Kurkov, Pastukhova, 2010, 2011) have recently realised a series of important studies on a new class of phosphorus containing reagents.

Medyanic N.L., Ghirevaia H.I. and Varlamova I.A. have applied the quantum-chemical approach when choosing the collector reagent for the floatation of coal with a low degree of metamorphism (Medyanik, Ghirevaya and Varlamova, 2005; Medyanik 2011, Shadrunova, Medyanik, Kalugina, 2011).

For sulphydric flotation reagents three-dimensional molecular models have been constructed. Distribution of partial charges to atoms in sulphydric reagents has been studied. It is shown, that in diethyldithio phosphinate and diethylmothio phosphinate, the partial charge on atom P has high positive value. The partial charge thiol of sulfur in diethyldithio phosphinate and diethylmonothio phosphinate has negative size that specifies in strengthening of compound of atoms of sulphur with cation metals of minerals.
The basic computer parametres of the general energy flotation reagents are defined. Are constructed molecular orbital's for sulphydric reagents and energy of their level is calculated. Updating sulphydric reagents by acetic acid with reception potassium (xanthate) acetate ROCS (S) CH_2COOK, sodium (dialkyldicarbamate) acetate (C_2H_5) $NCS(S)CH_2COO$ Na, sodium (thiohinoline) acetate has been executed.
At computer modelling key parametres connection (the general energy of compound, a charge on atoms, are constructed molecular orbital's and their energy is calculated) have been defined (Solozhenkin, Solozhenkin, Krausz, 2012).

2. METHODS

Computational modeling of minerals and reagents was performed using Chem Bio 3D and ChemOffice2005 by Cambridge Soft with optimization by MM2. The semi empirical calculations were provided by MOPAC 2012 in vacuum (Soloviev 2005; Khel`t`e 2012). Molecular structures of mineral clusters were created.
DTF approach was used to determine the optimal molecular structure and calculate atomic charge values, the compositions and energies of HOMO (Highest Occupied Molecular Orbitals), LUMO (Lowest Unoccupied Molecular Orbitals) and SOMO.
The strategy of collector activity evaluation has been proposed as a consistent approach to estimate the interaction between a collector and a mineral cluster as a difference of total energy and sum of cluster energy and collector energy (Solozhenkin 2012a, 2012b).

$$E = E\ \text{complex} - (E\ \text{cluster} + E\ \text{collector}),\ \text{eV}$$

Complex formation have been established with the aid of computational docking technique. The docking method is a search algorithm and a scoring function that predicts the preferable orientation of one molecule to a second, to form a stable complex and estimate collecting activity of reagents. The approach has proved useful in identifying relevant candidates for several flotation applications (Solozhenkin, 2008, Solozhenkin, Solozhenkin, Krausz, 2012).
This index was named Prognosis of Collector Activity Evaluation (PCAE). The lower PCAE, the stronger the ability of the collector to interact with the mineral cluster.
Based on the PCAE results, the synergistic effect of the combination of collectors on different minerals ore flotation has been established: for candidates in collectors for minerals of elements of platinum group flotation (Solozhenkin, Solozhenkin, Krausz, 2014), for oxhydryl collectors for alkaline earth minerals flotation (Solozhenkin, Krausz, Ibrahimova, 2015).

3. MOLECULAR MODELS OF MINERALS AND FLOTATION COLLECTOR CLUSTERS

As we made mention, the computational modeling applied was performed on different types of flotation reagents, with a wide use in industrial practice.
We will present as an example, some results obtained in the study of molecular models of oxhydryl collectors which are used in practice, such as oleic acid (OA) and modified collectors which can be prospective reagents for non-sulfide flotation such as butylxanthatoundecanoic

acid (BXUA), ω - ((N,N-diethyl dithiocarbamato)undecanoic acid (DEDTCUA) and ω - (N, N-dibuthyldithiocarbamato) undecanoic acid (DBDTCUA), used in flotation of alkaline earth minerals.

Figure 1 shown the structural formulas and 3D models of alkaline earth mineral clusters for barite, celestine and calcite.

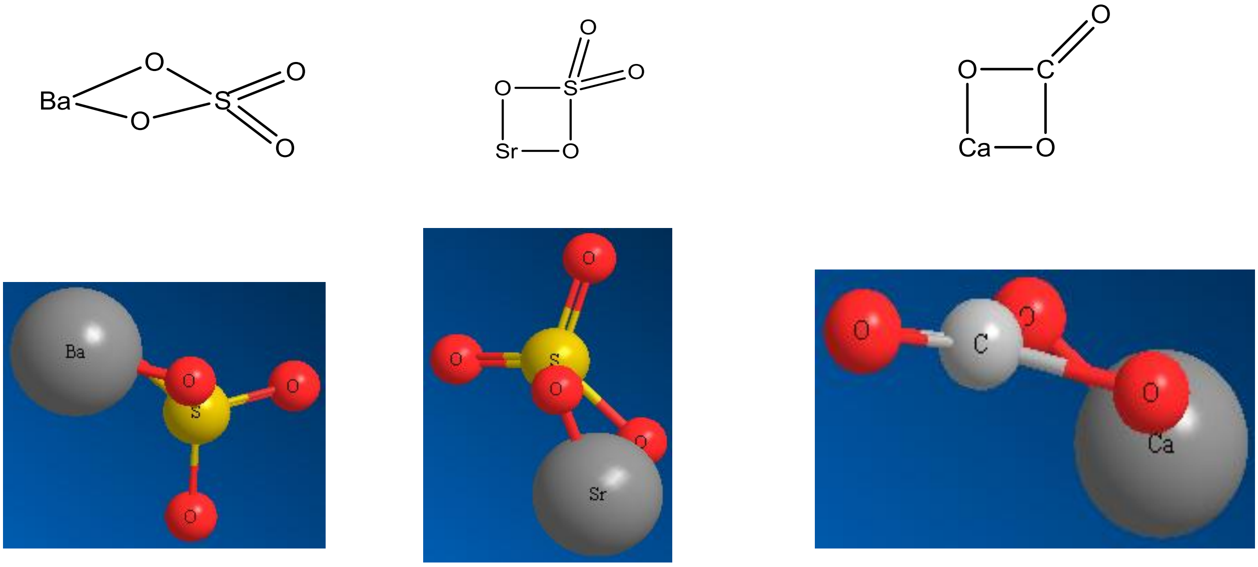
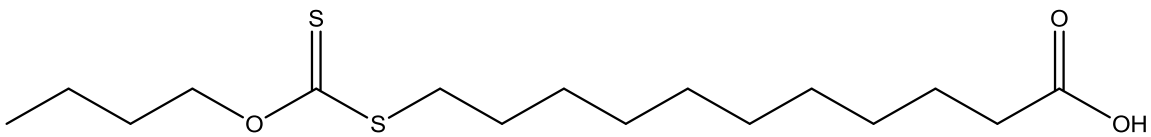
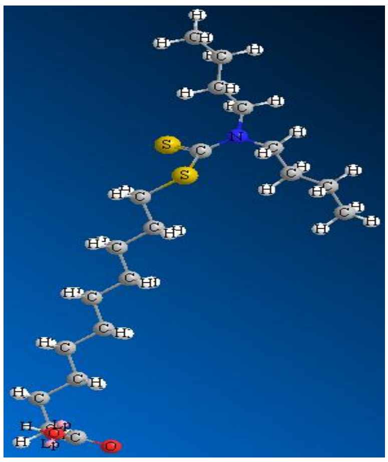


Figure 1. Structural formulas ans 3D optimized models of mineral clusters of barite, celestine and calcite

The modified fatty acids with the general formula R_2N - C - S_2 - $(CH_2)_{10}$ – COOH, where R – C_2H_5, C_4H_9, have been studied and geometrical structures have been created. The structure and optimized 3D models of modified undecanoic acids are presented in Figure 2.



a



b *c*

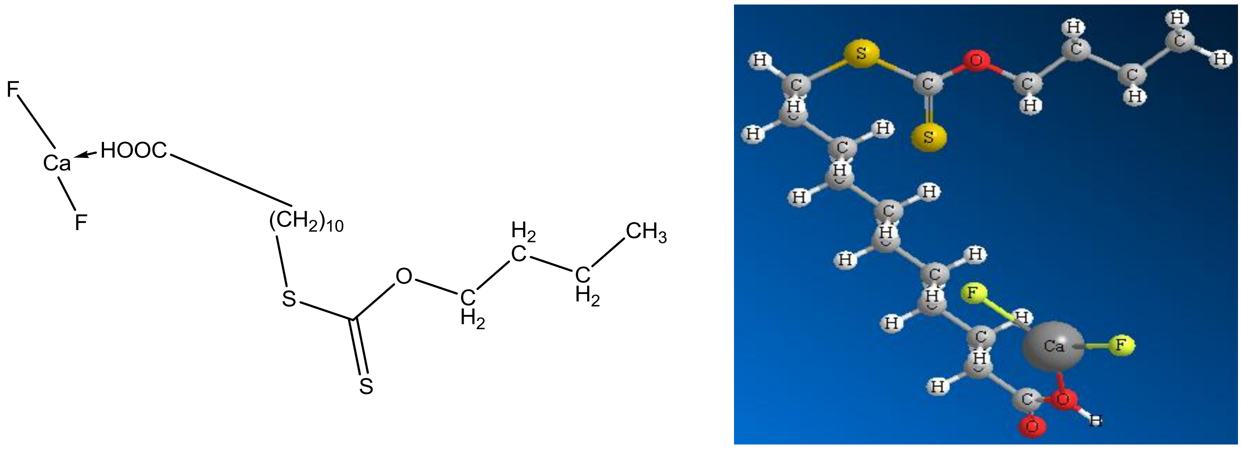
Figure 2.Structural formulas of butylxanthatoundecanoic acid (BXUA) (a), optimized 3D models ω - ((N,N-diethyl dithiocarbamato)undecanoic acid (DEDTCUA) (b) and ω - (N, N- dibuthyldithiocarbamato) undecanoic acid (DBDTCUA) (c).

Computer optimized parameters of molecules of studied collectors are presented in table 1 and according to the obtained values, is obviously that the longer the hydrocarbon chain, the stronger ¼ van der Waals interaction. The power of van der Waals interaction of three collectors is followed as OA<DEDTCUA<DBDTCUA. These results should take into account for improving the flotation performance.

Table 1: Computer optimized parameters of molecules of studied collectors

Parameters	***Reagent***		
	OA	***DEDTCUA***	***DBDTCUA***
Valence-bonds tensile	1.0032	1.1604	1.3306
Dihedral angles flexure	2.4598	4.9058	5.4514
Flexural tensile correction coefficient	0.3164	0.4848	0.5408
Internal rotation	-1.6081	1.9897	3.3070
Non van der Waals interaction	-3.4402	-3.7662	-3.9787
¼ van der Waals interaction	10.7999	11.6094	14.7534
Dipole/dipole interaction	1.6872	1.9300	1.8744
Total steric energy,kcal/mol	11.2182	18.3138	23.2788

Mineral and collector clusters form together a complex, as shown in Figure 3 for butylxanthatoundecanoic acid attached to fluorite mineral cluster, as an example.



a b

Figure 3. Complex of fluorite cluster with a molecule of butylxanthatoundecanoic acid (BXUA) attaching to calcium atom (a) and its optimized geometrical model (b).

Physical-chemical parameters of complexes created have been analyzed. It has been established that HOMO and LUMO are carrying the negative charge. Absolute hardness η and chemical potential χ by Pearson and Parr have been calculated. Ca, Ba, Sr – complexes with BXUA have been studied using chelate and bidentate schemes. The bond distances between O(11)-Ca(12) and C(1)-O(10) equal 1,595 Ǻ and 1,208 Ǻ respectively, which indicates the strong interaction between calcium atom and a collector.

It was noticed that the normal covalent bond and the back donation covalent bond occur in bidentate complexes. It was obtained that bidentate complex Ca- BXUA has α HOMO/LUMO and β HOMO/LUMO. The oxhydryl collector transfers its HOMO electrons to a metal atom to form the normal covalent bond. In addition the metal atom can transfer some of d-electrons to LUMO of the collector forming back donation covalent bonds which should increase interaction between a collector and a mineral. The results obtained show the decrease in charge on a calcium atom of the mineral cluster.

4. PROGNOSIS OF COLLECTOR ACTIVITY EVALUATION (PCAE)

One of the most important achievements of the interaction between collector and mineral clusters studies was establishing of the relationship allowing collector activity evaluation. Thereby, has been proposed as a consistent approach to estimate the interaction between a collector and a mineral cluster as a difference of total energy and sum of cluster energy and collector energy (Solozhenkin 2012a, 2012b, 2012c).

$$E = E\ complex - (E\ cluster + E\ collector),\ eV$$

From the relevant studies conducting on PCAE it can be concluded that BXUA possesses the higher collector activity (PCAE = - 8134,518 eV) comparing to OA (PCAE = - 4866,881 eV) for flotation of alkaline earth minerals. The value of PCAE referring to total energy is followed as $CaCO_3$> $BaSO_4$> $SrSO_4$> CaF_2 which corresponding to flotation. According to PCAE referring to electronic energy the decrease of prognosis of collector activity evaluation (PCAE) for minerals is in the following order: $SrSO_4$> $BaSO_4$> $CaCO_3$> CaF_2.
Based on the PCAE results the synergistic effect of the combination of collectors on alkaline earth ore flotation has been established. The sharp decrease of PCAE with binary mixture of collectors such as OA + BXUA and OA + DBDTCUA has been shown. The electronic energy was decreased with the difference of 14048,864 eV (-23007,083-(-3353,58 -5604,639) for CaF_2 + OA + BXUA comparing to the same parameter for individual collectors. From the previous discussion it is evident that the combination of collectors is more preferable comparing to the single collector.

5. FLOTATION OF ALKALINE EARTH MINERALS AND ORES

To optimize the flotation operation the combination of oleic acid(OA) and ω - ((N,N-diethyl dithiocarbamato)undecanoic acid (DEDTCUA) or ω - (N, N- dibuthyldithiocarbamato) undecanoic acid (DBDTCUA), have been investigated with the ratio of 1:1. Application of the binary mixture of OA and DEDTCUA (1:1) allowed to increase the recovery of fluorite as well as the grade of the concentrate.
The flotation was performed by using OA (100 g/t) and DEDTCUA (100 g/t) with the feed grade of 23,4% CaF_2. By using this technique the fluorite concentrate was upgraded up to 96,3% with the recovery of 85,35%. (Solozhenkin P.M., 2008)

CONCLUSIONS

1. The use of the established physical-chemical characteristics and of the computer design constitutes a strategy for the future, for choosing and using the most efficient reagents for complex problems solving and minerals capitalisation.
2. Fundaments were brought for the use of a series of indicators – as a criterion for the assessment of the flotation activity of organic compounds in relation to the cations of the

metals – representing the computer characteristics of reagents. It has been confirmed for a series of new reagents to have identical indicators to the standard reagents.
3. Based on the PCAE results, the synergistic effect of the combination of collectors on different minerals ore flotation has been established. Index PCAE has been calculated to analyze the docking activity of modified fatty acids with alkaline metals from mineral clusters, as an example. The approach has proved useful in identifying relevant candidates for alkaline earth mineral flotation with modified fatty acids.
4. Molecular modeling of alkaline earth mineral and modified fatty acid clusters has been created. The main physical-chemical parameters have been established.
5. The transfer of electrons has been investigated. It has been established that the classical transfer of charge occurs in bidentate complex with the decrease in charge on the calcium atom of the mineral cluster.

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THE DIVERSIFICATION OF TECHNOLOGIES TO CAPITALIZATION THE POTENTIAL OF ENERGY FROM FOSSIL FUELS AND SOLID WASTE

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ABSTRACT

The investments' volume and profitability will depend on the proper choosing of the technologies, compulsory based on a complex study of the influence factors. The characteristics of the working material, the energy consumed for processing, the quality requests of the fuel offered on the market and the environmental requirements regarding the emissions released when burning, impose supplementary costs and so a product more expensive then the traditional solid fuels. The work paper is showing the directions of the preliminary research for settling the work parameters and the accurate sizing of the technological equipments, which will ensure the obtaining of ecological fuels, competitive on the market.

KEYWORDS

In situ gasification, Fuel waste, Ecological briquettes

1. EXTRACTION AND RECOVERY SITUATION OF ENERGETICAL SOLID RESOURCES

The importance of the energy sector to society, as well as for all other economic branches, the development of this sector is carried out under the supervision of the State, in the long term through the development and implementation of a sectoral strategies, and in the short

term through the implementation of a policy related to the strategy. In an economy increasingly more globalized world, a country's energy policy must to be implemented in the context of the developments and changes taking place worldwide.
Total energy demand in 2030 will be about 50% higher than in 2003 and about 46% higher for oil. Certain known reserves of oil can sustain a level of consumption only until 2040, while those of natural gas, up in 2070. [6]
Forecasts indicated economic growth, which will involve an increased consumption of energy resources.
In terms of primary energy consumption worldwide, the evolution and prognosis of reference made by the International Energy Agency highlighted the growth of the share of natural gas (which will outstrip coal) and renewable sources.

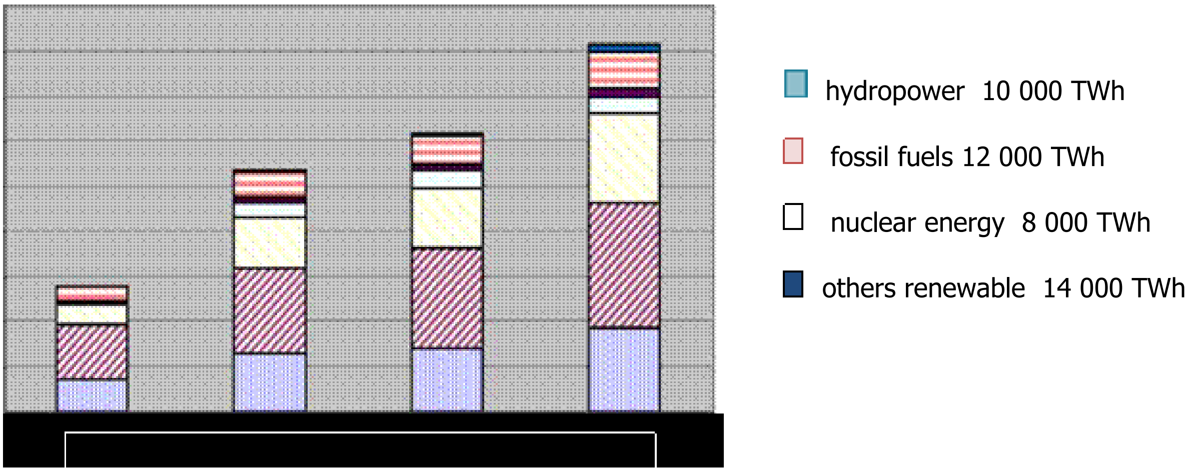

Figure 1: The evolution of the world demand of consumption of primary energy resources. Source: International Energy Agency

These resources are made up of energy groups, with wearers for primary energy and from transformation facilities, transport and distribution of energy.
Optimization criterion reflects the concrete plan, electricity company policy. In traditional planning, most comprehensive and most economically justified is the criterion of minimum total cost updated power system and, consequently, energy delivered.
The restrictions are generated by technical and technological aspects, the volume of capital expenditure admitted (investment), fuel structure, accepted impacts on the environment.
For Romania, forecasting energy consumption is determined by the reference scenario of energy demand in perspective that takes into account the evolution of the main macroeconomic indicators forecast in 2007-2020, developed by the National Commission for Prognosis. [5]
Diversification of energy sources and resources has become in recent years a process of constant concern to most countries of the world.
It was developed simultaneously with an increase of interest and political/regulatory decision-making for the purposes of the environment protection increasingly higher.
Criteria and environmental standards increasingly stricter were introduced producing an important impact in the energy industry.
In this context, coal began to be perceived by the public opinion and global decision-makers as a worn-out resource (in the broadest sense of the term), which is in a process of gradual replacement with other fossil or renewable energy resources "cleaner".
Identifying and encouraging the various innovative technologies that allow both to cost optimization and reduction of polluting emissions can give encouraging prospects of a new future in using coal, but also an industry tradition that otherwise are likely to continue their decline, despite political statements.

2. THE CAPITALIZATION OF THE JIU VALLEY COAL THROUGH GASIFICATION

2.1. GSC Technology – The underground gasification of coal

2.1.1. Conditions of application

-The depth of the layer of coal to be greater than 200 m;
-High resistance of rocks located in the bunk and the roof of coal;
-Low permeability rocks from the roof of the bunk and sterile layer of coal;
-There should be the possibility of control of oxidants injection pressure in the combustion chamber underground;
-The possibility of technological quick stop/gasification process;
-The minimum thickness of the layer of coal 2 m.

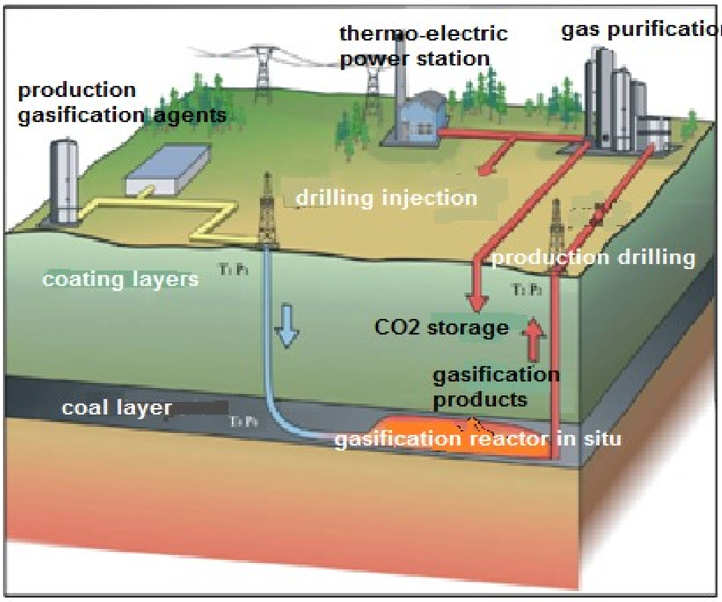

Figure 2 Schematic principle of energetic extraction and capitalization of fuel gas

2.1.2. Requirements for the effective implementation of the GSC Technology

-The existence of geological studies to provide detail information about: the geological structure, coal chemical analysis, coal strata and surrounding rocks, characterization of waste rocks surrounding, hydro-geology of the area;
- The existence of necessary design and execution technology for boreholes routed to ensure the oxidants injection and synthesis gas recovery;
- The existence of advanced systems of monitoring and modelling of underground gasification process, which ensures information relating to: operating pressure, the process temperature and the product gas flow and items pertaining to flow process thereof;
- The combined technology GSC-CCS offers the possibility of combining the coal exploitation with filling space operated with combustion gases from thermo-electric power station. At a suitable filling pressure it is possible increase the combustible mass recovery in production wells. Depending on the gasification agent used can produce energy-gas or synthesis gas sub-loan in chemical technologies.

2.1.3. Conditions for applying to the coal deposit in the Jiu Valley

The research was carried out at the laboratory level, the process of gasification of coal in the Jiu Valley, on models. Have studied 25 models, experimenting the drilling method (the channel creation, ignition and gasification) and by mining works. Main parameters follow the gas composition were correlated with temperature gasification agent and the resulting process.
The most important issues addressed in the laboratory studies were:
- gasification kinetics of chemical reactions in different conditions of pressure and temperature;
- the influence of gasification agent quality (air, oxygen);
- the simulation training small-scale channels;
- the research of permeability, fracturing and the cavity formation;
- the behaviour of surrounding rocks;
- the behaviour of materials used in gasification technology.

The conclusions of the laboratory research and documentation revealed the possibility of experiments in situ of the coal deposit in the J Valley, [6] having regard to:

- expenditure minimum regarding the placement in areas of the work of preparation;
- the ensuring of utilities (electricity, compressed air, water, roads) from mining in the area;
- the capitalization of the geological research conducted so far, by interpreting the results of the application of the GSC;
- the evaluating the possibility of exploiting the gas obtained from establishments in the area, to cover part of the cost of the experiment.

2.1.4. Comparison with the extraction technology of shale gas

In the Jiu Valley the geological research of coal deposit is advanced and detailed in some blocks and the drilling depth is much smaller and in sedimentary rocks with medium hardness. Application of the directional drilling reduces the cost for mining, rock fragmentation by making useful at lower pressures than mining. The existence in the area of utilities and industrial consumers and households reduce storage and transport costs of sub-loan product.
Concern for coal gasification plants and surface in situ must be intensified. GSC is possible for experienced in different blocks of the mining fields in the Jiu Valley, already identified (the area of the former micro pit coal Jieţ-Vest, Petrila-Est, EM Lupeni, etc.), with conditions for expansion in areas where the classic exploitation was stopped.
The proposed improvements in preparation techniques for gasification through drilling, fracture and detailed process of getting gas would lead to the complete re-evaluation of attitude towards this technology.

2.1.5. The solid waste gasification

Chemical recycling can be applied in the case of mixtures, sorted waste, industrial waste and municipal waste.
Pyrolysis occurs in the presence of catalysts, which are designed to increase efficiency in useful products, to develop pyrolysis products dehydrochlorination if waste containing PVC and to convert potential toxic compounds in useful products [4].
Following pyrolysis processes are obtained: gas and liquid fuels, a solid residue or monomers.

Composition of pyrolysis products depends on the conditions in which it is performed and the composition of pyrolysis waste polymeric materials (MP).
It takes into account the laminated composite materials and pyrolysis of organic matrix, aiming to recover the reinforcement materials, aluminum sheets (in the case of laminated packages originating in the food industry) and the matrix, in the form of fuels.

Application of pyrolysis to1 tonne of urban waste, results :

- 100 kg of different metals (aluminium, iron, etc.);
- 200 kg synthesis gas (1m^3 has a potential energy of sub-loan 11.2 kwh);
- 200 kg of hydrocarbons (1 kg has a potential energy of sub-loan 11.2 kwh);
- 300 kg coke/charcoal (used in the system; 6000 kcal/kg = 1,72 kWe)

Gas can be used in gas turbines, after a preliminary cleaning in special filters. Solid product of gasification process weight is about 20 percent, while the melting volume is about 5% of that of the original material.
Depending on the method of cooling you can get different types of material such as:
• cooling with air, it forms vitreous black stones that can be used in concrete or asphalt;
• can be molded into shapes and obtain prefabricated building materials;
• compressed air supply through the flow of the melt flow we get mineral wool, twice more efficient on thermal insulation than glass wool; it is also a good absorbent and can be used in water remediation of petroleum products.
Emissions of pollutants in the atmosphere is estimated to be less than 20% of the maximum permitted by the European legislation in force.
Benefits of pyro-gasification:
· requires a much smaller space than landfills, waste storage;
· produces electricity and heat;
· byproducts that can be capitalized;
· has emissions of inert, pollutes far less than sewage incinerators.
In the idea of sustainable management of resources, these facilities should be used only for final waste (waste can no longer be recycled or reused) and on the ramps of historical waste through the creation of mobile, in-situ processing, which may be moved to the next location when they cleaned one waste area.

3. THE CAPITALIZATION OF THE ENERGETIC POTENTIAL FROM COAL MINING DUMPS AND SOLID WASTE

The capitalization of energetic resources present on waste deposits, formed over time from each coal processing plant and some mining exploitations (Petrila, Lupeni) requires a detailed knowledge of areas with high levels of mass combustible, that is subject to extraction and processing.
Activity recovery of fuel material should be consistent with the use, at least in part, of the new waste for the production of building materials, eventually extracting some useful mineral components.
In order to process the waste from dumps of processing plants (figure 3) must take into account the following considerations:
- Extraction of waste on the dumps branches with mechanized installations, loading and transport in accessible area; Designing a mobile workstation for processing waste and deposit after ecological criteria favorable on environmental rehabilitation. It is possible that the product resulting from the operation of fuel stockpiles to raise additional issues burn in

outbreaks of producing heat. Required water to be taken from banks upstream of the clear branches.

- Design a facility suitable for the concentration of waste with high ash contents, in laboratory and pilot phase, using a wider range of concentration installations in gravitational and centrifugal field. On the basis of the obtained results can be made calculation of probable technologic indicators.

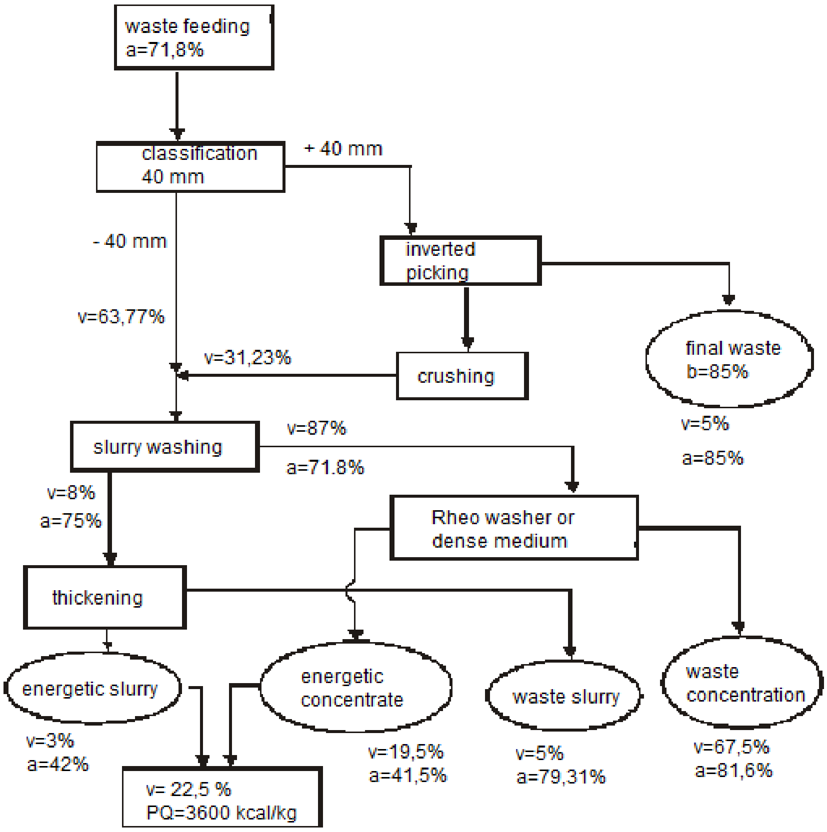

Figure 3 Schematic technological flow and balance sheet for the quantitative - qualitative dump Lupeni

- The final waste deposit will raise issues due to higher clay contents in dumps, plus much finer grain, whereas wet processing will promote the further degradation of mineral component.
- Waste processing to extract some useful substances, is an area little explored and waste dumps in the Jiu Valley mining may become Secondary Reusable Resources. Extraction of fuels from waste dumps will require amendments to the current deposits configuration in order to provide ecological rehabilitation works, activities that are stimulated through governmental programs.

3.1. Potential fuel and ways of recovery

The densimetric analyses of waste below 20 mm from Coroeşti, Petrila and Lupeni dumps shows that, within the range of density 1.75-1.95 kg/dm3 is a sharp increase of recovery in this area being placed the separation densities between energetic fraction and waste. The biggest coal recoveries are possible at Lupeni dumps and lowest at Coroești deposits with intermediate values placing at Petrila dumps.
The most quickly solution adopted, with predictable costs lowest consists in the construction of a classification-picking station and crushing to 40 mm. The final waste (+40 mm) can to

be used for carrying out a basis dam dig for the waste from the processing small class (40 mm). The concentration can to do it in a dense medium based on clay, or in Rheo washer, for which there is experience in exploitation. Income estimated in this phase of the research to be obtained from the mass of combustible recovery from dump Lupeni, we consider it acceptable for an investment in the field and at the same time by processing facilities may be made and eco-rehabilitation of the area, which can be backed up with money from environmental protection [2]. The success of the experiment of recovery of fuel mass on the first body Lupeni dump, may constitute an argument for the expansion and improvement of this technology to other waste dumps in the Jiu Valley.

4. ECOBRIQUETTES – SOLID FUEL FROM DOMESTIC CONSUMPTION

In the current situation of the market of fuels, is justified by the research possibilities of obtaining clean briquettes. The research undertaken so far, [1, 3] have decided to establish a briquetting technology with minimal investment through which a portion of the coal extracted can be exploited in the form of briquettes for household customers. It was envisaged the possibility of launching on the market a better fuel in terms of pollutant emissions. Eco-briquettes are produced from coal, lime (as desulphurisation agent) and biomass, such as wood waste, straw, manure, [3].
These ingredients are blended and then poured under pressure in briquetting machine. Eco-briquette is considered to be compatible with the capacity of environment selfepuration. Ash left after combustion has a favorable composition for improving soil uses.
Waste resulting from the operation of wood can be processed by drying and compaction in the combustible briquettes that can be used for energy purposes. In this way, it achieves both a superior use of waste from wood processing, as well as protecting nature of these pollution byproducts. Biocoal training is done through a high compressive strength with a desulphurisation agent such as Ca(OH)2 dispersed among the charcoal granules, favoring the catalytic reaction between sulfur content in fuel and this agent. During combustion, thus dropping to 60-80% of the pollutant in unpollutant solid compounds, that remain in the ashes. The primary requirement toward such a clean fuel is the absence from his burning of smoke and carbon black as well as harmful substances to human health and the environment. The research has targeted several aspects:

- working conditions, in terms of equipment and technology as possible to use;
- physical-mechanical characteristics of the materials that will enter into the composition of eco-briquette; optimal regime for briquetting; optimal shape and size of the briquette;
- the mechanical properties of the new fuel; caloric intake and ash content
- reaction to firing and the mode of the ecological requirements.

Resistance of briquettes is required to ensure the transport, handling and storage of their size without degradation. Briquetting process at "cold" with the use of vegetable binding material is economically advantageous and that polluting residues is recovered, with minimum energy consumption. You can find that for every typo-briquetting press size there is only one recipe for briquetting process results that satisfy the requirements of the market.
Development of complex installations for coal briquettes obtaining by mixing with sawdust allows creation of new attitudes towards environmental issues, as well as creating opportunities for recovery and the introduction into the economic circuit of the waste deposits. If sawdust would be used in a mixture with coal for the production of biobriquettes, could be produced annually 400,000 tonnes domestic fuel with a calorific power around 4000 kcal/kg, with a favorable impact on the environment, compared to direct use of fossil fuel to heat dwellings.

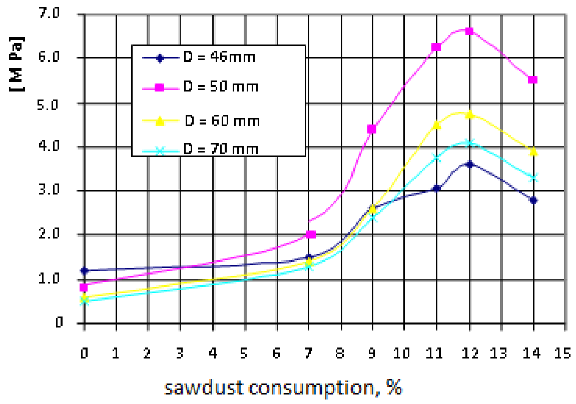

Figure 4 Effect of sawdust addition on resistance to pressure for various sizes of briquettes

CONCLUSIONS

1. Relaunch to exploit coal could be viable if it will resign to the "direct combustion" in favor of complex capitalization through gasification, liquefaction, eco-briquettes with combustible solid waste mixtures, etc.

2. The existence of geological detail coal fields in the Jiu Valley and mining areas from Oltenia offer guidance on the most favorable areas, reducing the cost of application of GSC.

3. Mining dumps in addition to combustible mass and other components can be used in the industry of building materials and extraction of some useful mineral components.

4. Eco-briquettes getting by using a wide range of various fuel sourcing with various physicochemical properties requires complex research in order to ensure the production of a marketable fuel.

5. The research undertaken proposed to establish a briquetting technology with minimal investments through which a portion of the coal extracted can be capitalized together with various combustible waste in the form of briquettes for household and industrial consumers.

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GOLD MINING AT APUSENI MOUNTAINS IN ATIQUITY

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ABSTRACT

Gold Dacia was the main cause of its conquest by the Romans, to save the Empire from bankruptcy. Gold and silver deposits Dacian were stationed in the Golden Quadrilateral of the Apuseni Mountains. It seems that when the Romans sacked 165.5 tons of gold and 331 tons of silver, and 165 years of occupation have mined 500 tons of gold and 950 tons of silver. The Romans were not satisfied with just taking over the mines and miners in the Apuseni Mountains, but also brought the technique used when the main mining centers of Hispania and Britannia Empire and skilled miners in Illyria. Archaeological research undertaken gives evidence on the mining organization and technology applied here in antiquity in order to obtain gold. This paper presents the organization of the ancient mining, mining methods used, ore transport, groundwater discharge, ventilation and illumination of the mines.

KEYWORDS

gold mining in antiquity, mining organization, mining technology.

1.INTRODUCTION

Extraction and processing of useful minerals appears together with the history of mankind in order to produce weapons and tools. The first rock to be employed was flint, but later on, in the Neolithic, gold and copper came to be utilized. In the second millennium B.C., bronze was discovered by amalgamating copper with tin or lead. Bronze tools and weapons were far better than those made of copper, as they had a superior hardness and were easier processed during molding. Such objects were discovered all over Romania, but more frequently in Transylvania where there were also found several non-ferrous ore deposits. Still here were discovered many treasures and gold items, with the assumption that those found at the East and South of the Carpathian Mountains – dating from the Bronze Age and the first stage of the Iron Age – were also made of gold that had been extracted and processed in Transylvania.

Probably, gold mining in the Apuseni Mountains (i.e. the Occidental Carpathians) started somewhere during the 7th century B.C., when some of the Greeks that had left their country for Caucasus in search of the *Golden Fleece* turned towards us, where they could also obviously find such a *fleece*. Otherwise cannot be explained the multitude of coins, household and art objects and of tools used at the extraction and processing of gold, all of Greek origin, which were discovered here and dated from this period. Some sources say that the Phoenicians would have been delving, as well, into this richness. By the 6th century B.C., some Scythian shepherds, who had already known how to get the gold from the river sand, as they were passing their sheep across the Carpathians, discovered the precious metal in the rocks of the mountains and settled themselves down on the Mureş River Valley to become outstanding gold producers.

About another branch of the Scythians – the Agathyrsi – there is also written evidence from several ancient authors starting with Herodotus. As he describes the war of 514 B.C. of the great Persian King, Darius, against the Scythians at the north of Danube, he mentions that Agathyrsi used to live in the Apuseni Mountains area and that they mastered the art of mining and of processing golden jewelry.

The art of extracting and processing of gold and silver was taken over from the Agatyrsi by the Dacians, who did not neglect the use of iron in the making of weapons either. Starting from the assertions of our great historian and archaeologist Vasile Pârvan in his *Getica,* it was believed for a long time that all the Dacian gold captured by the Romans would have been obtained only from the river silt. But, between 1999 and 2006, a team of French archaeologists and researchers from Centre National de Recherche Scientifique (CNRS) and from Unité Toulousaine d'Archéologie et d'Histoire (UTAH) together with geologists from Cluj-Napoca and München executed researches in the field of mining archaeology in some very old mining works at Roşia Montană. On this occasion, there were also discovered some wooden structures of mine sustaining elements. The dating of the samples of this wood, done by help of C_{14}, goes back somewhere between 295 and 90 B.C. that is, among 200 and 400 years before the Roman occupation!

2. MINING ORGANIZATION

The riches of gold and silver available in the Apuseni Mountains were definitely known to the Romans as well. The only significant gold deposits in the empire found in the Iberian Peninsula had already been exhausted, so that, the single rescue from bankruptcy of the proud empire could be the Dacian gold. Trajan already knew this very well so he couldn't leave anything happen by chance, but prepared himself thoroughly for the conquest of Dacia – the result of the two military campaigns of 101–102 and of 105–106, carried out by him. Having defeated the Dacians, Trajan remained here for another couple of months in order to organize the new province and especially the gold mining in the Apuseni Mountains. On the grounds of a *Lex Provinciae* the borders of the new province and its juridical basis were established, as well as the imperial domains and the capital at Sarmizegetusa. The main imperial domain was the gold-bearing area, directly subordinated to the imperial administration. Its headquarters were in Ampelum and it was run by a *procurator aurariarum* who exercised his duties by means of an administrative apparatus made out of technicians and clerks and which disposed of a limited number of soldiers to ensure the military guard of the gold-bearing area. The procurator was in charge of mining efficiency and he used to receive all the direct and indirect incomes of the domain. There was also the possibility of renting some of these mines by little entrepreneurs, the usual renting interval being up to 5 years without renewal. The renting fee was established by the procurator and it had the average value of 4,000 sestreti per year (1 sestret = 1 gram of silver) so, this was not too big. Among the most important mines worked by the Romans in the Apuseni Mountains are to be mentioned those at Bucium, Roşia Montană, Baia de Arieş and Zlatna, as well as those around the town of Brad. Initially, the hand labor employed by the Romans consisted of local inhabitants transformed into slaves. They were not allowed to move to a different place and could be sold or rented by their masters. In order to increase the amount of the extracted gold and silver, the Romans brought here colonists from Dalmatia and other areas having a tradition in working in mine deposits, to labor alongside natives. Dalmatians were settled down at Bucium in establishments called *vicus* and *castellum* in quite a large number, so that they organized themselves in a separate corporation run by Celesenius Constans to whom Opellius, the governor of Sarmizegetusa, raised a tombstone at Ampelum, the place where he died [*Corpus Inscriptionum Latinarum, III, 1322*]. A consequence of the employment of both native and colonist miners at gold mining in the Apuseni Mountains was a period of flourishing until the autumn of 167 which marked the beginning of the Macromanic

War (167–175). Macromans were one of the Germanic tribes related to Suebians and Longobards; they carried out two wars against the Roman Empire (167–175 and 178–180). In the autumn of 167 they reached up to Ampelum and Alburnus Maior, destroyed the whole mining area and pilfered all the gold and silver they found. The disaster was so great, that other colonists had to be brought here to work in the mines. The Macromans were defeated by Marcus Claudius Fronto, the governor of Dacia and of Superior Moesia (168–170), to whom the citizens of Sarmizegetusa raised a statue bearing an inscription in which they praised his bravery [*Corpus Inscriptionum Latinarum, III, 1457*]. The great German historian and archaeologist Theodor Mommsen (1817–1903), an expert in the history of the Roman Empire and coordinator of the monumental work in 12 volumes, *Corpus Inscriptionum Latinarum,* believes that the inhabitants of Roşia Montană and Bucium had hidden most of their riches from the eyes of the Macroman invaders in places known only to them. Mommsen is right as the same inhabitants will act in the same way along the next thousand years during the Barbarian invasions.

Many of the written information on the mining organization in the Apuseni Mountains come from a series of *waxed tablets* discovered at Roşia Montană in the old Roman mine galleries between 1786 and 1855. These are small wooden boards bound in sets of two (diptychs) or three (triptychs) pieces together and coated with bee wax on which different texts could be written. The total amount of discovered tablets was 40, of which only 25 have been preserved, four of them being complete triptychs. They come from the time of the Roman emperors Antoninus Pius (138–161) and Marcus Aurelius (161–180) and one of them from the time of Hadrianus (117–138). These texts contain contracts regarding the renting of the mines by individuals, or different associations done in order to run the mining process, contracts of sale and purchase of slaves, bills, an act regarding the dissolution of a funeral college, and a menu with all the dishes of a party organized by a college of artisans. As a matter of fact, at this party held on the eve of the calends of May, that is, on the 30th of April, the total amount of wine to be consumed exceeded by far, half of the entire expenditure! This demonstrates the everlasting validity of the saying: *„Food is swagger, drinking's the foundation!*"

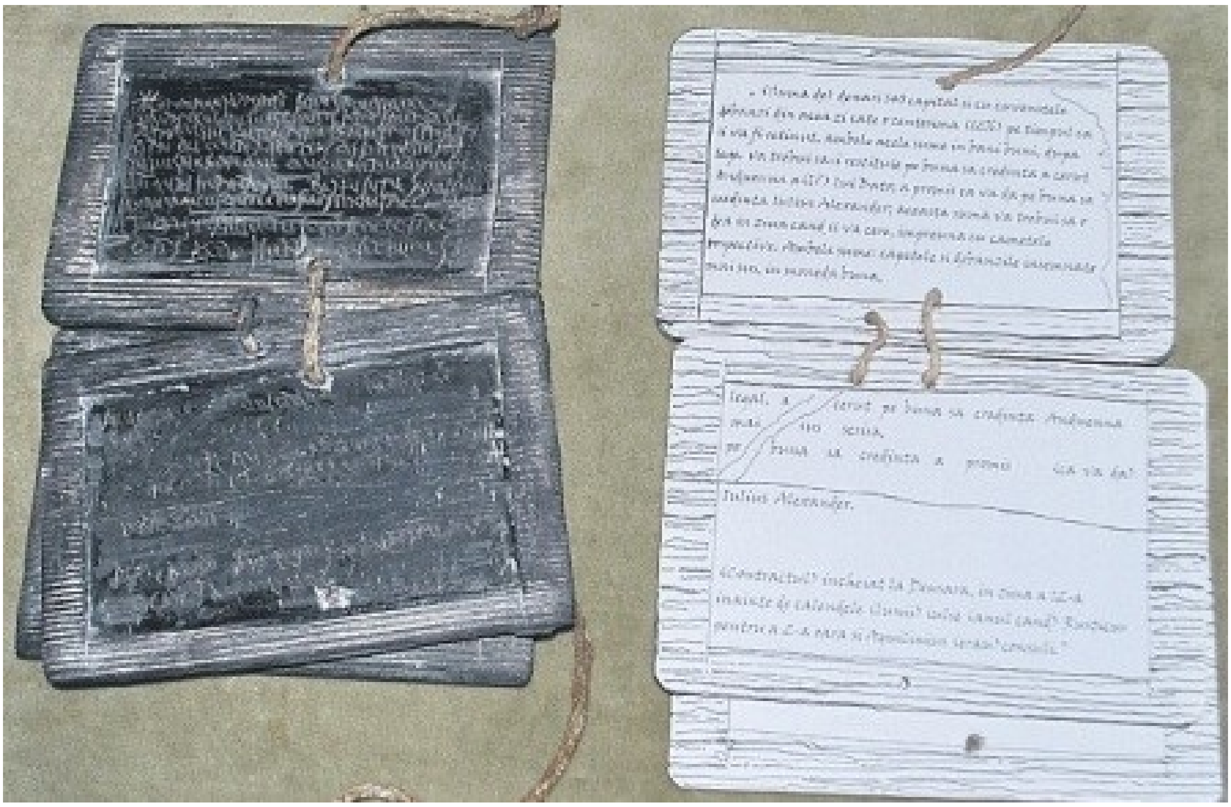

Figure 1: Triptychs of waxed tablets, resembling books

3. MINING TECHNOLOGY

Dacian mining technology could not be restored in the absence of relevant archaeological evidence. Certainly, they obtained the alluvial gold by the same procedures that had been used until the Middle Ages, and even later. The golden veins found in the mountain areas were washed by waters and the little parts of ore detached from the vein were taken down to great distances and crumbled into pieces. Those looking for the alluvial gold nuggets used to have simple tools. With the help of a hoe and of a container, the golden sand was taken out of the river bed and downloaded on the superior side of an inclined surface made of wooden boards and covered with a raveled woolen fabric. With a wooden dipper, water was taken out of the river and poured over the sand placed on the slanted board, in order to make it move downwards onto the woolen fabric. To help the sand move, there was also used a scraper. As the fleece retained the gold nuggets, this was washed out into a two-handled water tub and then, the resulting gold was separated from the remaining sand by help of a buddle.

It is hard to believe that the huge amount of gold gathered by the Dacians resulted only from river silt. Going upstream they discovered the outcrops of the gold-veins and started mining, initially at the surface, and then in the depth of the ground. Dacian mines were not such elaborated as those found in the Iberian Peninsula or Britannia, being probably just narrow coast galleries of short length or shallow wells dug into the veins. As already mentioned, it was scientifically proved that Dacians had already practiced underground mining several centuries prior to the Roman arrival.

Figure 2: Extraction of alluvial gold

The conquest of Dacia by the Romans also represented the improvement of both gold extraction and gold processing technologies. They were not satisfied with simply taking over the mines and miners in the Apuseni Mountains, but also brought along with them the technique of those days, used in the major mining centers of the empire, as well as skilled miners. The most interesting vestige of the Roman surface mining at Bucium is a trench called *Ieruga* , dug into the southern slope of *Corabia* (i.e. *The Ship*) into the outcrop of the gold-vein with the same name, and very rich in gold. It has a length of 500 m and an average depth between 20 m at the top, and 30 m at the bottom. The width of its basis is of 15 m at the top, and 20 m at its bottom. This work is a faithful copy of the Spanish *Corrugates* as seen and described by Pliny the Elder (23–79 A.D.) in his *Naturalis Historiae.* Exactly like in Spain, at the foot of this mine work there was arranged a lake of 120 x 120 m, corresponding to the lake of 200 x 200 steps described by Pliny, its water being necessary to separate the gold that resulted from the ore crushed in the mills. It's been estimated that the Romans had extracted only from this place, about 4 tones of pure gold. Nowadays, this area is forested, but in a picture made around 1900, the old Roman mining work is obviously seen.

By the end of the 19th century, in the area of the old lake at the foot of the Roman trench, there were discovered a grinding mortar made of amphibolic andesite and a stone of quartzy conglomerate used at crushing the golden ore. Further on, the crushed ore was ground in stone mills. The gathering of gold was done gravitationally, by help of the water in the pond which caused the moving of the grinded product onto the slanted plane, as already mentioned. The barren tailings were washed and taken away by water, while gold, heavier than that, remained onto the sheepskin or shaggy fabric on the slanted board. In order to avoid material flowing to the sides of the inclined plane, this had to be bordered. The gathered particles of gold were then melted in crucibles made of fireclay and placed into the ember of an open hearth. The melted content was actually an alloy of gold and silver, which also contained other impurities. To obtain pure gold, they introduced salt (NaCl) into this mixture and so, separated gold from silver, as described by the Roman historian of Greek origin Diodorus of Sicily in the 1st century B.C. In this way, they obtained pure gold and silver chloride. The silver chloride was mingled with the lead oxide of which, silver was separated by cupellation.

Figure 3: Ieruga dug by the Romans on the southern slope of Corabia

For the underground mining, the opening of mines was done by drifts dug from the surface. In the area of the ore deposit, works were then continued either by directional galleries, mined along the vein, or by cross-heading ones. Galleries (*cuniculi*) were opened as far as possible, in hard and compact rocks and digging was done by help of chisel and hammer. Directional galleries were between 2.1 and 2.7 m high, depending on the size of the vein, while the cross-heading ones were between 1.5 and 1.8 m high and between 0.6 and 0.65 m wide. Where the rocks were firm, galleries were not reinforced, but given a vaulted ceiling for a better distribution of pressure onto the side walls (fig. 5. a). In the case of an inadequate ceiling, reinforcement was done only with wooden beams tightened with wedges and lined with boards (fig. 5. b.), but if the walls we not strong enough they had to be reinforced either with half (fig. 5. c), or with complete wooden frames (fig. 5. d).

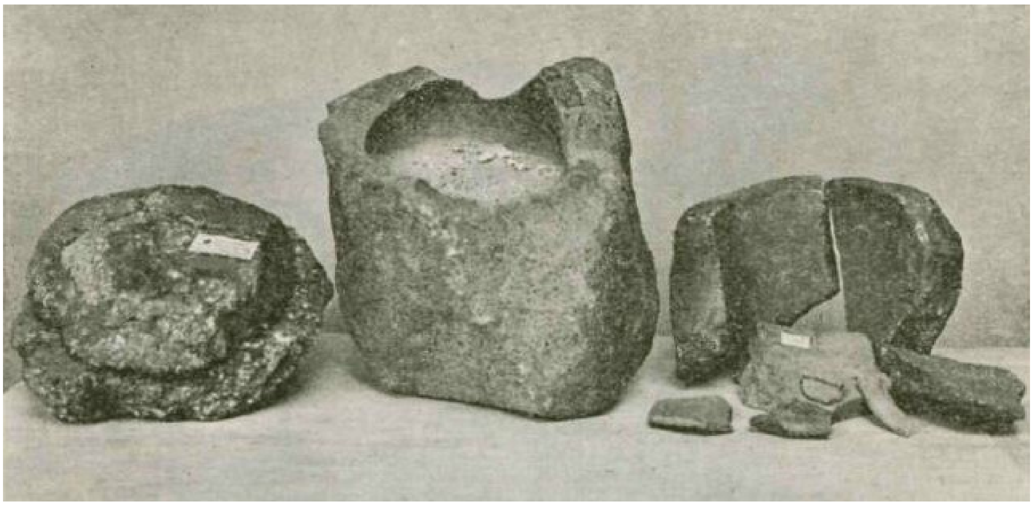

Figure 4: *Roman mortar used at crushing golden ore, discovered at Vulcoi*
Museum of Geology in Budapest, Hungary

The work in the heading galleries – in case of a hard rock – was done by cutting a square groove of 20 x 20 cm with a depth of 5–7 cm at the centre of the cross section of the drift; then, the groove was enlarged to 40 x 50 cm and then to 70 x 90 cm. In the end, the entire outline of the gallery was achieved and the wall was smooth, without cracks. This explains why such galleries as those at *Saints Peter and Paul* have been preserved in such a good condition for almost 2 thousand years. When the rock was very tough, *the method of fire and water* was used. The first written evidence on this ancient technique belongs to the Greek historian and geographer Agatharchides (2^{nd} century B.C.) and later, this is described by Diodorus of Sicily. First, the rock was heated by help of fire in order to produce its expansion, and then, it was cooled down by sprinkling of water upon it, to cause a sudden contraction and thereby, to make it crack or break into pieces. This is how the endless areas of sand in the desert came into being, with great heats during the day and very cold nights. In the writings of the ancient authors it is said that sometimes, water was replaced by vinegar, as the latter has a greater destructive power, due to its higher contraction value.

Among the *gold mining methods* applied by the Romans on the veins at Bucium, are to be mentioned:

a – *Mining in ascending directional strips, with the filling of the mined space;* this was practiced in those places where the rock was not too hard, and the material was dislocated by help of the chisel and hammer. The amount of backfill was small and this could be produced even in the working face drift, by cuttings done into the walls next to the vein.

b – *Mining in descending directional strips, without the backfilling of the mined space;* this was used in the diggings of Ieruga-Scursura, were the rock was hard and very hard. In this case, the vein was left aside in one of the working walls while the sterile, more fragile, was removed. The vein was then extracted with the chisel and hammer, by execution of grooves disposed perpendicularly, in a way that created squares of various dimensions which were then cut out. To avoid accidents, mined spaces were reinforced with wood.

c – *Operating by subsidence* was used in the areas with a dense network of thin veins. Advancing in the direction of the veins was done through overlapped galleries, separated vertically by safety floors. By subsequent collapsing of these floors, there resulted some huge empty spaces called *Corands,* such as the one at Dealul Frasinului (i.e. Ash Tree Hill) situated between Şasa and Muntari.

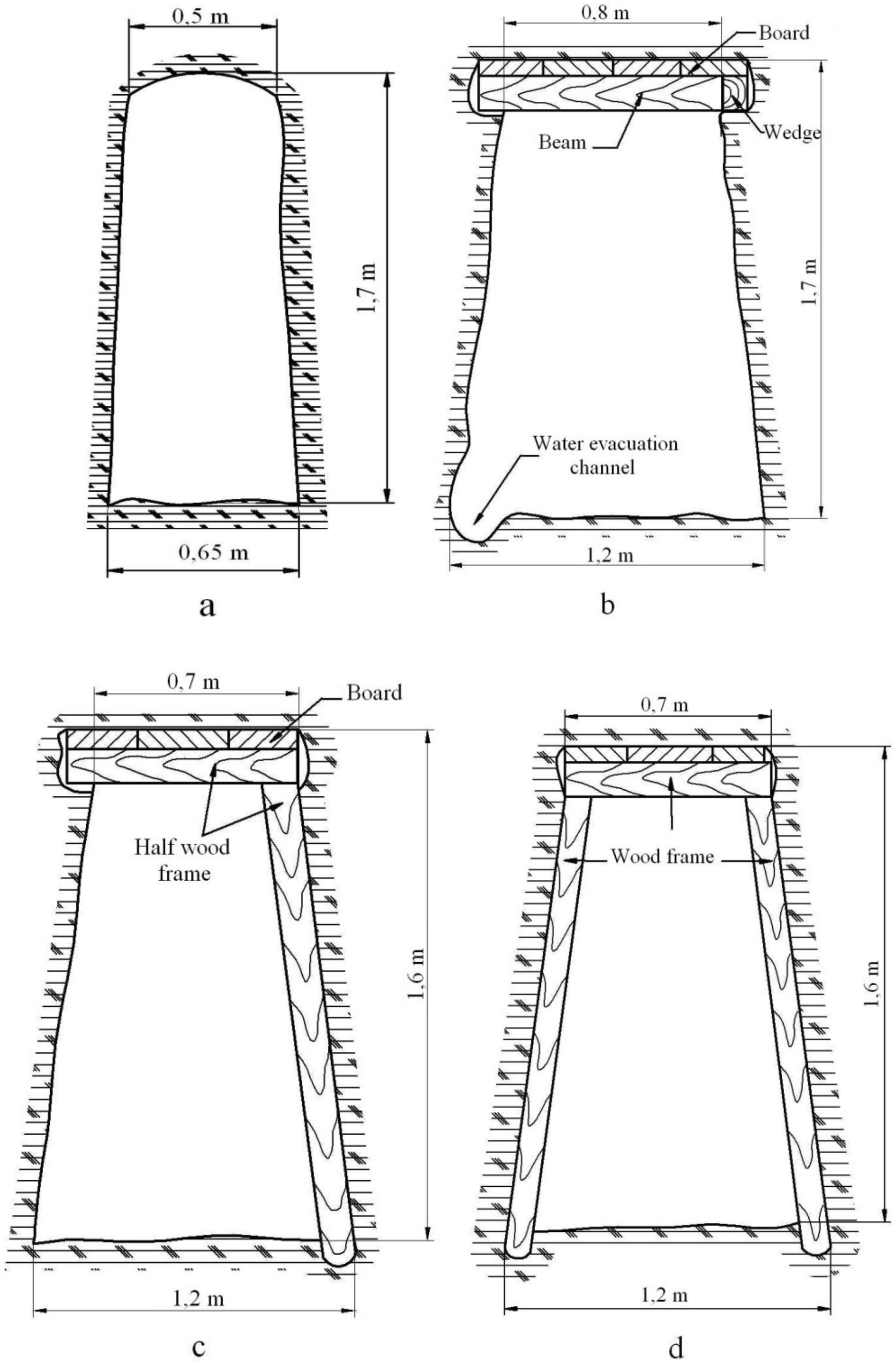

Figure 5: Types of Roman galleries

Ore transport to the surface was done manually, by means of wattled baskets fastened onto the shoulders. In the working face drift, an initial separation of sterile and useful ore was done, and only the latter was taken to the processing place. To evacuate the ore excavated in the very narrow directional galleries they used a sort of trough, that is, a vessel made by hollowing a wooden trunk of 1.4–1.5 m length and 0.4–0.5 m width. This was pulled out by help of a rope connected to a handle at its end. The uploading of the material was done with a wooden bowl. Both these objects have been found in a Roman gallery in the mine of *Saints Peter and Paul*, the bowl being made of ash tree wood.

Evacuation of water was one of the most difficult problems to work out with the technical equipment of the time but, starting with the first century A.D., the Romans made use of two such devices to evacuate water on the vertical: *Archimedes' screw* and the *Hydraulic wheel*. The first device had been invented by the great ancient scholar Archimedes (287–212 B.C.) as a military implement, afterwards being also used to evacuate waters from the gold mines of Egypt and the Iberian Peninsula. This was built of a wooden cylinder in which a spiral snail with the propeller made of wood or copper, was made to revolve. The screw was revolved manually, by means of a crank. Such a device, discovered in the Roman gold mines of the Iberian Peninsula, was about 3–5 m long, with an inner diameter of 20–30 cm, and able to evacuate 35–40 l of water/min and had an efficiency of 40–50 %.

The hydraulic wheel, similar to that of a water mill, was built of a shaft with spokes and an exterior rim having a diameter of 4–6 m, on which 20–24 cups were fixed and made watertight with resin and wax. The cups raised the water from a lower tank and discharged it into a superior basin through an adjacent pipe. This operation was repeated on the vertical, up to one of the drifts which was provided with a drain. The wheel was moved manually, by help of some handles fixed on the exterior side of the rim or by treading by one or two persons on a particular frame placed at the superior part of the wheel. The height at which water was lifted was of ¾ of the wheel diameter and the water discharge reached up to 70–80 l /min. The one who described these hydraulic wheels was the Roman architect Vitruvius (1st century B.C.) and several specimens were found in the Iberian Peninsula, Great Britain, and in Romania at Roşia Montană and Brad (fig. 7). At Rio Tinto, in Spain, 8 such wheels connected into a system that was projected to evacuate waters by taking them to a height of 30 m, have been discovered.

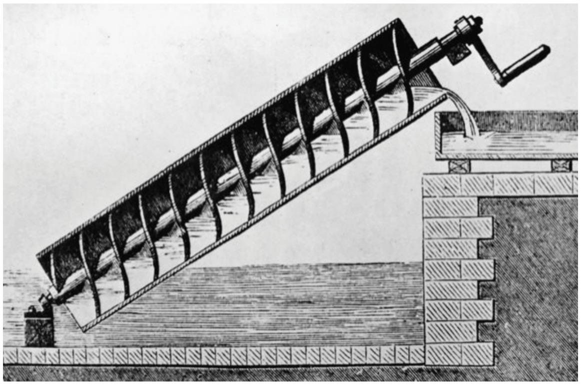

Figure 6: . Archimedes' screw *Figure 7 :Hydraulic wheel*

Mine ventilation was achieved by convection, that is, by taking advantage of the vertical movement of the air, due to the lower density of the warm air inside the mine, compared to the higher density of the cold air, outside. Ventilation was absolutely necessary in those places where fire and water were used, in order to evacuate smoke and steam. This was realized by digging above the main gallery, at a distance of 4–5 m, of another gallery and by joining them together through ventilation wells. Clean air entered through the main shaft, while vitiated air went out through a secondary one; at its end they used to make a fire in order to enhance depression. The ventilation wells were dug at about 10 m distance from one another. As soon as the new ventilation well was dug, the previous ones were backfilled in order to avoid evacuation of the fresh air through the ventilation well, but lead it towards the working place.

Such works have been described by several ancient authors (Lucretius, Vitruvius, Strabo and Pliny the Elder), and subsequently discovered *in situ* (i.e. in the site) at Rio Tinto in Spain. Ventilation wells and galleries had quite small sections of about 1 sq. m. According to Pliny's description, the quality of ventilation used to be checked by help of a lamp; in case the lamp failed to light, workers were evacuated and measures to improve ventilation had to be taken.

Mine illuminating was achieved by lighting lamps (*lucernae*). The lamp was made of burnt clay and it illuminated by means of a wick which was introduced into a container filled with tallow, lard or oil. The tank could be either open, or closed. In the latter case, the tank was endowed with one hole for the fuel and with 1–3 orifices for the wick. At Vulcoi, there was discovered a lighting lamp bearing the brand of *FORTIS.* The brand was always applied on the lower side of the tank and it displayed the name of the manufacturer. In order to be carried, the lamps were provided with a handle. Usually, they were placed in some niches carved in this respect, into the walls of the galleries. Pliny the Elder believes that the oil lamps were also used to measure the working time, probably a day, or a shift of 8 or 10 hours.

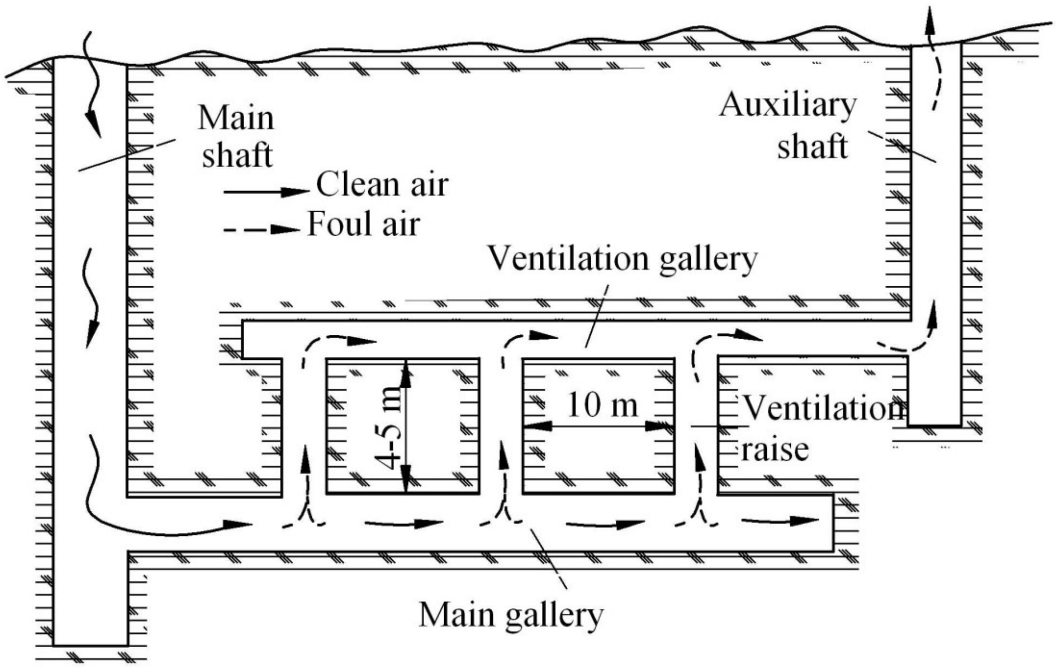

Figure 8: Ventilation in a Roman mine

Figure 9: Mining lamps

Traffic in the wells and between levels was done by wooden stairs made of trunks in which steps were carved at a distance of 0.4–0.5 m. Such stairs have also been discovered in the Roman mines at Vulcoi.

4. CONCLUSIONS

As already mentioned, the Romans had captured from the Dacians 165.5 tons of gold, and 331 tons of silver, and during the 165 years of occupation they extracted another 500 tons of gold and 950 tons of silver. Following the Roman withdrawal from Dacia, the entire course of the socio-economic life got a rural character. Economy turned back to grazing and extensive agriculture and the crafts declined, receiving a predominantly domestic character. Mining made no exception. After the Roman withdrawal, mining activity of the natives was reduced to the use of metals for making agricultural tools, weapons and household utensils. Gold mining in the Apuseni Mountains was probably reduced to the alluvial mining in the river beds, and mining in some of the poorer gold veins found near the surface, which had no relevance to the Romans. Yet, it's hard to believe that miners remaining here after the Roman administration withdrawal abandoned their job and started grazing animals – as agriculture seems impossible in the area. Gold and silver represented, for sure, a strong currency even in those troublesome times of which we know very little.

Roman mining technology was so advanced that in the next 1.500 years it remained unchanged not only in our country, but in the whole Europe, as well. On the land of our ancestors, the barbarian invasions erased the Roman–Dacian culture and civilization for the next thousand years and so, there followed the so-called *dark millennium.*

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CĂRBUNELE - CEA MAI SIGURĂ SURSĂ DE ENERGIE ÎN CONTEXT MONDIAL, EUROPEAN ŞI NAŢIONAL

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ABSTRACT

Cele mai recente date arată totuși că în prezent cărbunele este folosit pentru a produce 40% din cantitatea totală de electricitate la nivel mondial, iar gradul său de utilizare a crescut cu peste 50% în ultimii 10 ani.

KEYWORDS

Cărbunele, energie, national

1. ÎN PLAN MONDIAL

Producția globală de cărbune a înregisrat modificări ușoare până la 7,2 miliarde tone, cărbunele industrial pe bază de abur suferind o ușoară scădere de la 6300 Mt la 6200 Mt, iar cărbunele cocsificabil o creștere cu 100 Mt până la 1000Mt. Pentru prima dată din anul 1988, China a produs mai puțin cărbune (3,87 miliarde tone; -2,5 %), cu toate acestea producția de lignit din China a crescut. Producția în India de cărbune este estimată la 585Mt, cu 3 % mai mult față de anul 2013. Australia a crescut producția de huilă la 431 Mt (+5%). Statele Unite a crescut de asemenea producția la 904 Mt (+1%), însă în acest caz a intervenit propunerea administrativă prin Planul de Energie Curată de a reduce emisiile de CO2 cu până la 30 % până in 2030.

În ceea ce privește comerțul global de cărbune, huila ajuns la 1200 Mt în anul 2014. Australia a crescut exporturile de huilă cu 8,1 % la 387 Mt. Indonezia a scăzut exporturile la 408 Mt (-4%); India a importat 157 Mt de cărbune (+12%). China a importat aproximativ 229 Mt (-9%) de cărbune. Statele Unite a exportat 88 Mt, dintre care 39,2 Mt către Europa. Exporturile totale de cărbune au fost sub 100 milioane tone engleze pentru prima dată din 2010. Columbia a închis portul Drummond pe o perioadă de trei la începutul anului, eliminând aproximativ 6,5 Mt din comerțul pe mare. În total, Columbia a exportat aproximativ 75 Mt cărbune pe bază de abur.

Prețul pentru care cărbunele pe bază de abur este în scădere și această tendință cel mai probabil va continua. Principalul motiv pentru scăderea prețului la tona de cărbune este o capacitate prea mare datorată unei cereri prea mici, o consecință a încetinirii ratei de creștere a PIB_ului în Asia, în special în China, dar și a unei situații economice globale slabe. O altă cauză pentru scăderea prețurilor a reprezentat-o ratele de schimb; companiile miniere din Rusia, Columbia, Australia și Africa de Sud au avut avantaj de monedă care le-a permis să atenueze veniturile mai mici din cauza prețurilor scăzute la cărbune.

Dolarul american și-a consolidat în mod semnificativ poziția atât față de euro, cât și față de rubla rusească, producând noi avantaje de preț pentru exportatorii de cărbune din Rusia către Europa (figura 1).

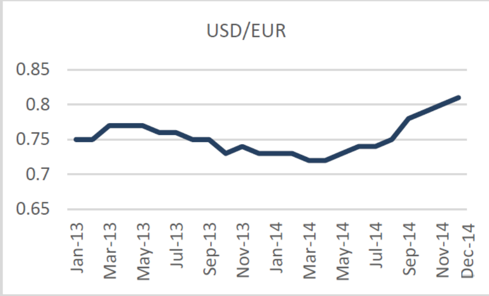

Figura 1: Fluctuația dolarului american raportat la euro

Un alt motiv pentru scăderea prețurilor la cărbune este că până la sfârșitul anului trecut, ratele de transport marfă au scăzut cu până la 5÷7 dolari americani pe ruta Richards Bay-Rotterdam, contribuind la prețuri mici pentru cărbune în porturi precum ARA (Germania).

Ca o concluzie primară, putem spune că,volumul mare de rezerve de cărbune existent în lume face ca această materie primă să fie considerată ca o resursă importantă şi sustenabilă de energie pentru viitor şi care ar putea face posibil:

- planificarea pe termen lung a utilizării cărbunelui în viitor în sensul folosirii lui pe perioada mai multor generaţii;

- recuperarea capitalului investit de antreprenori: în centrale termice şi electrice, uzine metalurgice, infrastructură de transport, logistică, etc. şi realizarea unor profituri pe termen lung;

- efectuarea de cercetări privind folosirea şi economia resurselor de cărbune, nu numai în aria de interes a ştiinţelor aplicate, dar şi în cea a ştiinţelor fundamentale.

Zăcămintele de cărbuni sunt răspândite în peste 100 de ţări de pe mapamond şi ca urmare locaţiile geografice ale zăcămintelor mari de cărbune situate în diferite continente şi regiuni ale globului terestru protejează importatorii şi utilizatorii de cărbune faţă de o eventuală monopolizare a furnizării acestei materii prime.

2. ÎN PLAN EUROPEAN

Una din provocările majore pentru Uniunea Europeană se referă la modul în care se poate asigura securitatea energetică cu energie competitivă şi „curată”, ţinând cont de limitarea schimbărilor climatice, escaladarea cererii globale de energie şi de viitorul nesigur al accesului la resursele energetice.

Viziunea politicii energetice europene de astăzi corespunde conceptului de dezvoltare durabilă şi se referă la următoarele aspecte importante: accesul consumatorilor la sursele de energie la preţuri accesibile şi stabile, dezvoltarea durabilă a producţiei, transportului şi consumului de energie, siguranţa în aprovizionarea cu energie şi reducerea emisiilor de gaze cu efect de seră.

UE elaborează o politică energetică ambiţioasă, care acoperă toate sursele de energie, de la combustibili fosili (ţiţei, gaz şi cărbune) până la energia nucleară şi cea regenerabilă (solară, eoliană, geotermală, hidroelectrică etc.), în încercarea de a declanşa o nouă revoluţie industrială, care să ducă la o economie cu consum redus de energie şi limitarea schimbărilor climatice asigurând că energia pe care o consumăm va fi mai curată, mai sigură, mai competitivă şi durabilă.

State din Uniunea Europeană dispun atât de rezerve de cărbune superior – antracit şi huilă - cât şi de rezerve de cărbune inferior – cărbune brun şi lignit. În Uniunea Europeană cărbunele superior este produs în Republica Cehă, Germania, Polonia, România, Spania, şi Marea Britanie.

Cărbunele brun şi lignitul sunt produse în Bulgaria, Republica Cehă, Germania, Grecia, Ungaria, Polonia, România, Slovacia și Slovenia.

Modernizarea pe scară largă a centralelor electrice pe bază de cărbune din Europa oferă o cale low-cost la reducerea emisiilor de gaze cu efect de seră prin îmbunătățirea eficienței. Alte co-beneficii includ plante curate cu emisii reduse de poluanți convenționali.

Prețurile europene de autorizare de carbon 2015÷2018 sunt așteptate să crească ușor, însă nu la un nivel îngrijorător. După analize și evoluția prețului pe piață (figura 2), proiecțiile cererii de cărbune arătă o stabilitate pentru următorii ani, în mod special cele din Europa.

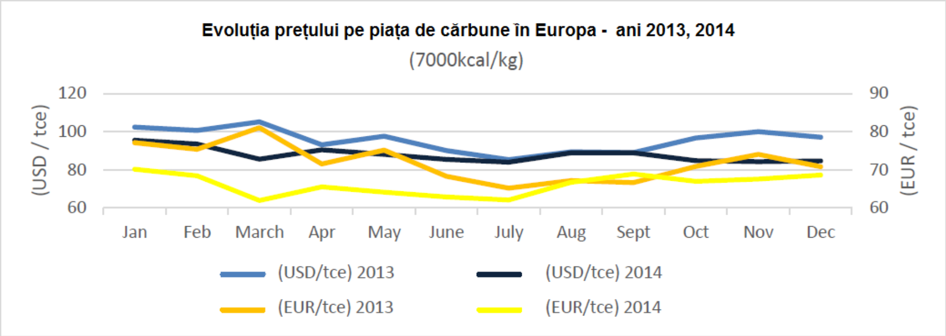

Figura 2: Evoluția prețului pe piața de cărbune în plan european pe ultimii doi ani

Piața europeană de cărbune a totalizat în anul 2013 o cantitate de 738, 7 Mt (defalcată în 111,7 Mt producție internă de huilă; 217,8 Mt importuri de hulă și 409,2 Mt producție de lignit), iar în anul 2014 a insumat 711,0 Mt (105,7 Mt producție internă de huilă; 204,6 Mt importuri de hulă și 400,t Mt producție de lignit), aspecte evidențiate în diagrama din figura nr.

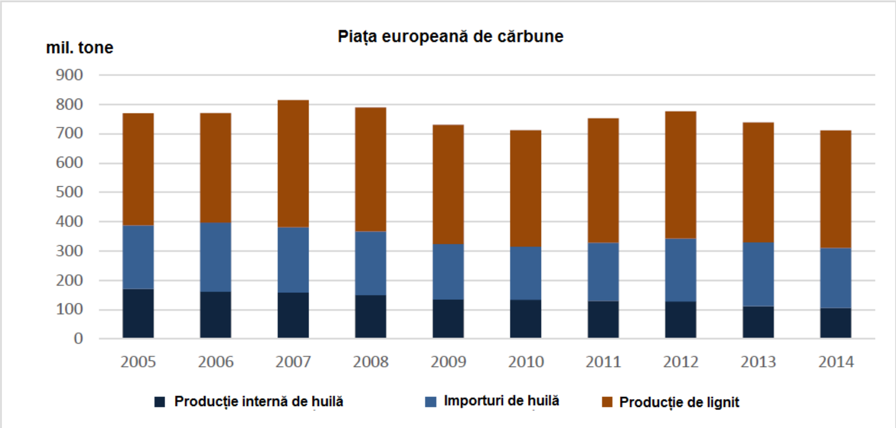

Figura 3: Repartiția pieței de cărbune în perioda 2005-2014 în Europa

În tabelul nr.1 se prezintă producția de huilă pentru anii 2013 și 2014, cu mențiunea că producția de huilă din Bulgaria s-a modificat, fiind acum drept lignit, iar in figura 4 se redă digrama producției de huilă a țărilor europene.

Table 1: Țările producătoare de huilă din Europa

Tara producătoare	2014	2013
	Mt	**Mt**
Bulgaria	0	0
Czech Republic	8.7	8.6
Germany	7.6	7.6
Poland	72.5	76.5
Romania	1.5	1.8
Spain	3.9	4.4
United Kingdom	11.5	12.8
Total	**105.7**	**111.7**

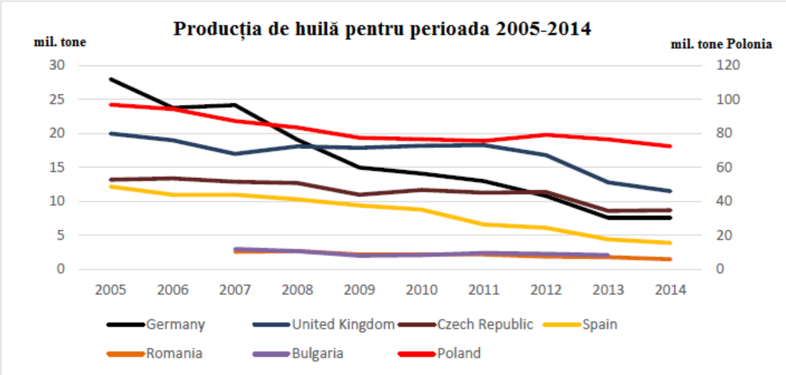

Figura 4: Evoluția producției de huilă

În tabelul nr.2 se prezintă producția de lignit pentru anii 2013 și 2014, iar in figura 5 se redă digrama producției de lignit a țărilor europene.

Table 2: Țările producătoare de huilă din Europa

Tara producătoare	2014	2013
	Mt	Mt
Bulgaria*	32.6	28.6
Czech Republic	38.2	40.4
Germany	178.2	183.0
Greece	50.6	52.5
Hungary	9.5	9.5
Poland	63.7	65.7
Romania	22.0	22.9
Slovak Republic	2.2	2.2
Slovenia	3.7	4.4
Total	**400.7**	**409.2**

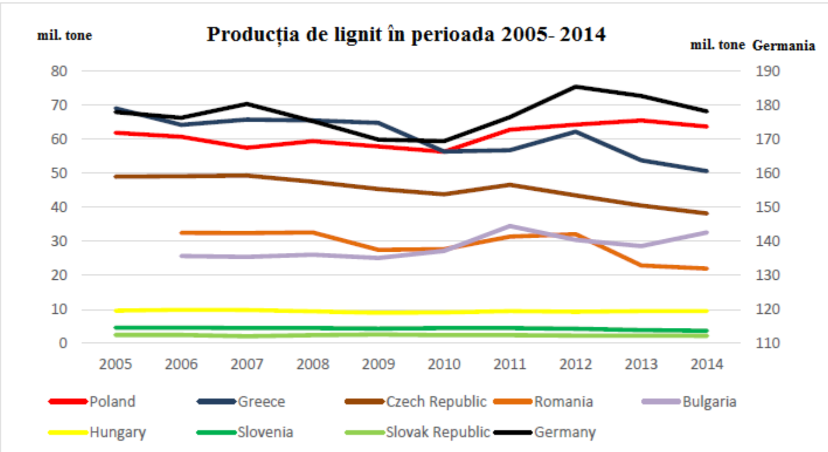

Figura 5: Evoluția producției de lignit în țările europene huilă

Astăzi, mai mult de 90 % din producţia de lignit şi 67 % din cea de cărbune superior se foloseşte în Uniunea Europeană în termocentrale pentru producerea energiei termice şi electrice.

În ceea ce priveşte producerea de energie electrică a Uniunii Europene, lignitul şi cărbunele superior deţine un procent de cca 30 %.

Analizând fiecare ţară producătoare de cărbune din Uniune, reiese faptul că acest combustibil va rămâne o coloana vertebrală absolut indispensabilă a sistemelor de energie electrică și termică în multe state membre. Este una dintre sursele de energie cele mai fiabile pentru Europa și fără ea nu există o reală securitate energetică europeană. În mod sigur cărbunele de care dispune limitează dependenţa Europei de importul de energie. De asemenea cărbunele diminuează vulnerabilitatea Europei faţă de criza energetică, datorită rezervelor proprii de cărbune şi unei bune funcţionări a pieţei mondiale pentru această materie primă.

3. ÎN PLAN NAŢIONAL

Obiectivul general al dezvoltării sectorului energetic al României, în perioada 2014-2020, este acela al acoperirii integrale a consumului intern de energie electrică şi termică, în contextul creşterii securităţii energetice a ţării, al dezvoltării durabile şi al asigurării unui nivel corespunzător de competitivitate.

În România, la acest moment cărbunele este deja resursa supremă ca pondere în producerea de energie electrică, asigurând în jur de 30% din energia consumată la nivel naţional şi chiar mai mult în perioadele de secetă.

3.1 Importanţa cărbunelui în România

În cadrul sistemului energetic naţional, exploatarea zăcămintelor de cărbune ocupă un loc prioritar în vederea asigurării din resurse proprii, într-o proporţie cât mai mare, a necesităţilor interne de energie electrică.

România dispune de o gamă diversificată, dar redusă cantitativ, de resurse de energie primară fosile şi minerale: ţiţei, gaze naturale, cărbune, minereu de uraniu, precum şi de un important potenţial valorificabil de resurse regenerabile.

Rezervele de cărbune superior din România se cifrează la aproximativ 800 milioane tone, iar resursele de lignit din România sunt estimate la circa 1.490 mil. tone, din care exploatabile în perimetre concesionate – 445 mil. tone, iar cele amplasate în perimetre neconcesionate se ridică la valoarea de 1.045 mil. tone .

În ultimii doi ani, cărbunele superior a fost extras dintr-o singură zonă a României şi anume din Valea Jiului, bazinul unde se găsesc cele mai importante rezerve de huilă ale României.

3.2. Oportunitatea cărbunelui inferior în România

Peste 90 % din întreaga rezervă de lignit a României este cantonată în zona Olteniei, motiv pentru care acestei zone i se acordă o atenţie deosebită în asigurarea resurselor de cărbune ale ţării.

Aproximativ 90 % din producţia anuală, se extrage din cele 13 cariere, care funcţionează în bazinele: Rovinari, Motru, Jilţ, Mehedinţi şi din 3 cariere (perimetre de exploatare) din zona Berbeşti-Alunu.

Date fiind caracteristicile cărbunelui extras în România (huilă energetică cu putere calorifică de 3650 kcal/kg şi lignit cu putere calorifică între 1650-1950 kcal/kg) utilizarea acestuia se poate realiza numai în termocentrale echipate pentru acest tip de combustibil şi situate cât mai aproape de furnizorii de lignit.

În cazul cărbunelui inferior, se justifică a fi folosit în termocentrale aflate la o distanţă de maxim 150 km faţă de locul de exploatare.

Principalii beneficiari ai lignitului extras în bazinele miniere din Oltenia sunt termocentralele Rovinari (cu o distanţă de transport a cărbunelui de la locul de extragere de aproximativ 4 km), Turceni (cu o distanţă de transport a cărbunelui de la locul de extragere de 3 km), Işalniţa, Craiova II, Halânga, Govora, Arad, Oradea, Timişoara şi Braşov.

În România există un program de modernizare a termocentralelor, care implică şi închiderea instalaţiilor vechi şi neprofitabile şi care va fi implementat în totalitate în viitorul apropiat. Se speră că modernizarea termocentralelor va duce la îmbunătăţirea indicatorilor de producţie şi în primul rând la un preţ competitiv al energiei produse pe bază de cărbune.

3.2.1 Sucursala Divizia Miniera Tg-Jiu – principalul furnizor de lignit din România

Sucursala Divizia Minieră Târgu Jiu (SDM), face parte din S. Complexul Energetic Oltenia S.A., al cărei obiect principal de activitate este extracţia lignitului din perimetrele miniere.

La momentul actual, în cadrul S.D.M. sunt în funcţiune 10 cariere (unităţi miniere de carieră) și anume: UMC Roșia, UMC Peșteana, UMC Tismana, UMC Pinoasa, UMC Rovinari, UMC Jilț Nord, UMC Jilț Sud, UMC Roșiuța, UMC Lupoaia, UMC Husniciora.

În anul 2014 la Sucursala Divizia Miniera Târgu - Jiu a fost realizată o producţie totală de 21,5 mil. tone şi 137,3 mil. mc. steril din descopertă.

Conform diagramei din figura nr.6, se observă că producția la nivelul carierelor variază între 957 mii tone (U.M.C Rovinari) și 3.045 mii tone (UMC Roșia), în funcție de condițiile geominiere, hidrogeologice, condițiile de zăcământ, dotarea tehnică s.a.

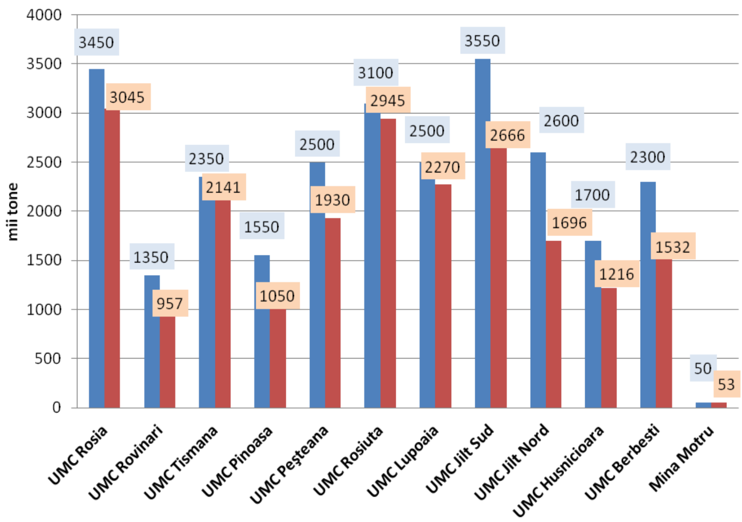

Figura 6: Dinamica producţiei de lignit pe anul 2014 pe UMC-uri

Nota: UMC Berbesti –externalizată; Mina Motru –în conservare;

De asemenea, calitatea lignitului (puterea calorifică) redată în figura nr. 7, variază între 1693 Kcal/kg (UMC Jilț Sud) și 1903 Kcal/kg (UMC Roșia), la nivelul Sucursalei Divizia Minieră obținându-se o putere calorifică medie pentru anul 2014 de 1810 Kcal/kg.

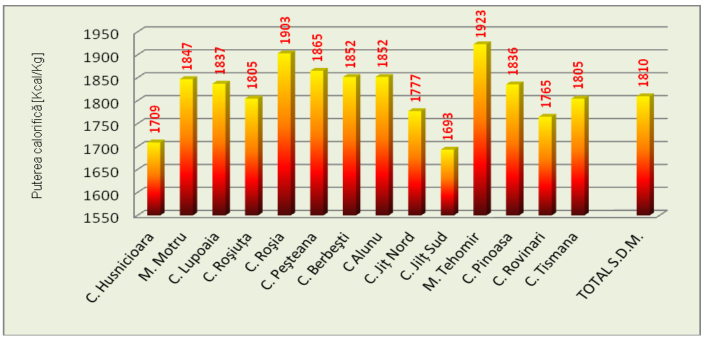

Figura 7: Calitatea cărbunelui realizată în anul 2014

Cărbunele (lignitul) extras din carierele ce aparțin Sucursalei Divizia Miniera din cadrul Complexului Energetic Oltenia este un cărbune inferior, folosit în termocentralele din ţară, cu următoarele caracteristici principale:

- putere calorifică - 1700 ÷ 1900 kcal/kg;
- cenuşă - 25 ÷ 40%;
- umiditate totală - 37 - 45%;
- conţinut de sulf - 1,26 – 1,89%.

Din punct de vedere al puterii calorifice, conform diagramei de mai jos (figura nr.8) lignitul din România se situează la o valoare medie, ținând cont de același tip de cărbune din țări precum Cehia și Germania.

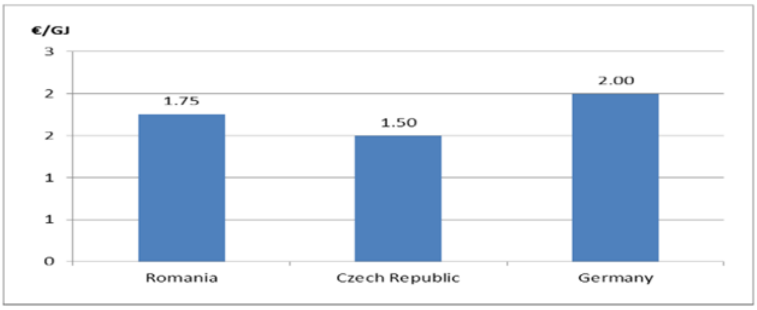

Figura 8: Comparaţia valorii puterii calorice a lignitului

La nivelul Sucursalei Divizia Miniera, dotarea tehnica existentă, este următoarea:

- **66** excavatoare cu rotor din care 27 modernizate;
- **48** maşini de haldat;
- **391** transportoare de mare capacitate, cu o lungime totala de 225,6 km;
- **24** maşini de depozit;
- **62** cărucioare cu bandă pe şenila;
- **Capacitatea de producţie** este de ***25,5 milioane*** tone/an lignit energetic, la un ***program de 5 zile/săptămână*** şi ***30,5 milioane tone/an*** lignit energetic, la un ***program de 7 zile/săptămână***, fiind determinată de dotarea tehnică, desfacere-livrare cărbune, baza materială, productivitatea şi condiţiile tehnologice.

Ca urmare a măsurilor întreprinse și din analiza costului unitar realizat pe subunități, a rezultat diminuarea acestuia de la an la an (figura 9), respectiv:

71,89 lei/t în anul 2012;
68,53 lei/t în anul 2013;
65,53 lei/t în naul 2014;
și **50,91** lei/t programat pentru anul 2015.

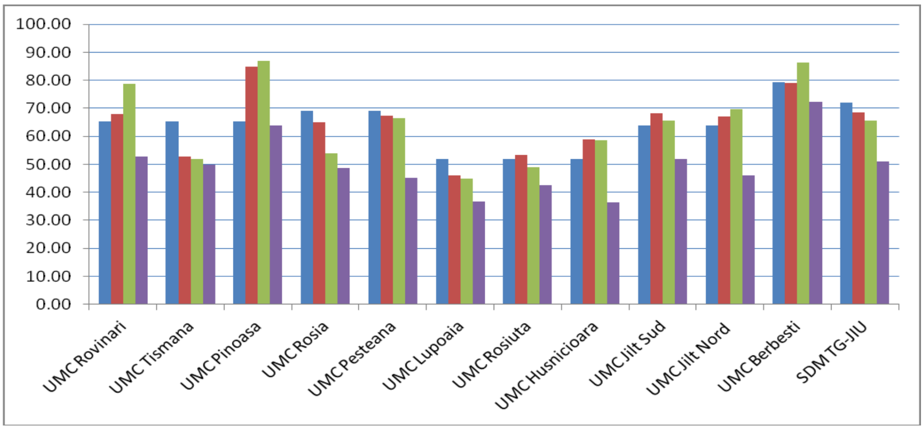

Figura 9: Situatia costului unitar pe subunitati și total SDM– ani 2012-2014 si plan an 2015

Din problemele întâmpinate se pot menționa:

· Acţiuni promovate în instanţe judecătoreşti de Asociaţia BANKWATCH ROMANIA şi GREENPEACE CEE ROMANIA pentru suspendarea şi anularea unor acorduri de mediu emise de Agenţia de Protecţia Mediului Gorj şi a deciziilor de scoatere din fondul forestier şi de defrişare emise de ITRSV Vâlcea.

· Necesitatea votării de către Parlament a Legii 255/2010 modificată şi completată, privind exproprierea pentru cauză de utilitate publică necesară realizării unor obiective de interes judeţean şi local. -Dacă Legea nr. 255/2010 - de utilitate publică pentru exproprieri - ar fi în vigoare, carierele ar fi deschise la capacitatea de producţie proiectată şi ar putea produce cantităţi mai mari de cărbune, ceea ce ar conduce la rentabilizarea acestora.

· Finalizarea completărilor solicitate de ministerele României privind documentaţiile pentru proiectul de HG, constând în declanşarea procedurilor de expropriere a imobilelor şi proprietăţilor private situate pe amplasamentul coridorului de expropriere necesar lucrărilor miniere de utilitate publică aferent carierelor Jilţ Sud, Jilţ Nord şi Roşia.

CONCLUZII

Lipsa unei legislaţii adecvate care să permită exproprierea terenurilor necesare pentru executarea lucrărilor miniere, conduce la costuri suplimentare în sensul că sunt necesare transportoare cu bandă care trebuie montate în funcţie de configuraţia terenului în loc să fie asigurate fronturi de lucru cu lungimi de 1,5 – 2 km, ceea ce ar însemna reducerea costurilor prin:

-***reducerea timpilor de staţionare aferente lucrărilor de montare a transportoarelor cu banda pe alte amplasamente;***

-***creşterea productivităţii orare şi implicit a masei miniere excavate prin dimensionarea corectă a fronturilor de lucru;***

- ***scăderea consumului de energie prin eliminarea transportoarelor suplimentare;***

-***reducerea numărului de personal de supraveghere şi exploatare şi a costurilor cu munca vie;***

-***asigurarea decalajului necesar pentru treptele inferioare de excavare care în general sunt purtătoare de cărbune şi implicit creşterea producţiei care în final duce la o activitate rentabilă din punct de vedere economic.***

În momentul de faţă se fac eforturi pentru implementarea acestei Legii nr. 255/2010 – privind exproprierea terenurilor pentru utilitate publică

Necesitatea implementării unui program de restructurare a activitătii miniere, este consecinta mai multor factori interni si externi care au afectat indicatorii de performanta ai S. Complexul Energetic Oltenia S.A.

Activitatea de extracţie a lignitului se va desfăşura pe teritoriul a două judeţe, Gorj şi Mehedinţi, în 13 perimetre miniere de suprafaţă la zi (10 unitati miniere de carieră), prin tehnologii de extracţie în flux continuu cu excavatoare cu rotor, transportoare cu bandă de mare capacitate şi maşini de haldat.

Sucursala Diviziei Minieră Târgu Jiu deţine licenţe de exploatare pentru toate cele 13 perimetre miniere de suprafaţă, licente active pana in anul 2027.

Rezerva de lignit cantonată în perimetrele de exploatare, asigură funcţionarea Complexul Energetic Oltenia, pentru o perioadă de cel putin 40 de ani.

Pe termen scurt, pentru revigorarea activității din cadrul Sucursalei Divizia Minieră se va trece la închiderea activității în perimetrele miniere neviabile datorită condițiilor existente și concentrarea activității în perimetre de exploatare viabile, cu condiții mai bune, care să asigure realizarea unor costuri și indicatori competitivi, comparabili cu cei realizați pe plan mondial.

În final trebuie să subliniez rolul carbunelui din Oltenia „Ce se întâmplă când nu bate vântul şi e secetă? Cam ceea ce se întâmplă în prezent şi ce s-a întâmplat cu câţiva ani în urmă: hidrocentralele produc mai puţină energie, eolienele mai mult stau, iar Cernavodă se închide, pentru că debitul Dunării scade şi apar probleme la răcirea reactoarelor. Dacă mai e şi iarnă, nici termocentralele pe gaze nu mai pot produce, pentru că nu sunt suficiente gaze naturale. Astfel, singurii care pot produce şi pe care se poate baza economia naţională rămân termocentralele pe cărbune. Practic, este vorba de ***siguranţa sistemului energetic naţional şi, în consecinţă, securitatea naţională a României.***

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SITUAŢIA MINERITULUI DIN VALEA JIULUI ÎN CONTEXTUL DEZVOLTĂRII DURABILE

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ABSTRACT

Conceptul de dezvoltare durabilă în minerit este în fază incipientă. Cu toate acestea industria minieră trebuie să adopte strategii de dezvoltare durabilă care vor stabilii obiectivele dezvoltării precum şi căile şi mijloacele de realizare a lor.

Principalele probleme ale Văii Jiului sunt: dependenţa aproape totală de exploatarea cărbunelui; lipsa altor activităţi economice importante; starea necorespunzătoare a infrastructurii tehnice; starea necorespunzătoare unei părţi însemnate a locuinţelor; deteriorarea mediului înconjurător; concentrarea unui număr mare de persoane fără loc de muncă; lipsa terenurilor cu potenţial agricol care să asigure alternative pentru subzistenţă; ponderea însemnată a populaţiei provenite din afara zonei, înainte de 1989.

Închiderea minelor a condus, atât la diminuarea veniturilor populaţiei din zona Văii Jiului cu consecinţe restrictive asupra economiei locale, cât şi la diminuarea veniturilor bugetelor locale.

Analizând evoluţia personalului în cadrul Sucursalelor diviziei miniere este necesară o politică sistematică de personal care să asigure în momentul ieşirii la pensie a personalului care îndeplineşte condiţiile de pensionare , înlocuirea cu personal calificat, care să îşi poată desfăşura activitatea în condiţii de sănătate şi securitate a muncii, atât pentru ei cât şi pentru utilaje şi zăcământ.

KEYWORDS

dezvoltare durabilă, zone miniere, indicatorii de dezvoltare durabilă

1 Introducere

Termenul de dezvoltare durabilă a început să devină, foarte cunoscut după Conferinţa privind mediul şi dezvoltarea, organizată de Naţiunile Unite la Rio de Janeiro în vara lui 1992, cunoscută sub numele de "Summit-ul Pământului". Ea a avut ca rezultat elaborarea mai multor convenţii referitoare la schimbările de climă (reducerea emisiilor de metan şi dioxid de carbon), diversitatea biologică (conservarea speciilor) şi stoparea defrişărilor masive. Tot atunci a fost elaborată şi Agenda 21 - planul de susţinere a dezvoltării durabile.

Ca ţară membră a Uniunii Europene, România şi-a asumat obligaţii precise în ceea ce priveşte implementarea acquis-ului comunitar, inclusiv în ceea ce priveşte trecerea la un model de dezvoltare durabilă, însuşindu-şi principiile, obiectivele şi modalităţile de lucru convenite în cadrul UE. Prin urmare, Strategia Naţională de Dezvoltare Durabilă, aflată în curs de elaborare, trebuie să restabilească şi să menţină condiţiile pentru codezvoltarea capitalului natural şi a sistemului socio-economic pe termen lung şi foarte lung pe teritoriul României.

Pentru a defini dezvoltarea durabilă trebuie avut în vedere modul în care interecţionează domeniile economic, politic şi cultural, între ele şi cu domeniul social, natural şi populaţia umană (Fig.1)

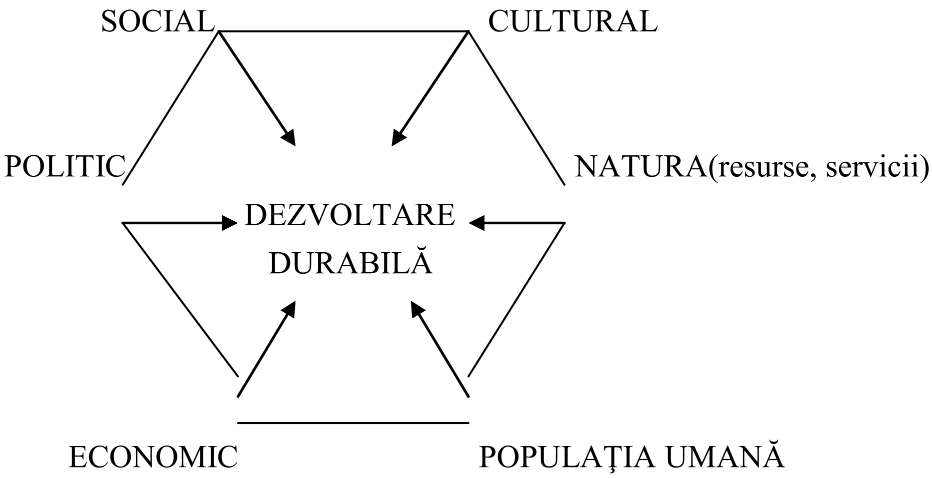

Figura 1: Domenii care interacţionează pentru realizarea dezvoltării durabile

Dezvoltarea durabilă poate fi definită şi ca păstrarea intactă a potenţialului de consum de bunuri comercializabile şi resurse naturale pe cap de locuitor al generaţiilor viitoare. Potenţialul de consum este o funcţie a celor două tipuri de capital:

$$W=W(K,E), \qquad (1)$$

unde: W este potenţialul de consum,

K stocul de capital creat de om,

E stocul de resurse naturale.

Valea Jiului este o microregiune alcătuită din 3 municipii: Petroşani, Lupeni, Vulcan şi 3 oraşe: Petrila, Uricani, Aninoasa, cu o populaţie totala de 149.582 locuitori. Administrativ, localităţile din Valea Jiului au în componenţă alte localităţi mai mici: Petrila are ca şi localităţi aparţinătoare Lonea, Cimpa, Jieţ, Răscoala şi Taia; Petroşani cu localităţile aparţinătoare Dâlja Mare, Dâlja Mică, Sălătruc şi Livezeni; Lupeni; Aninoasa cu localitatea aparţinătoare Iscroni; Vulcan cu localităţile aparţinătoare Dealul Babii şi Paroşeni; Uricani cu localităţile aparţinătoare Câmpul lui Neag și Valea de Brazi.

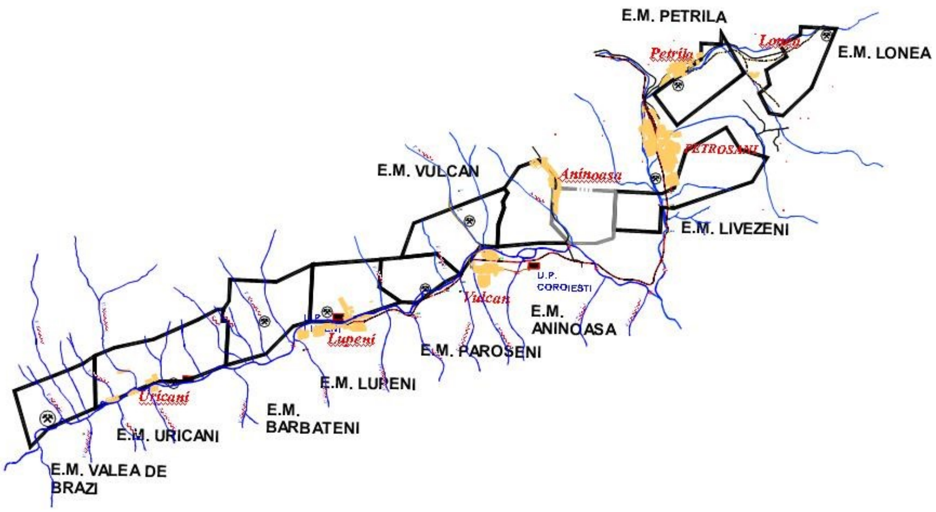

Figura 2: Bazinul minier al Văii Jiului

Bazinul Petroşani (Fig.2) este constituit dintr-un fundament cristalin şi depozite sedimentare de cuvertură. Fundamentul cristalin apare la zi pe rama bazinului şi este alcătuit din roci metamorfice cu grad diferit de metamorfism care aparţin pânzei getice şi domeniului autohton. Depozitele sedimentare aparţin Cretacicului superior, Paleogenului şi Miocenului şi sunt acoperite în mare parte de formaţiuni cuaternare.

Valea Jiului se înscrie în categoria zonelor urbane cu industrie în regres în care exploatarea minieră a devenit nerentabilă. Restructurarea activităţii miniere a atras după sine o cădere economică bruscă a acestei zone şi o amplificare a problemelor sociale, prin creşterea şomajului.

Principalele probleme ale Văii Jiului sunt: dependenţa aproape totală de exploatarea cărbunelui; lipsa altor activităţi economice importante; starea necorespunzătoare a infrastructurii tehnice; starea necorespunzătoare unei părţi însemnate a locuinţelor; deteriorarea mediului înconjurător; concentrarea unui număr mare de persoane fără loc de muncă; lipsa terenurilor cu potenţial agricol care să asigure alternative pentru subzistenţă; ponderea însemnată a populaţiei provenite din afara zonei, înainte de 1989.

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2 Analiza SWOT a mineritului din Valea Jiului

Statisticile şi prognozele internaţionale arată că în balanţa energetică a lumii cărbunele joacă şi va juca un rol din ce în ce mai important. Ponderea acestuia este prevazută să crească de la 30-40%, cât este astazi, la cca. 50% pâna în 2030.

În aceste condiţii, se cer - atât pe plan naţional, cât şi pe plan mondial – rezolvate acele probleme care încă determină o oarecare lipsă de atractivitate a sa ca resursă energetică, şi anume, emisiile de gaze cu efect de seră în urma arderii sale, degradarea mediului înconjurător, costurile relativ ridicate de transport şi nu în ultimul rând, expunerea personalului la riscuri profesionale.

Exploatarea cărbunelui pe plan mondial, dar şi în România, a fost, în ultimii 20 de ani, obiectul unei profunde reforme tehnologice, generate, pe fondul progresului tehnologic general, de acţiunea factorilor specifici ai mecanismelor economiei de piaţă, precum şi de unii factori conjuncturali, legaţi în primul rând de caracterul limitat sau creşterea preţului resurselor alternative, precum şi de înăsprirea restricţiilor de mediu.

Progresul tehnologic, realizat în primul rând prin măsuri tehnice, este supus continuu acţiunii restrictive a factorilor economici, eficientizarea procesului de extragere fiind rezultatul unor măsuri de ordin tehnic şi managerial, deopotrivă.

Pentru România, care se caracterizează prin rezerve de cărbune reduse în comparaţie cu marii producători mondiali, dar totuşi suficiente pentru a sta la baza asigurării producţiei unei părţi importante din energia electrică necesară, problemele se pun la alt nivel, dar direcţiile de acţiune necesare sunt, în mare masură, aceleaşi.

Tabelul 1 Analiza SWOT a mineritului din Valea Jiului

Puncte tari	Rezerve exploatabile de peste 300 mil tone
	Infrastructură deja existentă
	Concentrare teritorială a exploatărilor miniere într-o zonă relativ restrânsă
	Distanţă redusă faţă de beneficiari
	Personal calificat în activitatea minieră
	Instalaţiile de preparare deţinute pot realiza produse cu un conţinut energetic mărit
Puncte slabe	Condiţii geologo-miniere dificile de exploatare
	Grad ridicat de periculozitate a exploatarii
	Putere calorifică scăzută
	Grad de mecanizare a exploatării scăzut
	Lipsa unor tehnologii performante
	Personal cu mentalitate rigidă
	Dificultăţi în exploatarea selectivă a cărbunelui
Oportunităţi	Necesar crescând de surse de energie primară
	Piaţă de desfacere relativ stabilă
	Perspectiva realizării Complexului Energetic Hunedoara
	Menţinerea unei infrastructuri miniere adecvate
	Îmbunătăţirea calităţii cărbunelui vândut
Ameninţări	Agravarea crizei economice mondiale;
	Creşterea costurilor de producţie generată
	Vulnerabilitate socială mare datorită caracterului monoindustrial al zonei
	Lipsa unui preţ reglementat apropiat de costul de producţie
	Lipsa fondurilor pentru dezvoltarea extensivă a exploatării

3 Rezerva geologică de bilanţ.

Rezerva geologică de bilanţ a zăcământului de huilă din Bazinul Carbonifer Valea Jiului este de aproximativ 244 milioane tone de huilă, tab 2.

Tabelul 2: Situaţia rezervelor geologice ale unităţilor miniere din cadrul CEH în anul 2014

Unitate minieră	Rezerve geologice de bilanţ 2014
E.M.Lonea	22,407 mil. tone
E.M.Livezeni	76,141 mil. tone
E.M.Vulcan	23,304 mil.tone
E.M.Lupeni	31,061 mil.tone

Pentru toate perimetrele aflate în exploatare, CEH- SA deţine licenţă de exploatare până în anul 2024.

Rezerva industrială totală (valorificabilă) în perimetrele luate în concesiune de CEH- SA, în 2014 este de 54,355 milioane tone. Această rezervă poate asigura continuitatea exploatării pe o perioadă de peste 36,5 de ani, la nivelul actual de producţie de 1,490 mil. tone.

Producţia de huilă preconizată a fi extrasa de punctele de lucru ale CEH- SA în perioada 2015-2035, cu mentinerea fortei de munca prin noi angajari si finalizarea programului investitional privind achizitia de utilaj tehnologic minier, este prezentată în tab 3.

Tabelul 3 : Producţia de huilă preconizată a fi extrasa de punctele de lucru ale CEH- SA în perioada 2015-2035

ANUL	PRODUCTIA (Tone)
2015	1.200.000
2016	1.586.000
………	………
2035	1.586.000

Huila extrasă este supusă unui proces de sortare în urma căruia cantitatea ce îndeplineşte parametrii de calitate este livrată celor două termocentrale (Sucursala electrocentrale Deva-Mintia, Sucursala Electrocentrale Paroşeni componente ale C.E.H), pentru producerea combinată a energiei electrice şi termice. Această producţie este preconizată a fi livrată sub formă de huilă sortată.

Analizând evoluţia personalului, prezentată mai sus, în cadrul Sucursalelor diviziei miniere este necesară o politică sistematică de personal care să asigure în momentul ieșirii la pensie a personalului care îndeplineşte condiţiile de pensionare , înlocuirea cu personal calificat ,care să îşi poată desfăşura activitatea în condiţii de sănătate şi securitate a muncii, atât pentru ei cât şi pentru utilaje şi zăcământ.

Lipsa personalului este vizibilă atat la fronturile de lucru cât şi la locurile de muncă fără de care activitatea din subteran nu se poate desfăşura. Ţinând cont de faptul că în ultimii ani nu s-au făcut angajări de personal care să asigure continuitatea personalului calificat la locurile de muncă, şi având în vedere faptul că pregatirea unui muncitor calificat care să-şi poată îndeplinii sarcinile de muncă durează, acestea trebuiesc demarate cât mai urgent.

4 Investiţii de subteran

În cadrul Sucursalei Miniere a CEH, pentru eficientizarea activității miniere subterane este necesară creşterea capacităţilor de e producţie, fapt care se poate realiza prin executarea de lucrări miniere subterane de deschidere-pregătire. Acest fapt ar duce la reducerea costului total de la 108,75 lei/Gcal, în anul 2015, la 58,56 lei/Gcal, în 2018, şi creşterea producţiei extrase de la 1.340.000 tone, în anul 2015, la 1.900.000 tone, în anul 2018, cu extindere la anul 2042.

Pentru aceasta sunt necesare investiţii pentru:

- Dotarea celor 4 exploatări miniere cu echipamente şi utilaje tehnologice miniere performante, fiabile, automatizate şi cu productivitate ridicată
- Complex mecanizat pentru stratul 13 la EM Livezeni. Investiția este necesară până la sfârşitul semestrului I al anului 2016 pentru echiparea panoului 5, bl IX, stratul 13, cât şi pentru echiparea următoarelor panouri din blocul VII, de aseenea cu posibilitatea exploatării stratului 3.

- Un complex mecanizat cu subminare şi a utilajelor şi instalaţiilor necesare pentru deservirea acestora la EM Livezeni. Echimamentul va fi plasat în blocul II, stratul 3 şi va fi pus în funcţie în semestrul I al anului 2015.
- Complex mecanizat uşor la EM Lonea, care va fi intrdus în blocul III, stratul 3, pentru exploatarea feliei F.XXXVI, între numerele 36 - 34. Acesta va fi pus în funcţie în semestru I al anului 2016. Acest complex mecanizat uşor va înlocui un abataj frontal clasic dublându-i capacitatea, astfel crescând productivitatea muncii şi conducând la diminuarea costurilor de producţie, în vederea producerii unei Gcal mai ieftine.
- Combinele de înaintare în steril şi în cărbune vor asigura creşterea vitezei de avansare a lucrărilor de deschidere şi punerea în funcţie mai devreme a abatajelor.
- Echipament de exploatare mecanizată a pilierilor la EM Lupeni. Aceste echipamente vor fi plasate în blocul IV și V, stratul 3, pentru exploatarea pilierilor de siguranţă dintre două abataje exploatate. Acesta va fi pus în funcţie în semestrul II al anului 2017.

5 Investiţii de suprafaţă

După finalizarea investiţiilor din subteran, începând cu anul 2017 se pot face următoarele investiţii la suprafaţă:

- Achiziţia de echipamente şi tehnologii pentru procesarea sterilului din haldele de steril inactive, recuperarea fracţiilor cărbunoase din aceste halde şi reintroducerea acestui combustibil în circuitul energetic.
- Achiziţia de echipamente şi tehnologii pentru captarea CH4 din subteran în vederea utilizării acestuia pentru producerea energiei termice în anul 2015.
- Dotarea fiecărei exploatări miniere cu instalaţii de sortare performante, fiabile, automatizate în vederea creşterii calităţii cărbunelui livrat la cele două termocentrale pe parcursul perioadei anilor 2015 – 2016.

Concluzii

Aplicarea conceptului de dezvoltare durabilă în minerit, în special în zonele miniere, în care activităţile sunt, în general, monoindustriale este dificilă pentru că zăcămintele sunt resurse neregenerabile şi, prin urmare, mai devreme sau mai târziu, ele se vor epuiza.

Prin urmare, în aceste zone ar trebui să fie un minerit profitabil, care să permită dezvoltarea în continuare, sau în paralel, a altor activităţi .

Nu este o soluţie de a conserva astăzi resursele naturale pentru a crea bunăstarea generaţiilor viitoare .

Durabilitatea naturală în proiectele miniere va fi sinonimă cu creşterea generală şi susţinerea de afaceri miniere. Acceptare internaţională a unei astfel de dezvoltări este urgent necesar. Aplicarea principiilor dezvoltării durabile în activitatea minieră va depinde mult pe practicile de afaceri şi de standarde.

Durabilitatea este un proces evolutiv. Industria minieră la nivel mondial, de la bun început trebuie să adopte principiile ecologice generale de control al poluării. Este nevoie a se impune prevenirea şi combaterea poluării, nu numai controlul poluării, care în curând va fi de domeniul trecutului în alte industrii.

Închiderea minelor a condus, atât la diminuarea veniturilor populaţiei din zona Văii Jiului cu consecinţe restrictive asupra economiei locale, cât şi la diminuarea veniturilor bugetelor locale.

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Lipsa personalului este vizibilă atat la fronturile de lucru cât și la locurile de muncă fără de care activitatea din subteran nu se poate desfășura. Ținând cont de faptul că în ultimii ani nu s-au făcut angajări de personal care să asigure continuitatea personalului calificat la locurile de muncă, şi având în vedere faptul că pregatirea unui muncitor calificat care să-şi poată îndeplinii sarcinile de muncă durează, acestea trebuiesc demarate cât mai urgent.

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IDENTIFICATION OF POSSIBLY POLLUTED AREAS WITH PARTICLES COMING FROM THE TAILING PONDS FROM PAROSENI POWER PLANT

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ABSTRACT

One of the sources of pollution in the Jiu Valley is the Thermal Power Plant Paroseni by the gas emissions and by storing carbon and ash resulting from the technological process in ash and slag deposits. Thermal Power Plant Paroseni has large areas of ponds decommissioned and not reentered in natural cycles, and significant quantities of powders pollutants are transported by wind. The purpose of this paper is to identify areas with high dust pollution through the study of dispersion from the slag and ash ponds of the Thermal Power Plant of Paroseni.

Keywords: pollutants, dispersion, powders

INTRODUCTION

Jiu Valley is characterized by a mountain climate with average temperatures range from – 5° C to +6° C in winter, and +18° C to +28° C in the summer months. Due to depression location are occurring thermal inversions, and reduced movements of air masses create favorable conditions for stagnation of masses at low height above the ground. Relative air humidity, the monthly averages are higher in winter (84-88%) and lower in the summer (62-70%). Wind is having the NS direction - direction to Jiu Valley - especially predominant in the southern sector (11%) and on the NW with a frequency of occurrence of 5.1%, calm atmosphere, in all cases analyzed, has a frequency of 69, 9%. The EV transverse direction is almost zero wind speed frequency. Affected by wind speed values were lower due to the effect of specific housing depressions; prevailing winds are from the south and north.

Central Power Plant Paroseni is situated on the lower terrace of the right side of the river Jiu in proximity to Vulcan city, 8-10 m from the railway Vulcan - Paroseni - Lupeni. This site was determined by the existence of numerous coal extractions in the area (fig.1.1). It is located on the national road DN 66 A, which connects Craiova and Targu Jiu.

Neighborhood: North - Railway Livezeni - Lupeni, South - DN 66 A, East - Mining Exploitation access road Paroseni, West - Jiu River.

Thermal Power Plant Paroseni is a cogeneration power plant supplying heat and power production. Works with coal as fuel base and provide heat for the residents of the 4 mining towns in the area: Petrosani, Vulcan, Lupeni, Aninoasa.

Slag and ash deposits of the power plant Paroseni are having as surface area 56 ha:

Ash and slag deposit for case of accidents (S = 10 ha)

Deposit Valley Caprisoara (S = 46 ha)

Radon deposits (S = 10 ha), Ijak (S = 8 ha) and Feres (S = 10 ha) are reentered in natural circuit and covered with grass.

Paroseni Thermal Power Plant is evacuating hydraulically the ash and slag discharged from the combustion of coal in to the slag and ash deposit Caprisoara Valley. In case of accidents, slag and ash is deposited in the special deposit for cases of crash. The ratio of the water / ash is about 10: 1. Slag and ash deposit Caprisoara Valley is a valley deposit consisting of two deposits, located at 1.5 km from the Power and Thermal Plant. It occupies an area of 46 ha, with a total capacity of 5320000 m^3.

Slag and ash deposition is made by levels, consisting from raised slats performed successively in different compartments of the deposit. Water from ash and slag transport is recycled to the Power Thermal Plant by pumping.

To avoid dissipation of ash from deposits is used a water network in order to spray the deposits.

POLLUTING AGENTS

For the production of the electricity, the thermal power plants are using a source of primary energy - solid fuels. Chemical elements in contact with oxygen that produce heat (exothermic reactions) are: the carbon, hydrogen and sulfur. The final products resulting from the combustion are: carbon dioxide, water and sulfur dioxide.

Solid fuels, in addition to fuel, contain more sterile, which will be found after the combustion process in the form of slag and ash.

All products resulting from the combustion of solid are pollutants in the sense that they are changing the balance of the external environment or act directly on the animals and plants.

The main pollutants from power plants that are emitted by the chimney are: sulfur oxides (SO2 and SO3), nitrogen oxides (NO and NO2), carbon monoxide and carbon dioxide (CO and CO2), dust (fly ash particles unburned coal, clay, earth) and in smaller quantities: tars, hydrocarbons, soot, sulfates, organic acids, etc.

All the usual fuels (coal, coke, fuel oil) contain ash from non-combustible solid substances.

Thermal Power Plants are located near water sources such as rivers. The water used for cooling is reintroduced into the river at a temperature higher than that at which it was captured from the river. Therefore, power plants contribute to increasing water temperatures in the river, with all the negative effects for river ecosystem.

Slag and ash from Thermal Power Plant Paroseni has the following composition: 47.68% - silicon dioxide (SiO_2), 22.16% - aluminum oxide (Al_2O_3) 9.44% - iron oxide (Fe_2O_3) 5.38% - calcium oxide (CaO) 2.28% - magnesium oxide (MgO) 0.64% - sodium oxide (Na_2O) 1.08% - potassium oxide (K_2O) and 10.78% of other elements.

THE EFFECTS OF PARTICLES AIR POLLUTION ON THE ENVIRONMENT

In the interrelationships between man and his ambient environment, the last one exerts multiple influences on man, one of the most important is the effect on health.

Pollutant environmental action on the human body is very diverse and complex. It can start from simple discomfort to human activity, so-called discomfort, to strong disturbances of health.

The direct influence of air pollution on human health consists from body changes that occur in people exposed as a result of their contact with various air pollutants. In most cases, the direct action of air pollution is the result of interaction of several pollutants simultaneously present in the atmosphere and only rarely action of a single pollutant.

Air pollution dust could cause serious damage to the human body. Powders are irritant pollutants, fibrosis, and allergy.

Affections that can cause air pollution with dust on the human body are inflammations, rhinitis, pharyngitis, laryngitis, and bronchitis. If action is long lasting pollutant may occur chronic diseases.

In addition to the affections listed above, powders, especially those with large density persist in the lung, lung elasticity is decreasing as foreign body reaction with formation of new tissue around, all that being causes of fibrosis.

Organic or mineral powders as gases (nitrogen oxides, sulfur, carbon) or volatile substances from insecticides, detergents, plastics, drugs, may cause acute rhinitis, asthma or ocular problems (ex.: conjunctivitis) or skin problems (eczema, hives, etc.)

On vegetation, dust particles are deposited on their leaves preventing normal development. Depending on the thickness of particles deposited on, plants can even lead to death.

EXPERIMENTAL DETERMINATION

To identify possible polluted areas with high particles from settling ponds at Thermal Power Plant Paroseni was used Meti-Lis software release 2.03.

Meti-Lis 2.03 software allows us to determine how the dispersion of certain pollutants from human activities, taking into account the emission rate and other terms of issue such as location, the amount of pollutant, temperature and meteorological factors every hour or during the mediation.

Studies have been conducted on average values of the month of September 2014. For the study we used the following climatic data:

The average monthly temperature – +10°C,

Average monthly wind speed - 10 m/s

Wind direction - NE.

Possible dispersion of powders obtained for the deposit Caprisoara, which belongs to Thermal Power Plant Paroseni is shown in Figure 1.

The analysis was done for areas where ash and slag deposition ceased and for emergency deposit. The rest of the currently active surface of the deposits does not raise problems relating to entrainment of air dust particles as they are covered with water.

From the analysis of dispersion maps we can see that the dust raised from the lake Caprisoara is transported by air currents toward Valcan massif, only a small part of them reaching the habited vicinity of the Thermal Power Plant Paroseni.

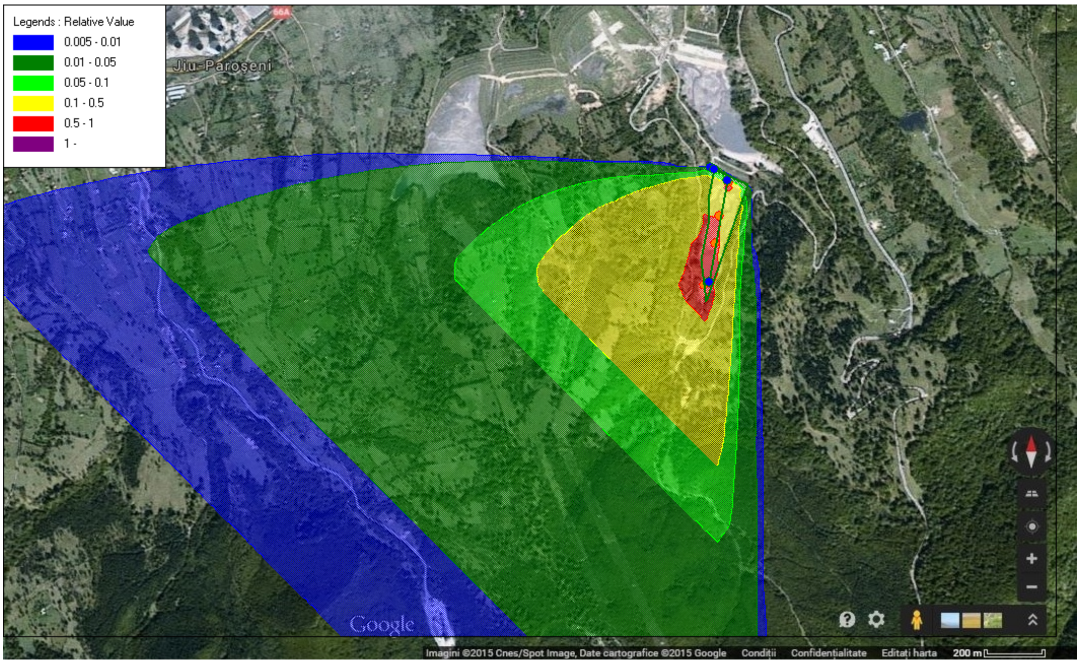

Fig. 1

Wind dispersion of dust powders driven from the inactive lake Caprisoara

In case of emergency lake deposit, wind-blown dust from its surface affects residential areas near the Thermal Power Plant Paroseni (Figure 2).

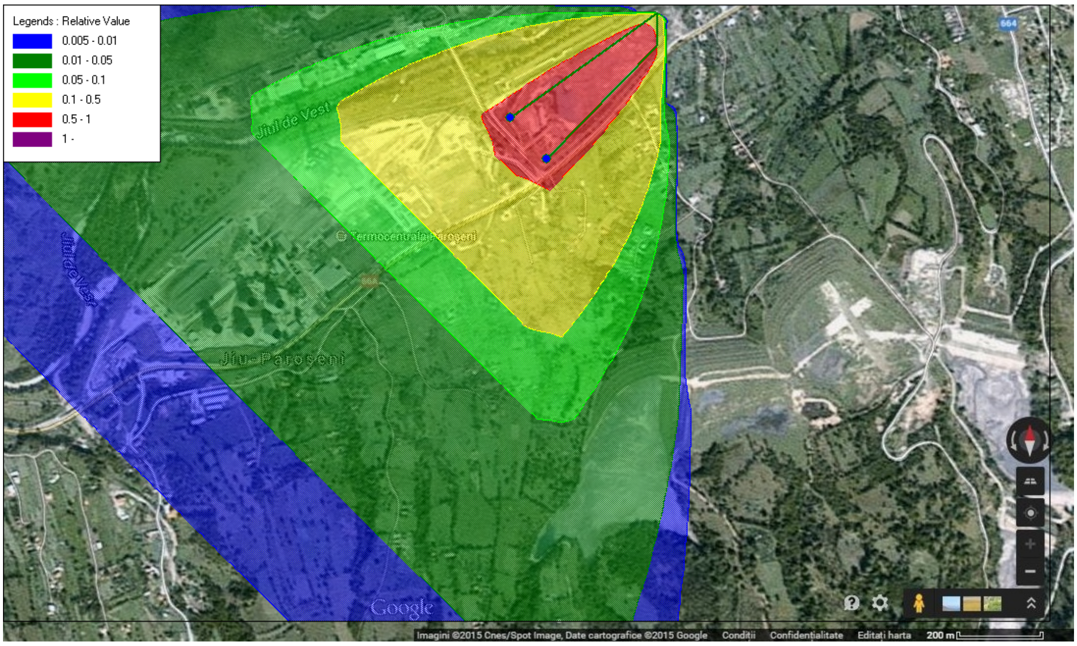

Fig. 2

Wind dispersion of dust powders driven from the emergency lake deposit

Due to overlapping dispersion of dust particles carried by wind from the two slag and ash surfaces, although there are long distances from the source of pollution, pollutant load is high (Fig. 3).

To reduce dust pollution from the slag and ash ponds of Thermal Power Plant Paroseni measures are needed of redevelopment and to return them in natural cycles.

As a result of the dispersion of particles carried by wind from the slag and ash ponds lead to air pollution. Non-reduction of pollution cause serious damage to environmental factors, with greater impact on vegetation because of the way of dispersion of pollutants.

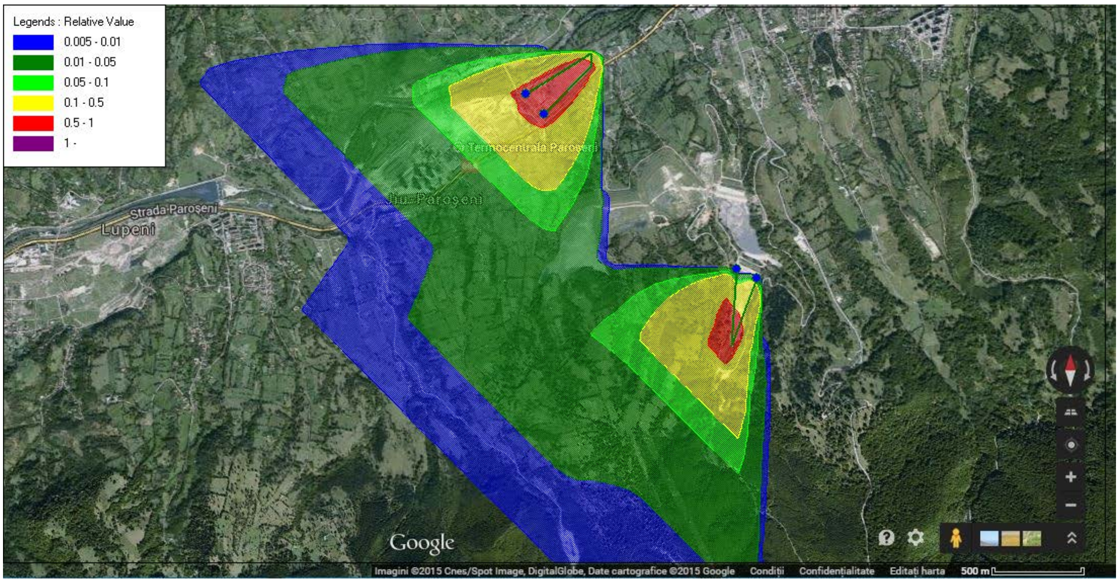

Fig. 3

Wind dispersion of dust powders driven from the emergency lake deposit and from the inactive lake Caprisoara

CONCLUSIONS

One of the main air pollutants produced by Thermal Power Plant Paroseni is solid particle pollution (dust).

From the lake surface of slag and ash, wind train large amounts of dust that is dispersed on the surrounding areas.

Dispersion of pollutants raised from the slag and ash ponds from Thermal Power Plant Paroseni is performed in the NE direction – to Massif Valcan, not affecting large habited areas.

Emergency lake is affecting in the highest proportion habited area near the Thermal Power Plant Paroseni.

To reduce particle pollution, redevelopment measures of the deposit are necessary to reintroduce these surfaces in natural circuit.

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ANALYSIS AND EVALUATION OF OPTIMUM OPERATIONAL STATUS OF ELECTRICAL STATIONS

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1 GENERAL CONSIDERATIONS

Dimensioning of electricity transformation stations and points is made when new consumers electricity supply is designed, and for periodic verification of installed power(determination of load degree). Re-dimensioning of electricity transformation stations and points is required when technologies and enterprises are updated, entailing reducing electricity consumption, as well as in the case of changing manufacturing profiles.

Adopting the optimum electricity supply solution for industrial consumers is a complex issue involving the analysis of a great number of restrictions and factors, with determining, quasi-determined and random character.

2 THEORETICAL BASIS OF OPTIMUM EVALUATION

In the design of SEE (SE, LE) connection of mining electricity distribution systems, the following problems should be solved:

- satisfying requirements of mining consumers;
- ensuring optimum safety degree for each development stage (of the area of the mining consumer), simple and economical solutions, adapted per categories and classes of consumers;
- adopting modular and elastic schemes allowing adaptation, in any stage, to modern solutions than might intervene in electricity installation, possibility of electricity supply for unforeseen objectives;

- adopting a flexible structure of the optimization criterion allowing the highlighting of possible differential solutions of influence factors;

Establishing electricity supply solutions for industrial consumers is a complex activity in which a series of factors having a direct influence on those should be considered.

The principal elements influencing the chosen solution are:

- Value of investment;
- Value of probable annual penalties caused to the consumer;
- Value of exploitation expenses;
- Number of electricity supply means;
- Type and place of fixing the automation equipment;
- Normal supply diagram of the consumer.

The preoccupation regarding the optimization of nominal power of electricity transformers, and the optimization of the configuration of transformation and distribution stations from the mining consumers, depending on the absorbed power, is justified by the important savings of electricity that might thus be obtained.

To obtain an as exact as possible value, most often two optimization criteria are applied: "cost of minimum losses of power and electricity” (CPW) and “total updated expenses) (CTA).

Operation of electricity transformers according to the optimum regime plan involves establishing the number of transformers in operation and their loading, so that the total losses would be minimal. It is required to disconnect the loaded transformers with an average of less than 40% of the nominal load and redistribution of power among the transformers left in operation, according to the loads of the supplied consumers.

To impede the decrease of safety level in the electricity supply, an AAR device is required, which should provide automatic connection of the stand-by, in the situation of a possible disconnection of an operating transformer.

When the load od the distribution station supplying the mining consumers undergo significant variations, in order to obtain a functioning regime as favorable as possible from the point of view of total losses of power or energy, and from the point of view of minimum annual cost, respectively, it is recommended to install several transformers.

In this situation, the problem is connecting or disconnecting a transformer, in case of total load variations per station, so that the plan of optimum functioning should be permanently followed.

Single-core diagrams, frequently met for electricity stations above ground in mines, are shown in Figs. 1 a, b and c.

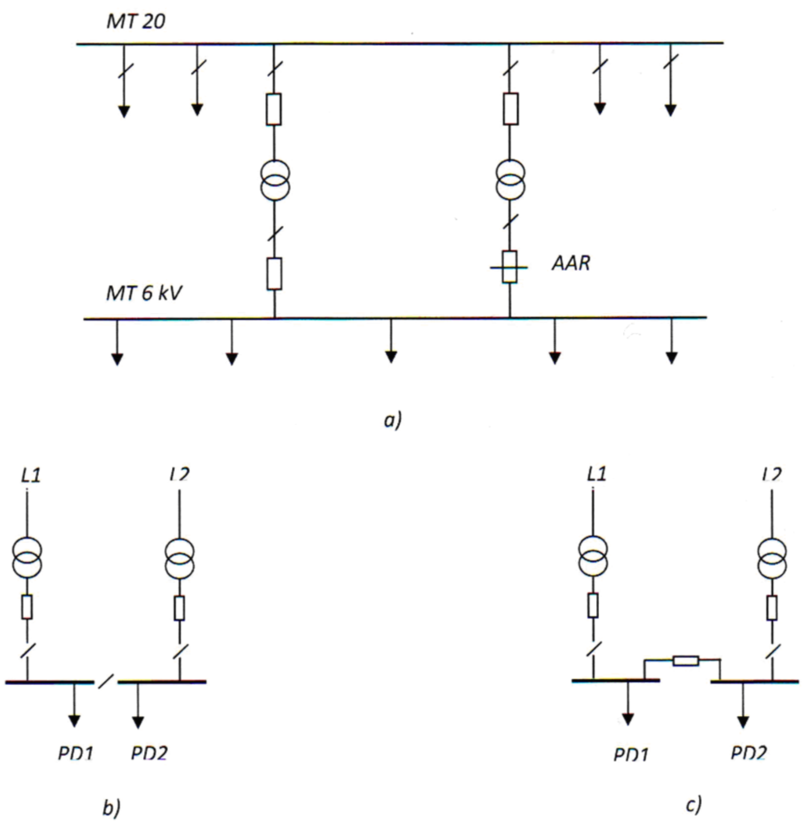

Fig. 1. Single-core diagrams of electricity distribution stations, MT/MT, used above ground in mines (2x100% type configuration)

For the analysis, the following basic hypotheses are admitted: nominal power of transformers is the optimum, the characteristics of the commuting apparatus of the same type are identical, and the instant absorbed power (S) is considered variable in time (along a working day). The commuting apparatus can be provided with an AAR system.

a) With two transformer units of continuous bars on the MT (6kV) side;
b) With two transformer units of sectioned bars on MT (6kV), by isolator;
c) With two transformer units of sectioned bars on MT (6kV), by circuit breaker.

The calculation formulae are shown below for the absorbed power where commuting between the two situations is required, depending on the optimization criteria applied and the factors of influence considered.

Considering the two possible situations mentioned above, and applying the criterion of minimum power loss (CP), noting with:

$$\Delta P_{12} = \Delta P_1 - \Delta P_2 \tag{1}$$

The difference of total power losses in transformers, in kW, referring to the two conditions, the following formulae are obtained:

When reactive power losses are ignored:

$$\Delta P_{12} = \frac{\Delta P_{kn}}{2} \cdot \left(\frac{S}{S_{nT}} \right)^2 - \Delta P_0$$
$$S = S_{nT} \sqrt{\frac{2 \cdot \Delta P_0}{\Delta P_{kn}}} \quad (2)$$

When the reactive power losses are considered as well :

$$\Delta P_{12} = \frac{1}{2} \cdot (\Delta P_{kn} + k_e \cdot \Delta Q_0) \cdot \left(\frac{S}{S_{nT}} \right)^2 - (\Delta P_0 + k_e \cdot \Delta Q_0)$$
$$S = S_{nT} \sqrt{\frac{2 \cdot (\Delta P_0 + k_e \cdot \Delta Q_0)}{\Delta P_{kn} + k_e \cdot \Delta Q_{kn}}} \quad (3)$$

The optimum or economical power when the commuting of transformers are justified, referring to the two situations, by the application of minimum cost criterion for power and energy CPW, is determined by the formula:

$$\frac{1}{2}(\Delta P_{kn} + k_e \cdot \Delta Q_{kn}) \cdot \left(\frac{S}{S_{nT}} \right)^2 \cdot C_k - (\Delta P_0 + k_e \cdot \Delta Q_0) \cdot C_0 = 0 \quad (4)$$

The analytical calculation formula of the optimum power, expressed in kVA, is:

$$S_{ec} = S_{nT} \sqrt{\frac{2 \cdot (\Delta P_0 + k_e \cdot \Delta Q_0) \cdot C_0}{(\Delta P_{kn} + k_e \cdot \Delta Q_{kn}) \cdot C_k}} \quad (5)$$

The optimum kunf loading coefficient for annual load peak is determined with the formula:

$$k_{1.\inf} = \sqrt{\frac{2 \cdot (\Delta P_0 + k_e \cdot \Delta Q_0) \cdot C_0}{(\Delta P_{kn} + k_e \cdot \Delta Q_{kn}) \cdot C_k}} \quad (6)$$

The final result is the analytical expression of optimal power for which commuting transformers are justified economically, with reference to the two situations of reservation of the electric station(passive reserve and active reserve):

$$S_{ec} = S_{nT} \cdot \sqrt{\frac{2 \cdot (\Delta P_0 + k_e \cdot \Delta Q_0) \cdot (C_p + C_w \cdot T_f \cdot T_{20})}{(\Delta P_{kn} + k_e \cdot \Delta Q_{kn}) \cdot (C_p + C_w \cdot \tau \cdot m_r \cdot T_{20})}} \quad (7)$$

The meaning of the new values appearing in the above formulae and the units is the following:

Tn – updated value of a functioning duration of n years and the expression is:

$$T_n = \sum_{x=1}^{n} (1 + a)^{-x} \quad (8)$$

C_0 – cost in updated values of a unit of power loss in iron for n years of functioning, in €/kW;

C_k – cost in updated values of a unit of active power loss in short circuit and in the hypothesis of an r rate of increase of the annual load peak, in

€/kW;

C_p – specific cost of installed power in basic power stations of equivalency, in updated values, in €/kW;

C_w – average specific cost per system of kWhour of losses, calculated at the transformation station level of ÎT/MT or MT/JT, in €/kWh;

m_r – load multiplier as:

$$m_r = \frac{1}{(1+a)\cdot T_n}\cdot\sum_{m=0}^{n-1}\frac{(1+r)^{2m}}{(1+a)^m} \tag{9}$$

Where r is the increase rate of the annual load peaks in the respective period, and a is the updating rate. When r=0 and n=20 years, and n=30 years, respectively, the load multiplier m_r=1;

The rest of the values have the known meaning shown before.

It can be seen that all the characteristics of the different values specific to kWhour of losses C_w go through the same point D (Fig. 2), where the derivate:

$$\frac{dk_1}{dc_w} = 0 \tag{10}$$

The value of the ordinate of the intersection point D ends with the formula:

$$\tau_D = \frac{T_f}{m_r} \tag{11}$$

The value of the ordinate of the intersection point D corresponds to the specific cost of energy losses C_w = 0 :

$$k_{ID} = \sqrt{\frac{2\cdot(\Delta P_0 + k_e\cdot\Delta Q_0)}{\Delta P_{kn} + k_e\cdot\Delta Q_{kn}}} \tag{12}$$

Analogically, as in the case of CPW criterion applied for the determination of the optimum load coefficient in the first year of exploitation of a transformer, in this case as well, in the hypothesis of minim of costs of losses and power and electricity, the theoretical field of variation of the optimal load in the annual load peak is limited by two characteristics:

$$k_{1.\inf.1} = \lim_{c_w\to 0} k_{1.\inf} = \sqrt{\frac{2\cdot(\Delta P_0 + k_e\cdot\Delta Q_0)}{\Delta P_{kn} + k_e\cdot\Delta Q_{kn}}} \tag{13}$$

$$k_{1.\inf.2} = \lim_{c_w\to\infty} k_{1.\inf} = \sqrt{\frac{2\cdot(\Delta P_0 + k_e\cdot\Delta Q_0)\cdot T_f}{(\Delta P_{kn} + k_e\cdot\Delta Q_{kn})\cdot\tau\cdot m_r}} \tag{14}$$

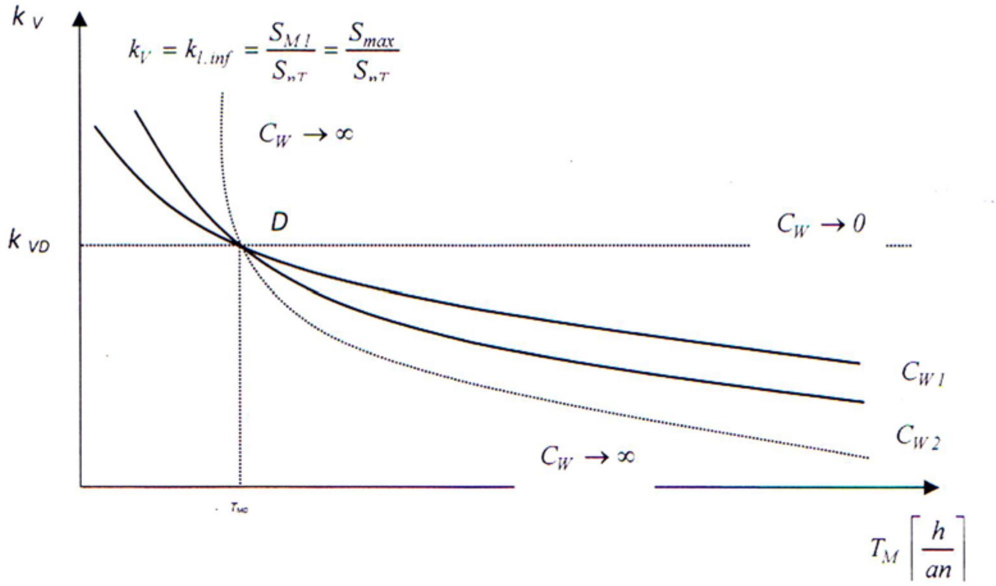

Fig. 2. Economical loads for the annual load peak, for the TT-AN and TTU-NL type power transformer series

The optimum load coefficient at the upper limit is determined by the formula:

$$k_{1.\sup} = 1.6 \cdot k_{1.\inf} = 1.6 \cdot \sqrt{\frac{2 \cdot (\Delta P_0 + k_e \cdot \Delta Q_0) \cdot (C_p + C_w \cdot T_f \cdot T_{20})}{(\Delta P_{kn} + k_e \cdot \Delta Q_{kn}) \cdot (C_p + C_w \cdot \tau \cdot m_r \cdot T_{20})}} \qquad (15)$$

3 TECHNOLOGICAL REFURBISHING POSSIBILITIES OF MEDIUM VOLTAGE CELLS

One of the solutions of technological refurbishing of electricity distribution stations implemented within C.N.H.-S.A. , and to which we took part, has been the refurbishing of Romanian make medium voltage cells, with Siemens vacuum circuit breakers, a solution adopted at TD 4 Petrila Mine.

It is generally acknowledged nowadays, that the superiority of vacuum circuit breakers lies especially in the high reliability and durability and low maintenance costs, compared to all the other known technologies, applied in the control and protection of medium voltage electricity distribution.

The qualities of the vacuum circuit breakers are mainly due to:

- simple and robust design of the quenching room (Fig. 3);
- small distance between the contacts (approx. 1 kV/mm), due to the very good dielectrical qualities (more than 340 kV/cm in even field) of the intense vacuum(10^5 ... 10^{-9} mbar), leading to the execution of simpler designs for actuation mechanisms and lower energy;
- extinguishing the electrical arc in maximum a semi-period (10 ms), irrespective of the value and type of electricity (up to the nominal breaking capacity

warranted by the manufacturer), vacuum commuting apparatus being actually known as apparatus with no critical electricity;

- low thermal strain of the contacts in the process of commuting, due to the short period of time of burning of the electrical arc(<10 ms), to the low voltage drop on the electrical arc(40 ...75V) and the specific development and burning of the electric arc in vacuum.

For currents up to 10 kA or for contact system with axial magnetic field, the electrical arc burns diffusely, all over the surface of the contact, thus the specific energy developed per unit of contact surface is low, not being able to cause serious wear to the contacts, and for higher voltages than 10 kA in the case of radial magnetic field, the electrical arc is rotated on the contact ring(Fig. 4) with speeds of the order of 100 m/s for the intense voltages, the leg of the electric arc always meeting cold surfaces, not being able to cause significant wear to the contacts.

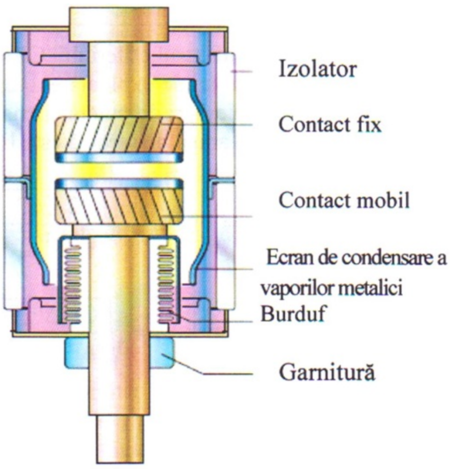

Fig. 3. Extinguishing room [insulator, fix contact, mobile contact, metal vapor condensation screen, bellows, gasket]

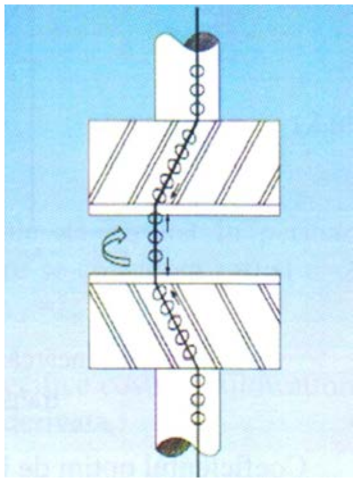

Fig. 4. Voltage lines and direction of concentrated electric arc movement

Due to these constructions, contact systems and phenomena (burning of electric arc in intense vacuum), manufacturers warrant vacuum extinguishing rooms with no maintenance for over 1000 shutdowns and breaks of short circuit voltages for nominal capacity, simultaneously with 10 000 maneuvers of shutting-opening at nominal current and voltage.

Based on these considerations, significant preoccupation exists in Romania as well, both among manufacturers and users, to carry out and apply medium voltage electricity distribution equipments, fitted with circuit breakers based on vacuum commuting technology. Vacuum commutation circuit breakers' performances (exploitation parameters, size, weight) involved new tendencies in the design if these equipments.

Medium voltage apparatus enclosed in interior metal case (cell) with insulation in air, fitted with vacuum room extinction circuit breaker, is meant for distribution and transforming stations supplied by cables. The tendency worldwide is to manufacture these products with as low as possible costs in view of reducing investment and maintenance expenses.

An important role in attaining the objectives from above is played by the design, spacing and volume of the cell, as well as the design of the equipping apparatus its technical level and functions achieved by it in a functional unit.

The principal tendencies have been the following:

- Use of insulating materials allowing reduction of volume of functional units;
- Reduction of the number of compartments and access only in the front in the case of apparatus in metal case resistant to free arc;
- Change of cell architecture by achieving a straight line for the primary energy transfer circuit from the general bars to the cable;
- Change of architecture of the cell fitting to reduce size;
- Use of fitting apparatus with multiple functions;
- Use of special insulators allowing capacitive dividers 9for signaling the presence of voltage), measuring sensors and voltage protection;
- Use of a multifunctional protection, measuring, control and signaling relay, based on microprocessor method.

Solution adopted at Petrila Mine

Petrila Mine, like any of the other mines in general, is an important industrial energy consumer, having in exploitation several medium voltage distribution stations, providing operation of equipment and tools specific to mining.

Taking into consideration the importance of continuous functioning of certain types of equipment, such as: main ventilation stations, compressors, and extraction machines, the problem of initiating modernization and technological refurbishing of electricity distribution stations has been raised.

Medium voltage cell is made up of a case made up of the compartment for cables, and general bars, compartment for carriages that could be de-fastened, and low-voltage compartment.

Broaches provide the working position in the connected stage of the circuit breaker on the general bars and isolated position in disconnected stage (Fig. 5).

Fig. 5. Fixing the circuit breaker

The front part of the circuit breaker is accessible entirely from the outside, connecting, disconnecting reinforcement maneuvers being easily done, with no significant efforts. Both reinforcement and fastening of the breaker are done with special keys, which make these maneuvers easier, circuit breakers adapted to these types of carriages are manufactured by a manufacturer specialized in them. The way of connecting reinforcements is also known, the system of bars mounted in cells being Romanian make. For electricity and voltage transformers, Romanian make has also been considered, with a known, classical solution of fixing. Problems occurred in the modification of the front door, which had to keep the aspect and size of the circuit breaker and to allow access to its front part; cutting out at the exterior has been practical and looked well, but when several circuit breakers had to be handled in neighboring cells, the width of the front doors opened for de-fastening at least at 90°, took up from the working space, making them thus insufficient, interventions having become cumbersome.

4 CONCLUSIONS

Due to the relatively high duration of restarting these elements, discontinuities occur in the production process, and in many situations, dangerous working conditions. These fallouts of the network elements lead to lack of voltage for consumers, which may be the signal for starting automatic control, with the condition of an adequate interconnection of various network elements, they not always being provided with spare elements, in the conditions of meeting the restrictions required by the operation of equipment in potentially dangerous atmospheres.

Control automation is possible in electricity transformation and distribution stations, in distribution points providing for complex powered faces or main conveying flows, in main transformation and distribution station on the ground, where several transformers are connected in parallel, operating with low loading coefficients. Automatic control is possible in other cases as well, but it is not economically viable in all the cases, due to the less important consumers.

The analyses made so far regarding electricity distribution systems in various underground showed that network elements with the highest influence on mining electrical energy systems, in case of defects, are commutation equipments for high and low voltage lines and mains.

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COMPARATIVE ANALYSIS OF TRANSPORTATION FLOW REGULATING SYSTEMS IN OIL PIPELINES

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GENERAL CONSIDERATIONS

The study of possibilities of improvement of oil transportation system parameters through main lines is a difficult problem, due to the fact that these systems are complex constructions, operate along significant distances, of thousands of kilometers, are exploited in in areas with great differences of civilization, cultural level, legal system, political regime, risk level etc[3].

Besides, the owners of these systems avoid or forbid even the main parameters and exact configuration to be known, for safety reasons. Moreover, it is difficult to perform *in situ* research and the costs are high compared to the value of the results obtained and sometimes are impossible to be done.

In the light of the above mentioned facts, there are several possibilities of improving the transport system parameters, either based on theoretical studies [2], and simulations on well-established models using performing software, or by experimental research on physical models and laboratory studies. There also is a variant in which the research method can be combined[1], if time and material resources allow this.

COMPARATIVE ANALYSIS OF TRANSPORTATION FLOW REGULATING SYSTEMS

In order to highlight the differences between the resistive flow regulating method and the method by pump rotation modification, in the oil transportation system through main lines, two cases were simulated.

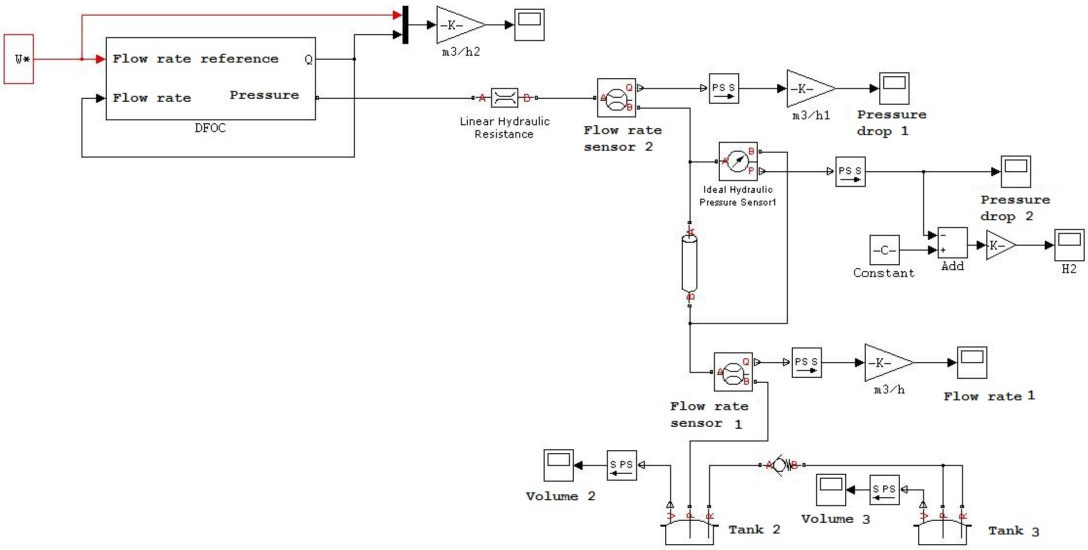

Fig. 1. Simulation diagram in Matlab Simulink in case of resistive regulation

For resistive regulation case, the Matlab Simulink scheme is shown in Fig. 1. Unlike the case of regulating the flow by rotation speed modification, presented above, it is noticed that a resistive element had been introduced along the pressure line.

As a result of simulation, the diagrams shown in Figs. 2 ... 5 were obtained, as a result of simulations for flow rate, pressure drop, and absorbed power by the motor and specific energy consumption variations. The simulation was made in the situation of the use of the pump actuated by a motor with the power of 160 kW and 1487 rpm, and the initial temperature of the transported oil was considered to be 60^{o}C.

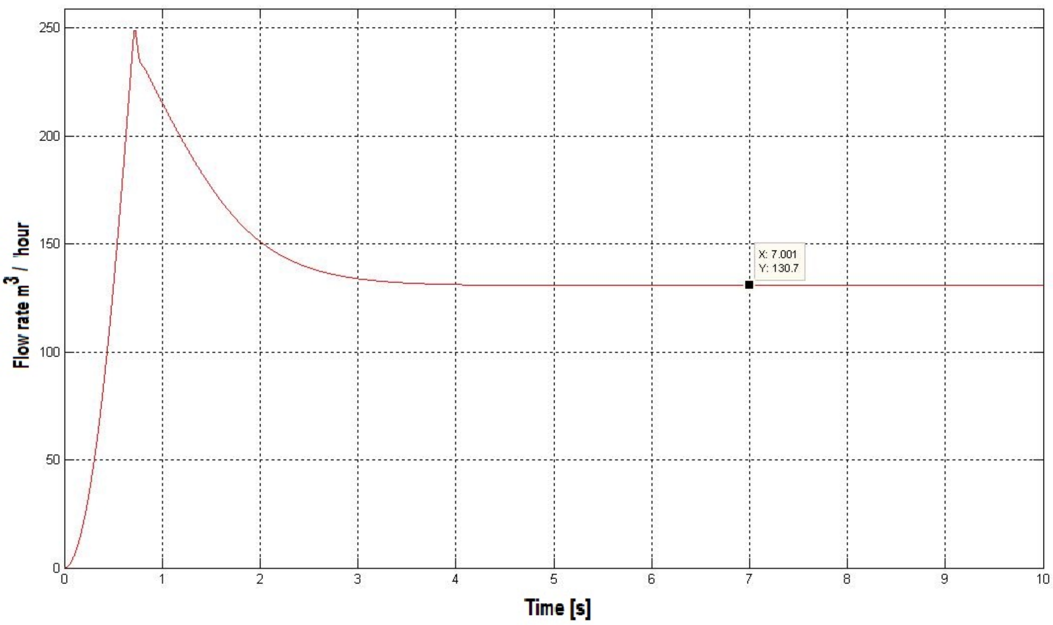

Fig. 2. Flow rate variation versus time

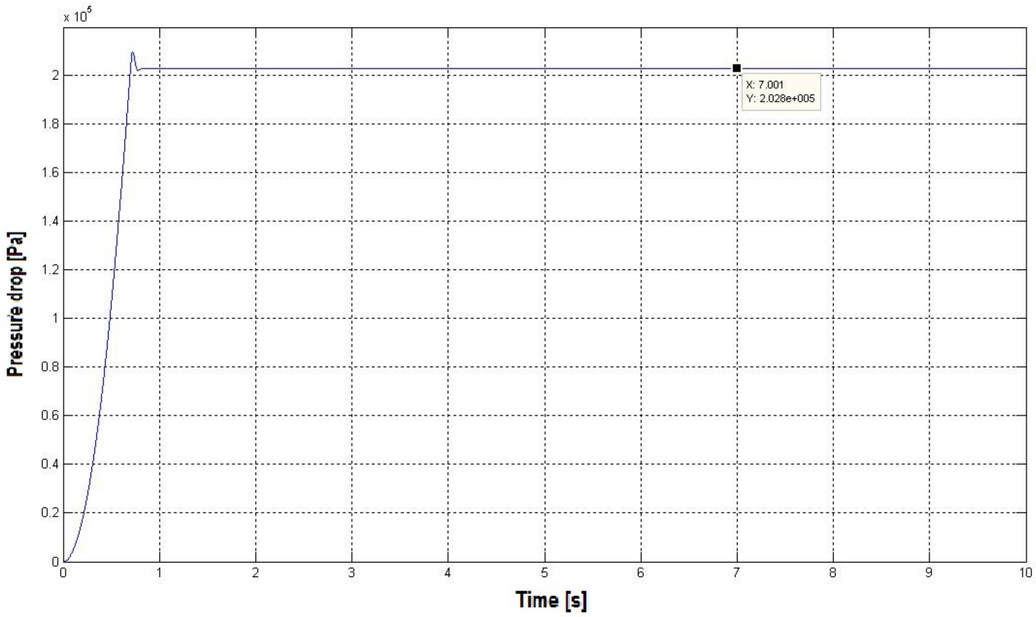

Fig. 3. Variation of pressure drop along the line

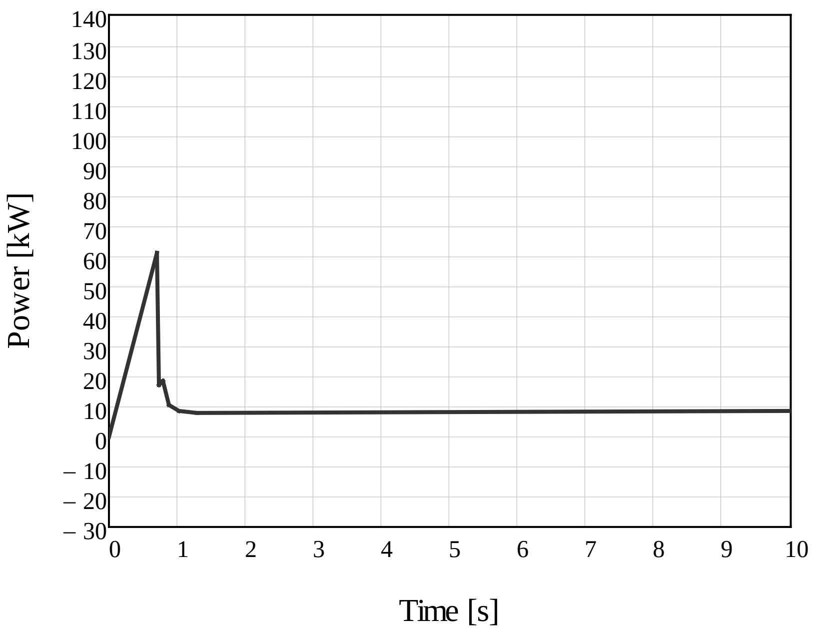

Fig. 4. Variation of absorbed power by the motor versus time

For the same operating conditions, the case of flow regulation by automatic regulation of the pump rotation was simulated. For exemplification, in Figs. 6 and 7 the variation curves are presented for the absorbed power and specific energy.

The analysis of the variation diagrams for the power absorbed by the motor, Figs. 4 and 6 shows that in case of flow regulation by pump rotation modification, the power absorbed by the motor is up to 500% smaller than in the case of the use of resistive method of flow regulation.

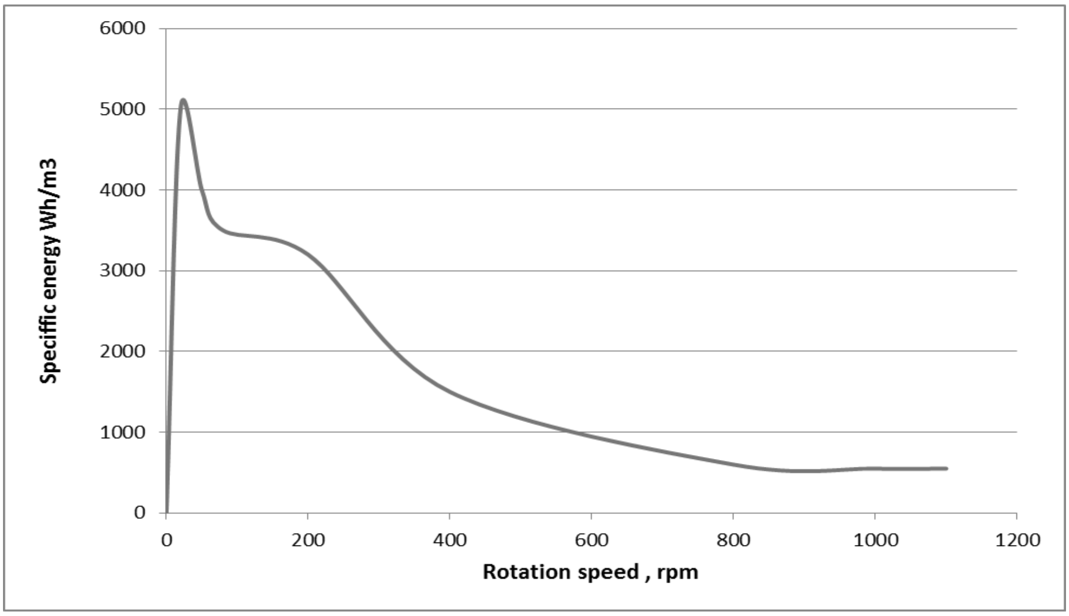

Fig. 5. Variation of specific energy consumption

Comparing Figs. 5 and 7, we can notice that in the case of resistive regulating system the specific energy consumption increase dramatically with reduction of pump motor rotational speed, even in a nominal working regime is greater than in the alternative way, explained by the energy loss in regulating valve. Another issue is the possibility of extrapolation of the results obtained by simulation, along a line with equivalent given diameter and length. In this sense, for a known system, the diameter influence on the pressure drop have been studied.

Fig. 8 represents the variation curve for the pressure drop for various diameters of the main transportation line.

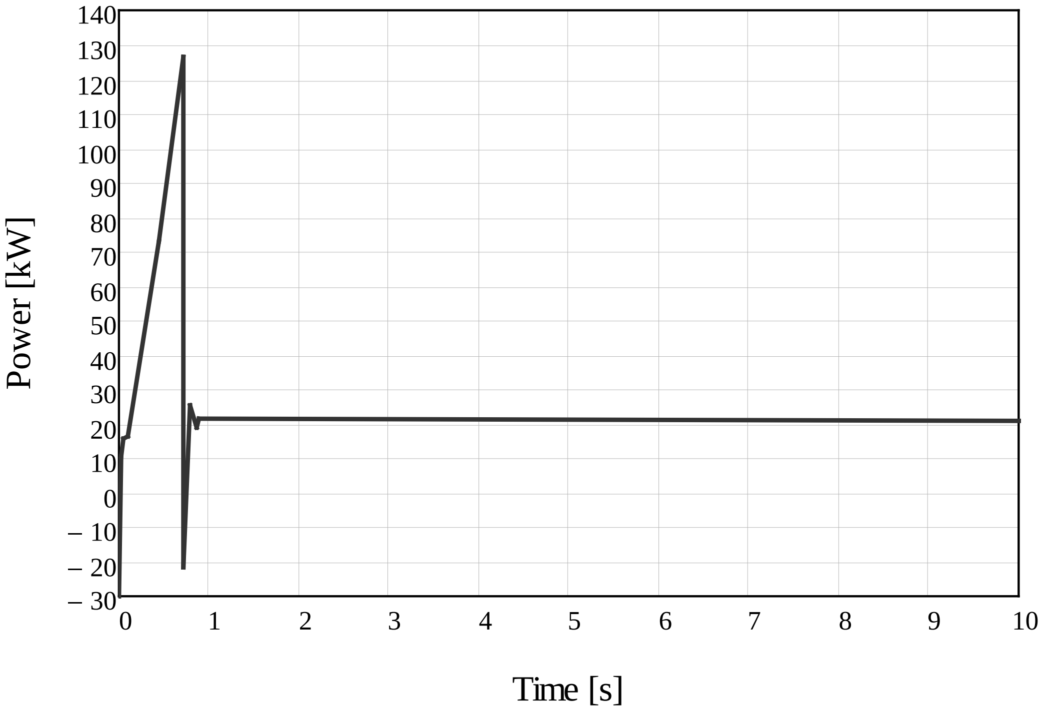

Fig. 6. Variation of absorbed power by the motor versus time

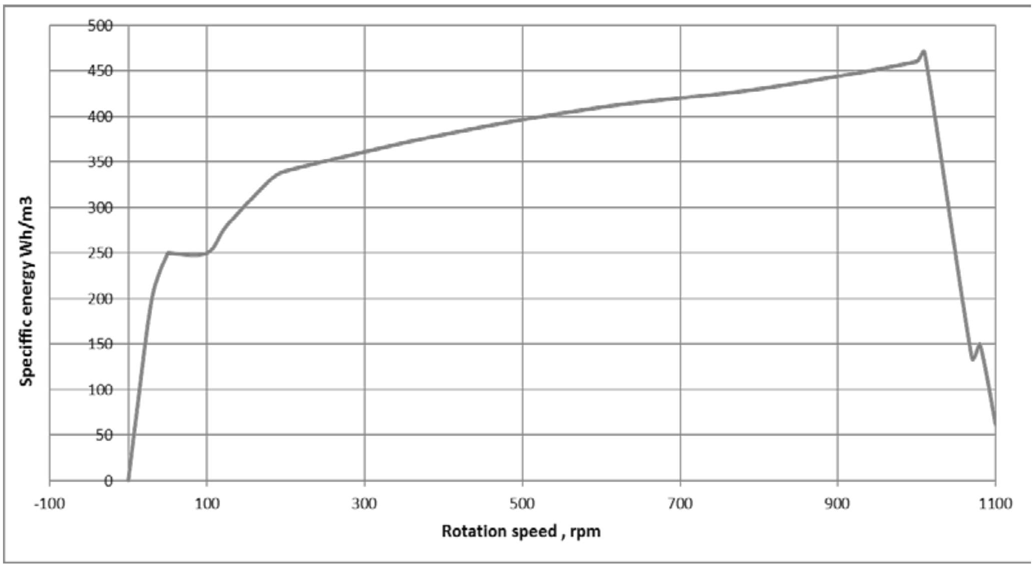

Fig. 7. Variation of specific nergy consumption

It is noticed that this curve is polinomial with the form:

$$\Delta p = 216.2 \times d^{-4}, \quad \text{Pa} \tag{1}$$

where d is the inside diameter of the pipe in m.

With the help of this curve predictions can be made regarding the pressure drop for other pipe diameters for the same flow handled.

It can be concluded that the simulation result for the equivalent length considered can be extrapolated by similitude in a linear model, for any equivalent length. If the main pipe diameter is modified, for the same flow of the pipe, that is if both parameters are modified, then the other simulations are required to obtain similar results.

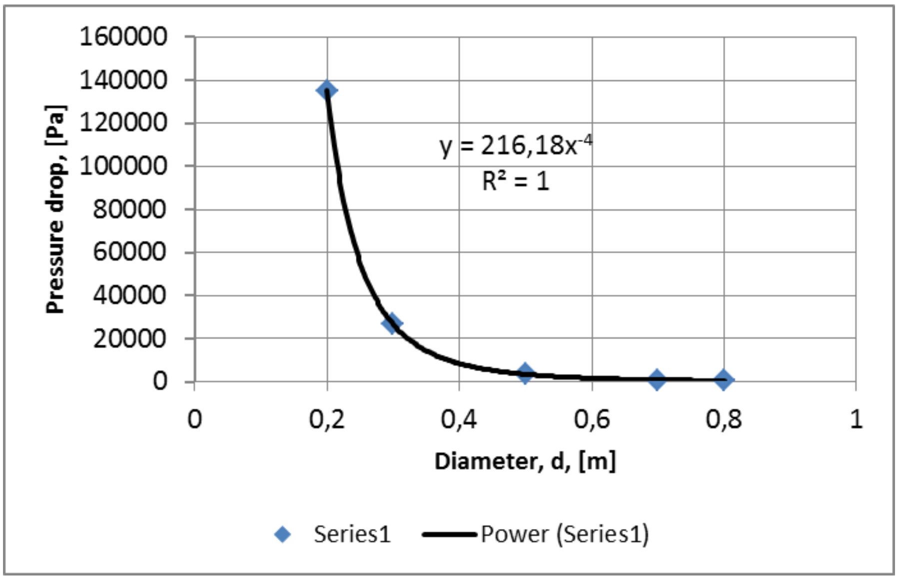

Fig. 8. Variation curve of the pressure drop for various line diameters.

CONCLUSION

To highlight the differences existing between the resistive flow regulation and the pump rotation modification method, for the oil transportation systems through main lines, the two cases were simulated, a series of dependencies resulting, showing that by the use of flow regulation by means of pump rotation modification, the power absorbed by the motor is up to 50% smaller than in the case of using resistive method of flow regulation.

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MODIFICAREA TEHNOLOGIILOR PRIN MODERNIZARE ŞI EXTINDEREA CERINŢELOR PIEŢEI ÎN DOMENIUL EXPLOATĂRII ȘI VALORIFICĂRII RESURSELOR ENERGETICE/

THE TECHNOLOGY CHANGES BY UPGRADING AND EXPANDING MARKET REQUIREMENTS IN THE EXPLORATION AND EXPLOITATION OF ENERGY RESOURCES

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ABSTRACT

The paper shows that, in fact, the life cycle of technology in the exploration and exploitation of energy resources reveals that saturation occurs. At some point the growth rate of technology distribution market (productive economic environment in the exploration and exploitation of energy resources) slows down progress in reaching stagnation and decline further. This paper is a summary of takeover extension study entitled Modern Technologies (Author: Maria Gâf- Deac, Ed. FRM, ISBN 973-582-808-1, Bucharest, 2004) with the application of case law in expansion, extractive mining and energy sectors, respectively in the nuclear industry.

KEYWORDS

energy resources, technological resources, technological risks, conventional technologies, technological investment flows, technological.

1. Introducere

Ciclul de viaţă a unei tehnologii în domeniul exploatării și valorificării resurselor energetice evidenţiază faptul că apare *saturarea.* Într-un anumit moment rata de creştere a distribuţiei tehnologiilor pe piaţă (în mediul economic productiv, în domeniul exploatării și valorificării resurselor energetice) îşi încetineşte evoluţia ajungând la *stagnare* şi în continuare la *declin*.

Dacă se cheltuiesc sume ridicate pentru dezvoltarea pieţei şi pentru menţinerea unor relaţii, pentru acestea – în condiţiile unei tehnologii în domeniul exploatării și valorificării resurselor energetice predispuse la erodare – şansa menţinerii canalelor de distribuţie este redusă.

2. Transformări ale tehnologiilor în domeniul exploatării și valorificării resurselor energetice

Problema retragerii de pe piaţă a unei tehnologii în domeniul exploatării și valorificării resurselor energetice este suficient de gravă, mai ales că apare necesitatea reglementării a cel puţin două categorii de aspecte:

– modificarea tehnologiei vechi (sau înlocuirea), ceea ce presupune un act investiţional;

– contracararea restrângerii pieţei ocupată într-o etapă de tehnologia sortită eşecului (la saturare).

Variantele de acţiune pentru ieşirea rezonabilă din cadrul problematic de mai sus sunt formulate divers şi aplicate de la caz la caz.

În continuare se amintesc câteva situaţii cu caracter exemplificativ.

a) *Continuarea folosirii tehnologiei şi cedarea drepturilor de piaţă unei alte companii din ţară sau străinătate, care are acces la o piaţă (locală sau externă) identificată ca fiind încă extinsă.* De exemplu, concernul Renault a cedat dreptul de piaţă şi a transferat în anii '70 în România tehnologia de fabricaţie a automobilelor marca *Renault* 10 (Dacia 1100) şi în continuare *Renault* 12 (Dacia 1300), având în vedere că acesta a lansat în acea etapă alte mărci (*Renault* 16, respectiv 19 etc.) cu care ocupa mai performant noile segmente de piaţă. Tehnologiei i-a fost astfel prelungit ciclul de viaţă.

Un exemplu similar s-a înregistrat în cazul complexelor mecanizate de abataj pentru exploatarea subterană a cărbunelui, în anii 1977-1980 când firma *Hemsheidt* din Germania a cedat drepturile de fabricaţie şi piaţă pentru tehnologia de construcţie a elementelor hidraulice de susţinere, în momentul în care ea a lansat pe piaţa germană şi în lume un alt tip de echipament complex mai performant. În acest mod, tehnologia de susţinere a abatajelor cu stive păşitoare a beneficiat de o extindere a ciclului său de viaţă.

b) Continuarea comercializării tehnologiei, dar încetarea fabricării acesteia. Tehnologia în domeniul exploatării și valorificării resurselor energetice poate fi importată de la un producător cu un cost mai redus (cererea se poate stimula prin reducerea preţurilor).

c) Elaborarea de studii detaliate pentru resegmentarea pieţei. Tehnologia în domeniul exploatării și valorificării resurselor energetice va putea fi replasată (localizată) pe unele segmente de piaţă cu caracter „ultimativ" în existenţa sa ca produs.

d) Exportarea tehnologiei în ţări cu o economie mai slab dezvoltată, înfiinţând unităţi de producţie pe teritoriul acestora în domeniul exploatării și valorificării resurselor energetice şi importarea unei părţi a producţiei de pe piaţa ţării companiei-mamă. Exemplele de la punctul a) pot fi luate în considerare şi în acest caz.

e) Reabilitarea tehnologiei şi extinderea cererii combinând activităţi cum sunt: reamplasarea pieţei, modificări calitative, modificări funcţionale, schimbarea mărcii ş.a.

Modificările operate asupra tehnologiilor în domeniul exploatării și valorificării resurselor energetice de regulă sunt protejate. Procedeele de protecţie diferă de la ţară la ţară însă, în esenţă ele se referă la următoarele:

1) Protecţia legală a noii tehnologii se realizează prin a) brevetare, b) înregistrarea mărcii de comerţ şi c) înregistrarea proiectului industrial.

Brevetul este un document care oferă deţinătorului dreptul de a stopa exploatarea de către alţii a inovaţiei tehnologice care îi aparţine.

O invenţie tehnologică (noutatea înserată în tehnologia care suferă astfel modificări) trebuie să îndeplinească unele condiţii cum sunt: originalitatea, să aducă elemente de noutate, să poată fi aplicată la scară industrială, să nu fie „exclusă” prin definiţie.

Înregistrarea mărcii de comerţ a tehnologiilor marchează legătura între mărfurile (de natura tehnologiilor) şi producători sau comercianţi, distingând bunul tehnic ca fiind al unei companii, firme ş.a.

Marca este protejată prin înregistrare, oferind astfel proprietarului dreptul exclusiv de a fi folosită.

Înregistrarea proiectelor industriale tehnologii în domeniul exploatării și valorificării resurselor energetice conduce la protejarea tehnologiilor faţă de imitaţii. Acest demers se diferenţiază faţă de brevetare prin faptul că nu trebuie să conţină strict un element nou.

2) Adaptarea parametrilor constructiv-funcţionali ai tehnologiei la cerere tehnologii în domeniul exploatării și valorificării resurselor energetice.

Companiile producătoare de tehnologii tehnologii în domeniul exploatării și valorificării resurselor energetice realizează periodic investigaţii atât în teren cât şi prin analize care identifică noile cerinţe constructiv-funcţionale ale echipamentelor şi utilajelor în raport cu situaţiile operaţionale concrete întâlnite în fluxurile productive practice.

3. Ameninţări şi riscuri tehnologice în domeniul exploatării și valorificării resurselor energetice

Un proiect de investiţie în domeniul exploatării și valorificării resurselor energetice poate fi afectat de două tipuri de riscuri: fizice şi financiare.

Pentru tehnologiile moderne, convenţionale, riscurile fizice afectează exactitatea previziunii vânzărilor, exigenţele legate de tehnologie, necesarul de resurse materiale sau de forţă de muncă.

Pentru produsele pentru care deja există un contract, posibilitatea de erori şi omisiuni tehnologice este redusă. Dacă baza de capital este estimată real, riscurile fizice scad.

Când rezerva pentru riscuri fizice depăşeşte 15-20% din baza de capital, este necesară investigarea imediată a situaţiei şi cu ajutorul fead-back-urilor să se obţină reglările necesare (reducându-se astfel nivelul de risc).

Prin natura sa orice obiectiv economic, inclusiv tehnologic apare şi funcţionează în condiţii de risc şi incertitudine. Riscul şi incertitudinea în tehnologie în domeniul exploatării și valorificării resurselor energetice sunt, în general, determinate de cauze obiective şi subiective, cum sunt:

– schimbări tehnologice rapide, în urma cărora produsele devin depăşite, iar utilajele şi echipamentele de producţie – uzate moral;

– erori de analiză tehnologică, tehnică, economică şi financiară;

– atitudinea exagerat de optimistă sau pesimistă a echipei de analiză a riscului tehnologic;

– schimbarea condiţiilor din mediul economic – inclusiv invalidarea experienţelor anterioare care au stat la baza estimărilor în calculele asupra tehnologiei din punct de vedere economic şi financiar.

Luarea în considerare a riscurilor şi incertitudinilor tehnologice în domeniul exploatării și valorificării resurselor energetice se poate realiza prin:

– metoda **generală** (efectuarea de analize cost – beneficiu în mai multe variante);

– metoda **variantelor optimistă şi pesimistă** (modificarea estimărilor din varianta tehnologică de bază imprimând analizei un sens favorabil – optimist, şi un sens nefavorabil – pesimist pentru a evalua efectele asupra rentabilităţii);

– metoda **analizei de sensibilitate** (schimbarea uneia sau mai multor estimări ale elementelor de calcul într-o direcţie favorabilă sau nefavorabilă şi reluarea analizei cost – beneficiu pentru diferite combinaţii tehnologice – ale elementelor favorabile şi nefavorabile). Analiza de sensibilitate se efectuează pentru acele niveluri care au cele mai probabile posibilităţi de apariţie.

Dintre elementele de influenţă se reţin:

– imposibilitatea maturizării, respectiv consolidării tehnologiei datorită neconvenţionalităţii sale accentuate;

– se realizează produse care au caracteristici convenţionale (absorbante pe piaţă) sau cu totul noi, neobişnuite, care nu au utilitate previzibilă, respectiv parcurg dificultăţi faţă de posibilitatea de acces pe o piaţă reală;

– se manifestă o agresivitate reală, directă asupra mediului înconjurător (sau au un grad relativ redus de afectare);

– nivelul costurilor tehnologice în domeniul exploatării și valorificării resurselor energetice este ridicat sau scăzut;

– diferite performanţe tehnice sunt pozitive, obişnuite sau mai scăzute în termeni reali, comparabili.

În figura. 1., [18] este redată o tentativă de clasificare a unui grup de tehnologii, care după conţinutul lor emană linii de ameninţare în mediul productiv general.

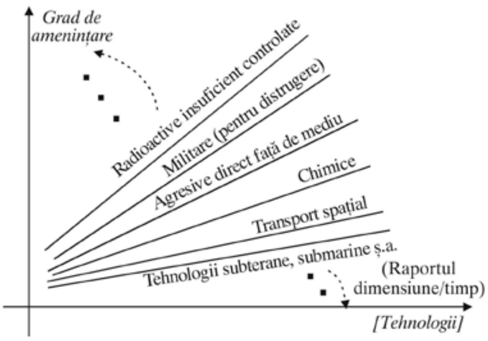

Figura: 1. Gruparea domeniilor tehnologice după nivelul de ameninţare faţă de sistemul de ansamblu al societăţii omeneşti

În mod obişnuit, la evaluarea riscului rezultat din neconvenţionalitatea tehnologiilor în domeniul exploatării și valorificării resurselor energetice este necesară identificarea unui număr cât mai semnificativ de factori de influenţă - din familia celor amintiţi mai sus – astfel încât să se cuantifice, cu un grad de obiectivitate cât mai reprezentativ, nivelul de risc convenţional.

Tehnologiile în domeniul exploatării și valorificării resurselor energetice nu au întotdeauna finalitate benefică. Ele conţin şi „ameninţări” ce pot fi refulate în sistemul general productiv (inclusiv cel social) cu consecinţe directe în dezechilibrarea structurilor convenţional acceptate.

4. Concluzii

Un proiect de investiţie în domeniul exploatării și valorificării resurselor energetice poate fi afectat de două tipuri de riscuri: fizice şi financiare.

Pentru tehnologiile moderne, convenţionale, riscurile fizice afectează exactitatea previziunii vânzărilor, exigenţele legate de tehnologie, necesarul de resurse materiale sau de forţă de muncă.

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STUDY OVER THE STATE OF STRESS AND DISPLACEMENTS FROM THE STRUCTURE OF THE TOWERS OF THE HOIST DEVICES DUE TO operating LOADS

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ABSTRACT

The demand of safety in the hoisting process continuously imposes the optimal functioning of these devices, as important element in the transport flow of the mineral substance and the waste rock as of personal, equipment , and different materials between the underground and surface.

In the paper there is presented an analysis of the behavior of the towers of the hoisting devices with regard to stress and displacements of the tower structure during the operation in case of drums as wrapping element for the cables.

1. INTRODUCTION

The calculation the structure of the mining hoist's towers is done taking into consideration all the unfavorable combinations of the practically possible different loads called groups of loads and are established taking into account in their form the compatibility of their acting simultaneously.

The loads are classified into: permanent, short term - temporary, long term - temporary, and exceptional. The groups of loads with loads that can be introduced into groups of loads are the fundamental group of loads which contains permanent loads, long term loads, one or more short term loads and the special loads grouped from the fundamental group and one of the exceptional loads.

In order to establish the state of strain and displacements from the structure of the tower due to the short term functioning loads transmitted through the extracting cables during an extracting cycle, it has been taken into study the tower of the extracting installation ,, Auxiliary well Valea Arsului" Vulcan Mining Plant, which has the general and working data presented as follows.

2. THE HOIST CONSIDERED FOR ANALYSIS

The hoist which works on auxiliary well Valea Arsului, from Vulcan Mining Plant, which is destined [3] for the underground supply with materials and tools as well as for transporting personal among levels 580, 650, and 700 the surface level being 783 m from the sea level.

The extracting installation that supplies the well (fig.1) is unbalanced and has an extracting machine type 2T-3,5$\times$1,7 (fig.2) equipped with one asynchronous motor type AKH -14 - 46

Fig.1.Hoisting device ,,Auxiliary shaft“

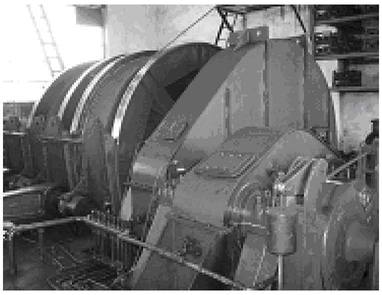

Fig.2.HOISTING machine type BAMERT 3$\times$0,9

Fig.3. Hoist tower ,, Auxiliary shaft “

-10, of 600 kW , 585 rpm. The reducer of the machine is of type TD-170 having the transmittance ratio of 11,5. The extracting cables with diameters of $\varnothing$42 mm and a mass (on a linear meter) of 6,9 kg/m on the left branch (from the extracting machine to the well) and $\varnothing$40 mm and a mass 6,17 kg/m on the right branch are wrapped around the two extracting pulleys of $\varnothing$ 3500 mm with a mass (the pulley, the axis of the pulley and the bearing of the axis) of 3050 kg (fig.3), laying on the tower at a height of 23,7 m (pulley axel).

The cables are wrapped in a single layer (row) on each of the two wheels of the machine, from which one is fixed and one is mobile and which are hooked at one end by the exterior end (side) of them. The other end of the cables going through the extracting pulleys is hooked to the extracting vessel through the cable tie device D.L.C.

The extracting vessels are cages with one level, with two trolleys per level weight a mass (own mass plus D.L.C.) of 4661 kg. The mass of a trolley is of 650 kg, and the effective load is 1800 kg/trolley.

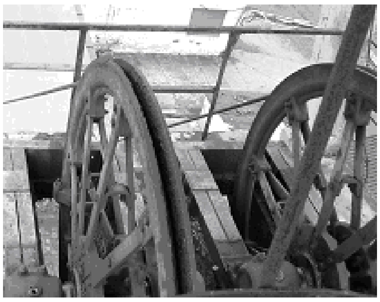

Fig.4. Pulley platform

Fig.5. Leading component

Fig.6. Abutment

The height of the tower (fig.3) till the pulley axis of 23,7 m. The structure of the tower is composed of the extracting pulley platform (fig.4) sustained by the leading component(fig 5) and the abutment (fig 6) The extracting machine lies on the ground (at a height of 0.7 m to the 0 level of the well (well collar), sideways from the tower (well tower), at a distance (of the wheel axis), towards the vertical portion of the extracting cables which enter the well of 42m.

The length of the cable chord (the distance between the tangent points of the cable to the deviating pulley from the tower and the wheel of the extracting machine, in the central position of the chord (perpendicular on the wheel axis)), is for the left branch L_{cs} = 46,226m, and L_{cd} = 46,358m for the right branch.

The incline angles of the cables chords are $\beta_s = 34^0\ 04'\ 29''$ for the left branch and $\beta_d = 29^0\ 44'\ 41''$, for the right branch, and the deviating angles (which are formed in the limit positions of the cable chord towards the interior side (interior angle) or exterior (exterior angle) of the wheel, over the central position of the chord) are: $\alpha_{e\ st} = 19'29''$ and $\alpha_{i\ st} = 45'21''$ For the left branch and $\alpha_{edr} = 31'53''$ and $\alpha_{i\ dr} = 32'46''$ for the right branch.

3. LOADS TRANSMITTED TO THE TOWER

Considering the elevator leaving the horizontal 580m until it reaches the surface ramp (783 horizon) it has been considered for analysis, the case of personal transport entering the underground when the left elevator full of personal is descending on the right wing (case 1); the right elevator is descending on the right wing (case.2). The kinematics elements for the cases taken into analysis are presented in fig 7 and 8.

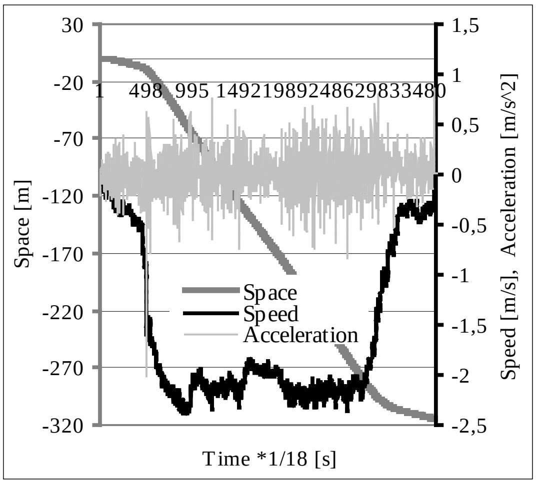

Fig.7. Kinematic elements on the elevator left climbing personal entrance, case1

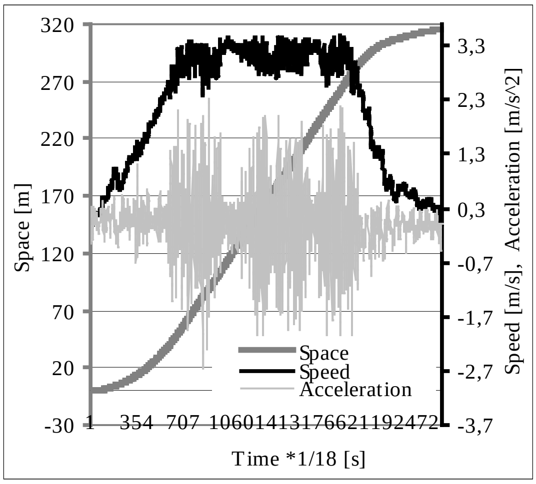

Fig.8. Kinematic elements on the elevator left descending personal entrance , case 2

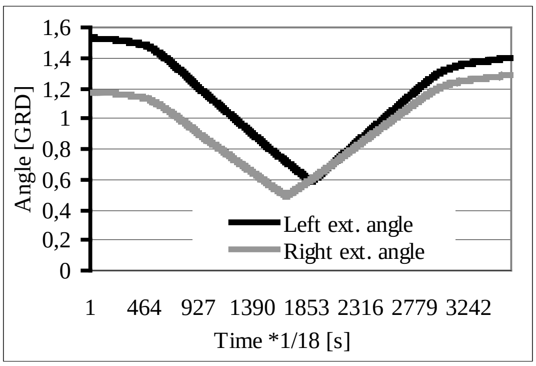

Fig.9. Deviating angles for case 1 from fig 7

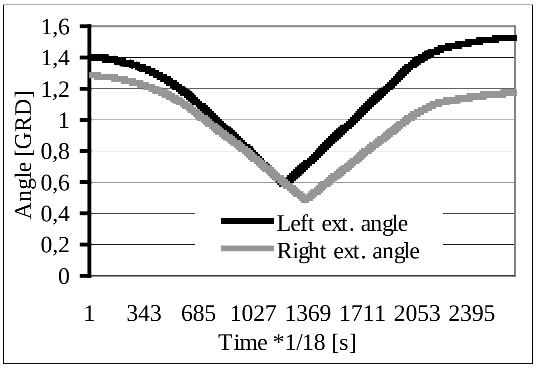

Fig.10. Deviating angles for case 2 from fig 8

The calculation of loads has been done taking into consideration the static, friction and dynamic forces [1], [2].

In the calculation of loads it has been used the d'Alembert [1] principle decomposing the efforts from the cable chords, in their touch points on the pulleys into components on three perpendicular directions which correspond to the axis system chosen in the discretisation of the structure of the tower of the installation. The components of the efforts from the cable chords variate both because of the incline angles of the chords but also because of the deviation angles of them (fig.9 and fig.10).

Considering the left bearing and the right bearing, of each deviating pulley, there is presented the variation of the components of the forces on each pulley (fig.11 and fig.12) and the loads on the entire tower (fig.15 and fig.16), for each case taken into study.

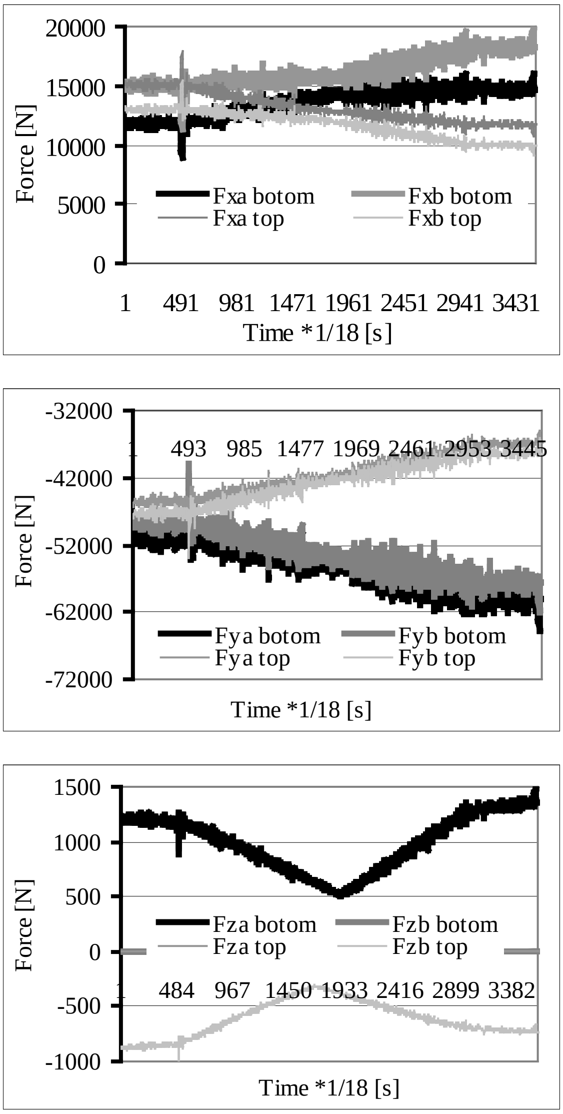

Fig.11. Forces in the pulley bearings left and right in case 1

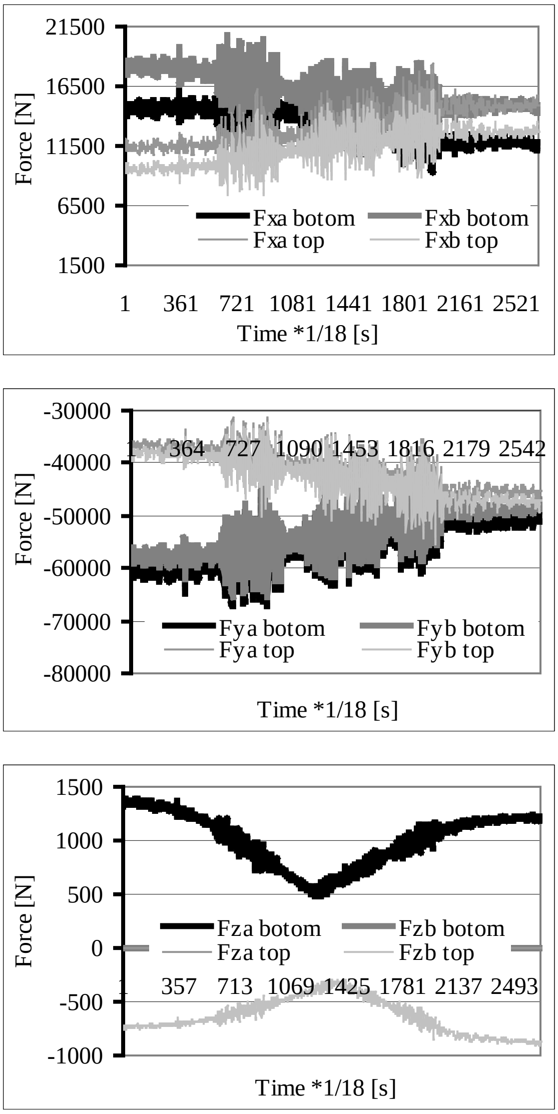

Fig.12. Forces in the pulley bearings left and right for case 2

4. STRESS AND DISPLACEMENTS

Due to the complexity of the tower the most appropriate method of study is [1] that of the finite element.

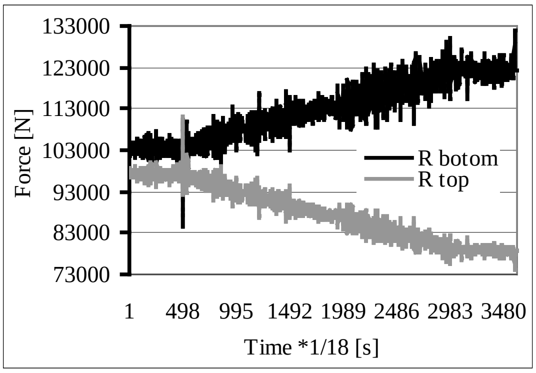

Fig.13. Forces on the pulleys elevator left climbing, right descending, case 1

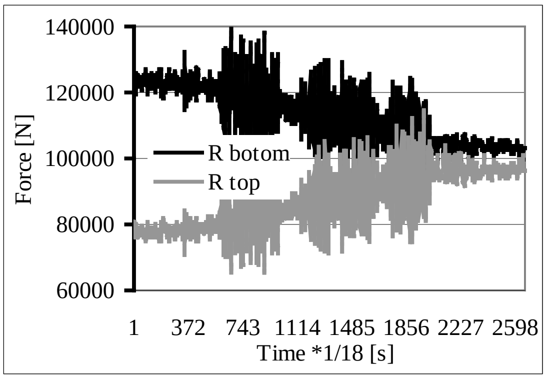

Fig.14. Forces on the pulleys elevator left descending, right climbing, case 2

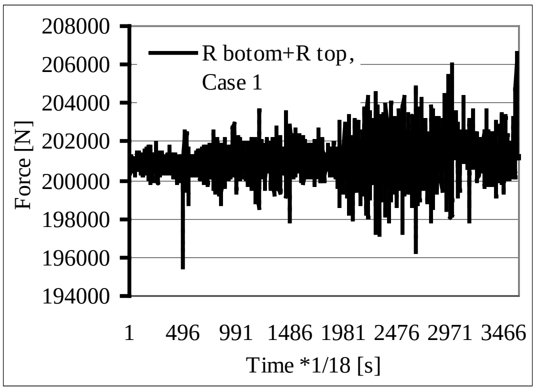

Fig.15. Total loads when the elevator left climbing , right descending case 1

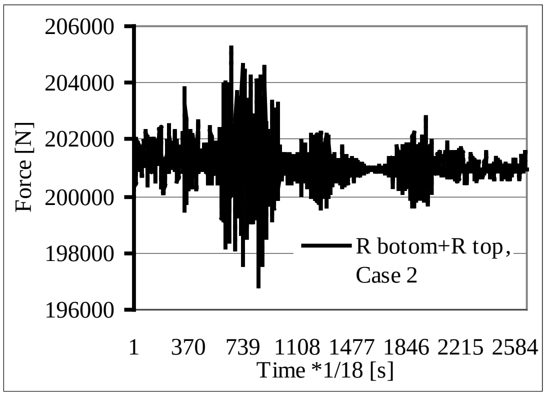

Fig. 16. Total loads when the elevator left descending, right climbing, case 2

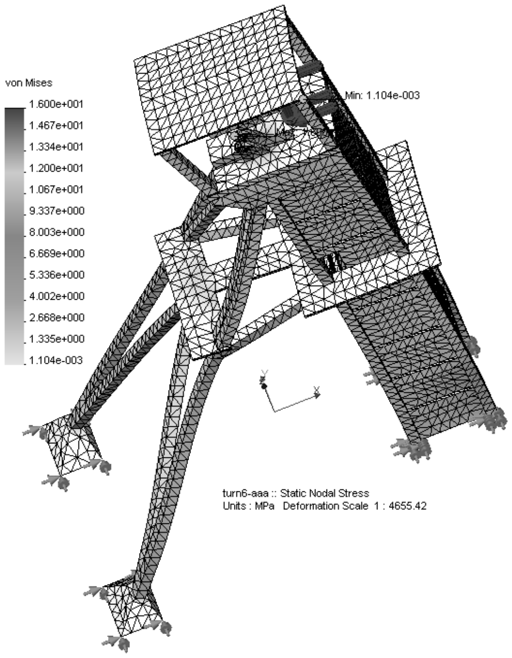

Fig.17. Stress, case 1

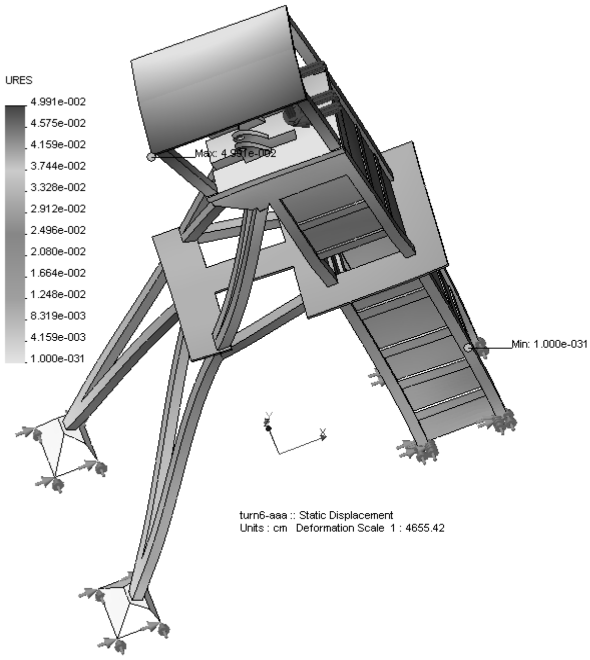

Fig.18. Displacements, case 1

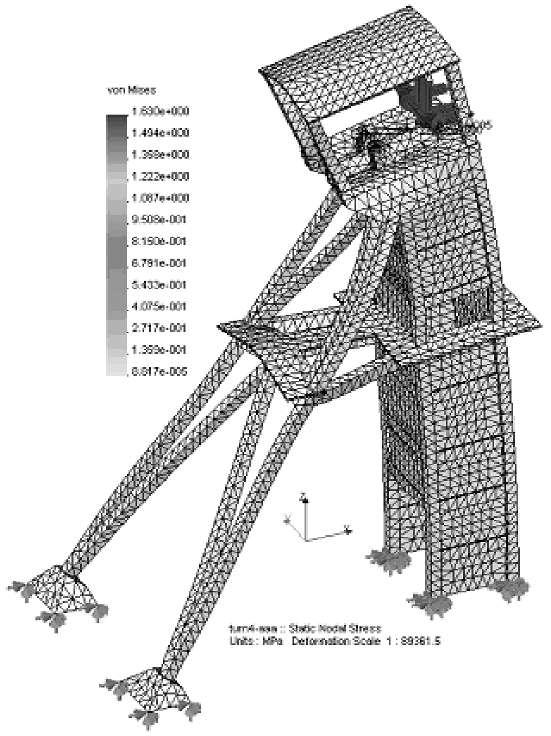

Fig.19. Stress, case 2

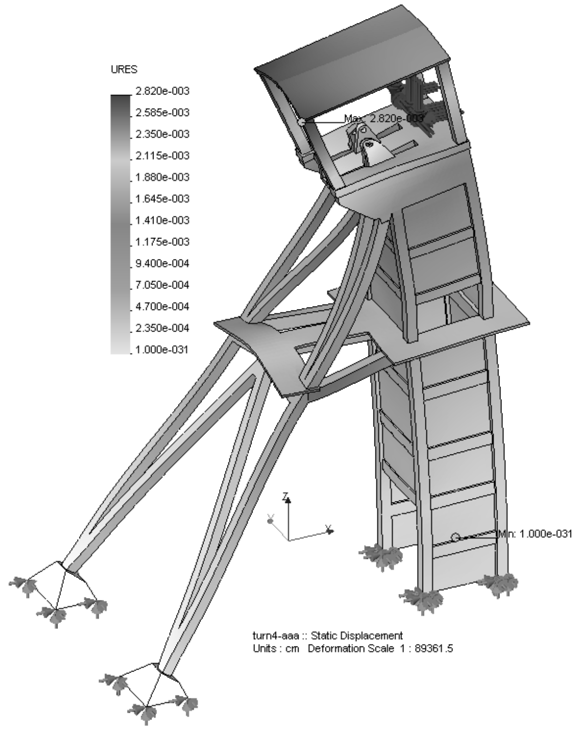

Fig.20. Displacements, case 2

In order to analyze the state of stress and displacements with the method of the finite element and the tower structure has been modulated the geometrical and mechanical characteristics have been established and introduced into the calculation software. In the cases taken into study the mass of the tower has been calculated with the help of the software. In fig 17 and 18 there are presented the strains and displacements for case 1, and in fig 19 and 20 for case 2.

5. CONCLUSIONS

The max values of strain and displacements have been determined from the tower structure, in order to establish the measuring points and to verify through experimental measurements the values obtained through numerical calculation. Following these results there have been obtained information necessary in order to improve the maintenance of the extracting installations and to improve the existing system of repair and supply for this type of installations.

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PRODUCŢIA MINIERĂ URANIFERĂ CA VARIABILĂ STRATEGICĂ ÎN ÎNTREPRINDEREA EXTRACTIVĂ/

URANIUM MINING PRODUCTION AS RANGING STRATEGIC MINING COMPANY

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ABSTRACT

The article shows that in ordinary economy, many businesses bravely abandons some phases of production (manufacturing) resorting to alternative supplies. Such technological phases are outsourced and businesses adjust overall costs with less favorable phases expenses met by another manufacturer specific replacement for what the company initially produced a distinct technological flow, localized (integrated in the classical manner). Relocation of production of uranium by plants in the transfer areas (countries) where the cost of labor, low taxes are lower is not always a viable strategic basis. One such action involved some elements that need - in particular - taken into account, such as nuclear safety, insufficient control over nuclear activities, duration and cost of training of staff, transport costs, transfer, special administrative formalities etc. So not always transfer (relocation) production is strategically justified. This paper is a summary of takeover extension study entitled Modern Technologies (Author: Maria Gâf- Deac, Ed. FRM, ISBN 973-582-808-1, Bucharest, 2004) with the application of case law in expansion, extractive mining and energy sectors, respectively in the nuclear industry.

KEYWORDS

the uranium mining production, technological sophistication, organization of mining technology, mining technology organization model, the strategic variable, mining company.

1. Introducere

Caracterul transnaţional al activităţilor productive uranifere desfăşurate de marile companii din lume se bazează pe difuzia de tehnologii, ca purtătoare de capacităţi de transformare a materiilor prime, materialelor, energiei şi informaţiilor.

La sfârşit de secol XX cca. 100 de firme în clasamentul mondial al companiilor sunt considerate *noii stăpâni ai lumii*.

Conferinţa ONU pentru Dezvoltare din septembrie 1999 arată că motorul sistemului productiv mondial integrat este compus în ordine de către *General Electric, Ford şi Shell* care în 1998 au avut împreună o cifră de afaceri de 2.100 miliarde USD, adică de 1,5 ori mai mare dect PIB-ul Franţei sau de 6 ori mai mare decât PIB-ul realizat de Mexic.

Cele 100 de întreprinderi din fruntea economiei mondiale aveau 1.800 miliarde USD din activele lor localizate în străinătate.

Toată această extindere se bazează în principal pe tehnologii, care dobândesc rapid noi valenţe calitative şi de performanţă, ceea ce determină ca proprietarii lor să devină competitivi pe pieţe şi să colecteze profituri imense.

Globalizarea tehnologică cu mare expresivitate se regăseşte – pentru exemplificare – în sfera industriei nucleare controlate, a comunicaţiilor (sateliţi) şi a computerelor.

După anul 1945 până către sfârşitul secolului XX semnele globalizării se regăsesc sub trei structuri care integrează schimbările:

a) globalizarea *tehnologică*;

b) globalizarea *economică*;

c) globalizarea *politică*.

În mediul internaţional este recunoscută clasificarea (ierarhizarea) tehnologiilor în succesiunea de mai sus. De fapt, prioritatea tehnologiilor în ansamblul transformărilor este însuşită practic atât la nivel microeconomic cât şi la cel macroeconomic.

2. Tehnologiile în noul mediu productiv-economic dominat de concurenţă

Dimensiunea producţiei unei companii se regăseşte într-un ciclu integrat caracterizat de o anumită amploare. Producţia minieră, inclusiv cea din zăcăminte uranifere, nu mai este un parametru aservit creşterii ci chiar ea determină creşterea.

Între gestiunea executivă şi gestiunea productivă minieră încep să se evidenţieze diferenţe necontradictorii.

Producţia minieră începe să conducă perspectiva unei întreprinderi, deci ea dobândeşte dimensiuni strategice. Tehnologiile constituie suportul efectiv al producţiei uranifere.

În câmpul minier productiv contemporan se manifestă:

– tendinţa de accentuare a transformărilor în procesul productiv uranifer;

– tendinţa de integrare a fluxului de materiale şi materii prime uranifere;

– tendinţa de integrare a fluxului de informaţii tehnologice şi productive uranifere;

– căutarea unei coerenţe globale a ansamblului de faze tehnologice miniere concurente;

– căutarea unui ansamblu optim al ciclului de producţie uranifer.

În anii '70 integrarea se realiza în jurul unor tehnologii (în sistem) electromecanice (fizice, spaţiale, de transformare). Întreprinderea trebuia să procedeze la reunirea tendinţelor respective sub forma „economiei de scară", cu serii lungi.

În principal, se asista la *o localizare productivă* pe o arie comună.

Instabilitatea pieţelor şi soluţiile tehnologice extrem de diverse (uneori contradictorii, de ruptură) au determinat *delocalizarea producţiei*. Acest fenomen nu a putut prolifera în sectorul extracției și prelucrării uraniului.

În economia obișnuită, numeroase întreprinderi abandonează cu curaj unele faze de producţie (fabricaţie) apelând la furnituri alternative.

Astfel fazele tehnologice sunt *externalizate*, iar întreprinderile reglează costurile de ansamblu cu cheltuieli favorabile mai reduse pentru fazele satisfăcute de un alt producător specific, înlocuitor pentru ceea ce iniţial producea compania într-un flux tehnologic distinct, localizat (integrat în manieră clasică).

Delocalizarea producţiei uranifere prin transferul uzinelor în ariile (ţările) în care costul forţei de muncă, nivelul taxelor sunt mai reduse nu are întotdeauna o bază strategică viabilă.

Într-o astfel de acţiune intervin unele elemente de care trebuie - în particular - ţinut seama, cum sunt: securitatea nucleară, control insuficient asupra activităților nucleare, durata şi costul formării personalului, costuri de transport, de transfer, formalităţi administrative speciale ş.a. Aşadar nu întotdeauna transferul (delocalizarea) producţiei este justificat strategic.

Se apreciază că parteneriatul productiv este o formă mai viabilă, care include caracteristici de dezvoltare propriu-zisă (tehnologică, managerială etc.).

Aşa numita „*dezenclavizare a producţiei*" conduce la efectul de sinergie „comercialului" cu „financiarul" şi „acţiunile de cercetare".

Procesele de mai sus arată că în tehnologii se produc mutaţii, care prevăd:

– schimbarea propriu-zisă a conţinutului (performanţe, competitivitate) tehnologiei;

– dislocarea unor faze din amonte sau aval de tehnologie, respectiv a unor faze din corpul propriu-zis al tehnologiei.

Astfel, în sistemele tehnologice,de exemplu,- miniere, conceptul de coerenţă devine primordial, iar mediul organizaţional este afectat corespunzător.

Ansamblul transformărilor în manierele de mai sus semnifică dimensiunea productivă ca fiind una strategică.

Prin extensie dimensiunea tehnologică devine *o variabilă strategică* majoră a companiei.

Însă tehnologiile nucleare constituie resursa operaţională cea mai importantă a globalizării.

Traseul *naştere-creştere-maturizare-dispariţie* a unei tehnologii poate fi adecvat în tentativa de a întocmi o ierarhizare a importanţei unei tehnologii în raport cu alta în mediul productiv şi social-economic.

Statutul tehnologiilor, inclusiv a celor nucleare, în câmpul productiv este influenţat de gradul de reprezentativitate a acestora din perspectiva atotcuprinderii conţinuturilor operaţionale (figura.1). [9]

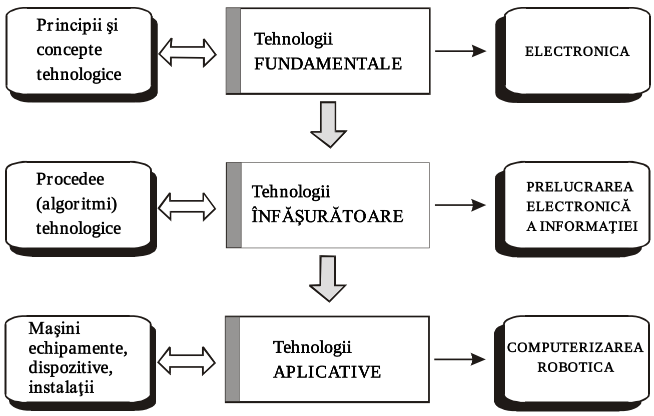

Figura: 1. Clasificarea tehnologiilor după nivelul conţinuturilor operaţionale

Ţările *puternic* dezvoltate sunt posesoare principale de *tehnologii nucleare moderne fundamentale.* Ele impun restricţii sau măsuri de protecţie fiind puternice distribuitoare a tehnologiilor moderne în concurenţa de pe piaţă.

Ţările *mediu* dezvoltate au acces la tehnologiile nucleare moderne înfăşurătoare, având capacitatea de preluare din mulţimea tehnologiilor fundamentale a liniilor de maximă operaţionalitate în concordanţă cu cerinţele pieţei.

Ţările *în curs de dezvoltare* sunt preponderent deţinătoare de *tehnologii aplicative*, a căror transpunere fizică rezultă din înlănţuirea (compunerea) operaţională a modulelor sau direct a maşinilor, echipamentelor, instalaţiilor ş.a.

De regulă, aceste ţări sunt importatoare de tehnologii. În această categorie productivă este evidenţiat semnificativ ciclul de viaţă al unei tehnologii care prin calificativul de „*modernă*” se identifică drept „*actuală*”.

Tehnologiile nucleare fundamentale au ciclul de viaţă lung şi foarte lung, în schimb tehnologiile aplicative suferă schimbări rapide în conţinut şi destinaţie.

Dezvoltarea tehnologică vizează studierea semnificaţiilor de mai sus. Este identificat *un ciclu al ciclurilor de viaţă tehnologică*, atent urmărit de marile companii transnaţionale.

Modulele din fig.1 subliniază existenţa unei reţele cu întindere orizontală (Io) preponderentă a centrelor de tehnologii în raport cu ierarhizarea acestora după performanţe (Ip).

Maximizarea eficienţei structurilor nucleare tehnologice globale (STO) rezultă din compunerea reţelei cu ierarhia:

$$MAX\ STO = Io * Ip \qquad (1)$$

În mediul economic curent deja nu se pune problema accentului pe un indicator structural sau altul. Este recunoscută formula sub care reţelele şi ierarhiile trebuie să îndeplinească următoarele condiţii:

a) *extindere*

$$\begin{cases} Io \longrightarrow max \\ Ip \longrightarrow max \\ Io * Ip \longrightarrow max \end{cases} \qquad (2)$$

b) *proporţionalitate*

$$(Io \sim Ip) \rightarrow optim \qquad (3)$$

c) eficienţă (E)

$$\begin{cases} Io \sim Ip \\ Io * Ip \qquad \Rightarrow E \\ Io \longrightarrow max \\ Ip \longrightarrow max \end{cases} \qquad (4)$$

Retehnologizarea reprezintă intervenţia directă asupra unui sistem tehnologic prin care se realizează o transformare structurală a configuraţiei productive aflate în funcţiune.

Elementele de mai sus conferă premisele reconsiderării statului tehnologiilor nucleare în cadrul întreprinderilor.

Noua filosofie productivă uraniferă presupune abordarea sistemică a restricţiilor, accentul pe corecţii şi fezabilitatea proiectelor însoţite de previziuni cu înalt grad de rezoluţie.

3. Restructurarea tehnologică a sistemelor industriale miniere uranifere

Dimensiunea proceselor tehnologice uranifere este în schimbare. Unele categorii de tehnologii se grupează în sfera celor reduse dimensional, concomitent cu creşterea performanţelor (C_1).

Pe măsura creşterii dimensiunii acestora peste o limită naturală, autoreglată, este posibilă scăderea performanţelor. (figura. 2). [9]

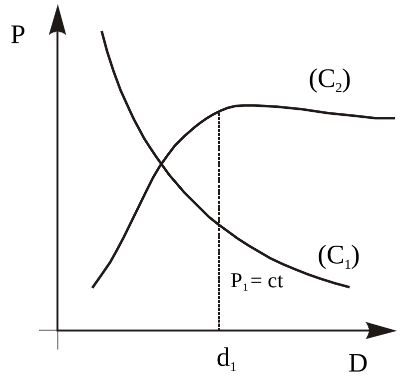

Figura: 2. Corelaţia performanţe-dimensiuni pentru sistemele tehnologice uranifere

P = performanţe; D = dimensiuni

Un al doilea caz de evoluţie a raportului performanţe-dimensiuni este evidenţiat de alura curbei (C_2).

Se observă că, în principiu, până la o dimensiune optimă d_1, performanţele tehnologice cresc odată cu dimensiunile lanţurilor din proces.

După momentul d1 performanţele rămân constante (P_1=ct), ceea ce nu mai justifică creşterea dimensionată.

Retehnologizarea este un proces imediat, continuu şi obligatoriu într-un mediu economic intern şi exterior în continuă modificare.

Intensitatea retehnologizării este diferită, depinzând esenţial de:

1) resursele financiare cu suport pentru schimbare, şi

2) programul concret care înfăţişează elementele precise de schimbare.

În practică se regăsesc circuite multiple de restructurare, dintre care cel de bază cuprinde în principal următoarele:

1) *Cercetarea situaţiei actuale a pieţei* stabilindu-se dacă produsele şi tehnologiile prezente se regăsesc în poziţii favorabile (fezabile);

2) *Diagnosticarea sistemului tehnologic actual* pentru obţinerea datelor de performanţă comparată şi evidenţierea stadiului atins de tehnologii în ciclul propriu de viaţă;

3) *Identificarea de noi cereri pe piaţă* vizând atât tehnologiile în sine (ca produse distincte) cât şi produsele ca rezultate ale procesului productiv;

4) *Identificarea resurselor financiare* pentru suportarea costurilor ce vizează schimbarea tehnologică;

5) *Achiziţionarea de tehnologii noi* care înlocuiesc sistemele prezente:

6) *Perfecţionarea managementului tehnologic* în concordanţă cu noile tehnologii pentru stăpânirea complexităţii acestora şi a paşilor productivi în fluxul tehnologic;

7) *Operaţionalizarea tehnologiilor noi* care constă în montarea, verificarea montajului, rodajul, exploatarea şi valorificarea funcţională a modulelor productiv-industriale;

8) *Obţinerea de noi produse* în concordanţă cu cele solicitate de piaţă (rezultatele examinării actualizate a pieţei);

9) *Satisfacerea noilor cerinţe ale pieţei.*

Se reţine că relaţia „tehnologie-produs-piaţă" joacă rol fundamental în decizia de restructurare.

Odată implementată, această relaţie semnifică îndeplinirea unei schimbări structurale industriale, prin retehnologizare, procesul derulându-se într-un prim circuit de bază.

4. Fluxul investiţional tehnologic uranifer

Scopul acestuia este atragerea de credite şi capital. În principiu, un sistem tehnologic uranifer complex, de mare dimensiune, nu oferă întotdeauna suficiente elemente de atracţie imediată pentru investitorii străini.

Strategic însă, atragerea de credite şi capital din străinătate – de exemplu pentru România – în vederea implementării sistemelor cu tehnologii nucleare moderne este esenţială în perspectiva compatibilizării economiei naţionale cu structurile productiv-tehnologice europene şi mondiale (a ţărilor dezvoltate).

Tactica adoptată prevede pornirea acţiunilor de implementare a capitalului de la următoarele premise:

• partenerul local nu are disponibilitate financiară (locală şi valutară);

• există interes (piaţă) în rândul partenerului local;

• partenerul străin (investitorul) de asemenea, se consideră că nu are disponi-bilităţi valutare; directe, imediate;

• există posibilitate tehnică, tehnologică şi managerială din partea investitorului străin (bonitare);

• se ţine seama că în prezent şi în viitor, în lumea economică se realizează într-o manieră tot mai restrânsă, operaţii cu capitalul prin vânzări şi cumpărări directe.

Având în vedere elementele de mai sus este posibilă crearea unei activităţi comune, reciproce pentru acţiuni de mişcare a creditelor, a capitalului străin şi autohton (figura.3). [9]

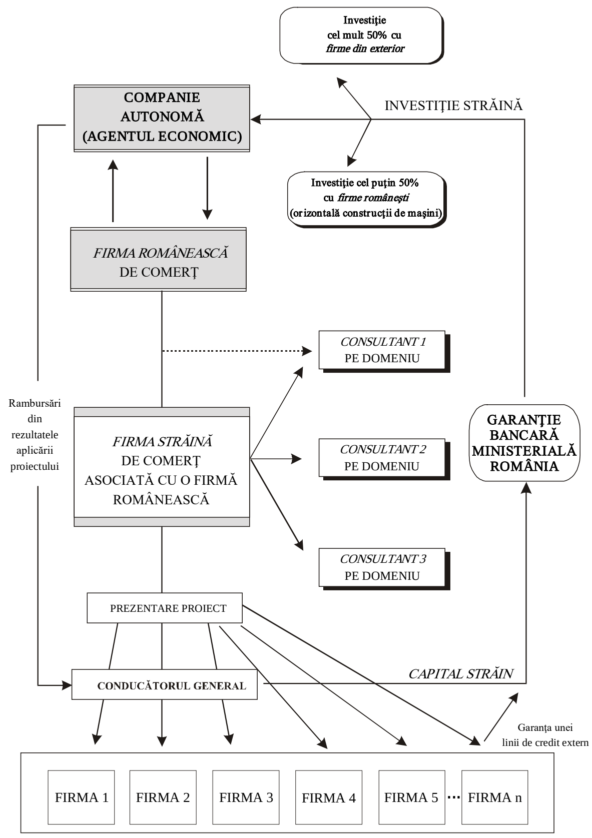

Figure 1: Figura:3. Desfăşurarea fluxului investiţional pentru tehnologii uranifere în vederea atragerii pentru investiţie a capitalului străin

Orice firmă, are în vedere continuarea analizelor cu firme străine pentru atragerea acestora în investiţii cu caracter tehnologic pornind de la baza de materii prime, de la existenţa unei infrastructuri de exploatare tehnologică şi mai ales de la existenţa sigură a pieţii interne de desfacere în ţară a diferitelor produse (figura.4). [9]

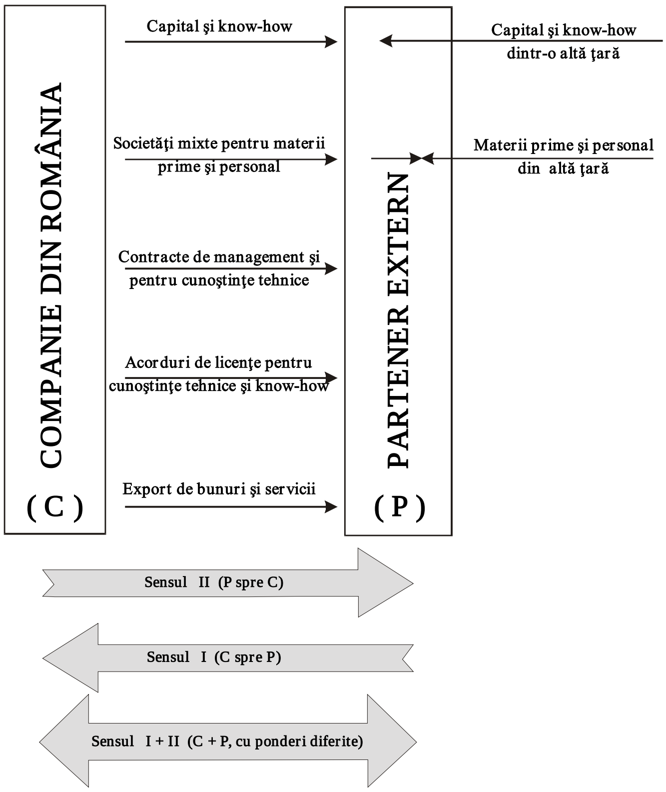

Figura: 4. Posibilităţi şi forme de afaceri cu tehnologii uranifere între firmele autohtone şi cele străine

Între partenerii autohtoni şi cei externi se pot institui activităţi şi formule organizatorice de acţiune comună, conjugată, cum sunt:

– schimb de capital şi know-how nuclear;

– societăţi mixte (joint-venture) pentru materii prime nucleare şi personal;

– contracte de management şi contracte de implementare a cunoştinţelor tehnice;

– acorduri cu licenţe pentru know-how nuclear;

– exporturi de bunuri şi servicii/energie nucleară.

Sensul derulării activităţilor poate fi unidirecţionat sau bidirecţionat.

Conducerea fluxului investiţional tehnologic nuclear nu este numai o colecţie de metode.

În mod obişnuit, în mediul economic sunt aplicate formule extrem de diversificate care să asigure la etapa considerată varianta ponderată maximă a afacerilor.Use this style for bulleting.

7. Concluzii

Tehnologiile nucleare fundamentale au ciclul de viaţă lung şi foarte lung, în schimb tehnologiile aplicative suferă schimbări rapide în conţinut şi destinaţie.

Dezvoltarea tehnologică vizează studierea semnificaţiilor de mai sus. Este identificat un ciclu al ciclurilor de viaţă tehnologică, atent urmărit de marile companii transnaţionale.

Apreciem că țările puternic dezvoltate sunt posesoare principale de tehnologii nucleare moderne fundamentale. Ele impun restricţii sau măsuri de protecţie fiind puternice distribuitoare a tehnologiilor moderne în concurenţa de pe piaţă.

Ţările mediu dezvoltate au acces la tehnologiile nucleare moderne înfăşurătoare, având capacitatea de preluare din mulţimea tehnologiilor fundamentale a liniilor de maximă operaţionalitate în concordanţă cu cerinţele pieţei.

Ţările în curs de dezvoltare sunt preponderent deţinătoare de tehnologii aplicative, a căror transpunere fizică rezultă din înlănţuirea (compunerea) operaţională a modulelor sau direct a maşinilor, echipamentelor, instalaţiilor ş.a.

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A SOLUTION FOR CARBON DIOXIDE STORAGE AND COAL BED METHANE BENEFICIATION IN JIU VALLEY COALFIELD

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Abstract:

The paper deals with a proposal of an integrated project for CO_2 storage coming from the coal burning power plants and a joint CH_4 (so called CBM) recovery and its valorization in energetic applications which will lead to a substantial reduction of the delivering price for the produced energy.

Coal deposits considered to be non-exploitable for technical or economic reasons are proven to be of major importance for the storage of CO_2 captured from industrial burning installations because coal is characterized by the existence of large volumes of micro-pores inside which are able to physically absorb various gases, one tone of coal containing even more than 25 m^3 of absorbed methane, and at the same time it being characterized by higher affinity for carbon dioxide gas than for methane.

Because the capture, processing and transport of carbon dioxide are technically resolved, the paper is focused mainly in the issue of storage, and the joint process of methane gas replacemet and its boosted delivery from coal seams. In both these processes, the main issue is the adsorbtion /desorbtion capability of the coal versus CO2 and CH4, on which basis the in place methane amount and the carbon dioxide storing capacity can be calculated.

The main outcome of the study is the proof of feasibility of this technology in the Jiu Valley coal basin, which will contribute to the revitalization of coal mining and energy production activity in the area.

Keywords: carbon dioxide, Greenhouse Gas, beneficiation, Jiu Valley

1 FOREWORD

Among the large range of clean coal technologies, the Carbon Capture and Storage **(CCS)** technology seems to be the most promising option, because of its high potential of reducing carbon dioxide emissions, coming from the fossil fuel burning. Apart from other emission mitigation technologies, the CCS can beneficiate from existing research results regarding capture, sequestration, liquefaction and transportation already demonstrated in pilot projects, proving its technical, technological and economic feasibility.

As the **Intergovernmental Panel on Climate Change** Special Report states, „Carbon dioxide (CO2) capture and storage (CCS) is a process consisting of the separation of CO2 from industrial and energy-related sources, transport to a storage location and long-term isolation from the atmosphere" is considered „as an option in the portfolio of mitigation actions for stabilization of atmospheric greenhouse gas concentrations". Nevertheless, at the moment they are a lot of unsolved financial, commercial, social and legal and also technical problems, related mainly on the storage issues, which may have a strong influence on the global implementation and development of this technology.

As a result of the coal mining downsizing in Jiul Valley coalfield, the extraction activity is concentrated only in the perimeters which allowed optimal geologic-mining conditions to apply mining methods leading to best economical results.

This downsizing of mining perimeters and the closure of non-performing mine plants led to the situation in which only 30% of reserves are considered in concessions, and only 5% are considered as industrial reserves.

The coal deposits considered to be non-exploitable by technical or economic reasons can be used as storage environments for large volumes of the captured carbon dioxide resulted from the burning in coal fired power plants, and, in plus, the injection of the carbon dioxide in the virgin coal seams can be used as a stimulant of the contained methane gas, which produces a double benefice: an environmental one, avoiding the emission of a GHG namely the methane, and an economic one, by using it as a secondary energy resource or raw material for chemical industry.

2. SEQUESTRATION OF CO_2 IN GEOLOGIC FORMATIONS

In order to be stored in geologic formations, the carbon dioxide must be compressed until the supercritical (liquid) state, which is maintained as is in depths over 800 m, as a result of the geothermal gradient and strata pressure joint action. As storage media, can be used exhausted gas and oil reservoirs, coal seams, and deep saline continental or off-shore aquifers.

The storage media must satisfy many criteria, among which the most important are: porosity, permeability and storage capacity; the presence of an impermeable rock overburden, or a catching structure which avoid the vertical migration of the sequestrated CO_2 ; location at a depth over 600 meters, where the strata pressure is high enough for maintaining the supercritical state of the dioxide, maximizing the storage capacity.

The un-exploitable coal seams represent appropriate storage media for CCS technology. The coal is characterized by the existence of a huge number of micro-pores in which different gases are absorbed or adsorbed physically, mainly methane, e.g. one ton of coal can contain about 25 m^3 of methane.

Meanwhile, the coal presents a higher affinity for the carbon dioxide than for the methane (figure 1), so the ratio of volumes absorbed in the coal matrix ($VolumeCO_2/VolumeCH_4$), can vary from 1 (the case of anthracite), until 10 or more for other sorts of coal.

While injecting carbon dioxide in coal seams the methane will be released, so by CCS the recovery rate of CBM can reach 90 % in comparison with the usual 50 % of CBM drainage.

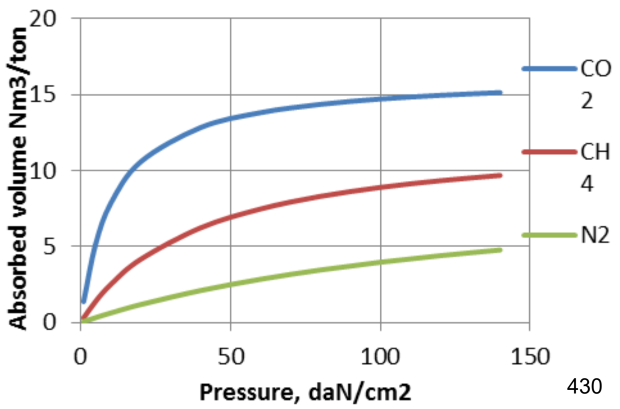


Fig.1 Absorbtion curves of diferent gases in

Only the virgin coal seams can be candidates for CCS but it must be avoided a possible future conflict between CCS and an eventual demand of mining out the coal seam considered.

3. POTENTIAL STORING CAPACITY ASSESSMENT

It exists many methods to establish the storing capacity, in general based on the content of gas in place, to be replaced with CO2, and the geometry of the reservoir (strata).

A method largely accepted in Canada, Australia and UK [2], is used for many type of reservoirs such as coal seams, exhausted oil/gas reservoirs, salt formations. For the non-exploited coal seams, which are interesting for our study, one determines the initial gas volume, IGIP (Initial Gas in Place) using the formula (1):

$$IGIP = A \cdot h \cdot \tilde{n}_c \cdot G_c \cdot (1 - f_a - f_m), \quad m^3 \tag{1}$$

Where:

A and h – surface, respectively the thickness of the seam (in m^2, respectively m);

n_c – coal density (in t/m^3);

G_c – gas content factor (m^3/t);

f_a and f_m – ash and respectively moisture content of the coal.

Nevertheless, while calculating the potential storage volume of a reservoir, one must distinguish between. In this respect, the theoretical volume is based on theoretical models and includes economically non-viable hypotheses, the effective volume take into account the technical and technological limitations and the particularities of the strata, and the real volume penalize the last one with economic restrictions.

4. DETERMINING THE CARBON DIOXIDE STORING CAPACITY IN COAL

In comparison with other storing media, e.g. exhausted oil/gas reservoirs, salt aquifers etc., for which the research is somewhat advanced enough, the research regarding the storage of CO_2 in coal seams is relatively recent, the results validating only partially the theoretical assumptions.

For the assessment of storing capacity of carbon dioxide in Jiul Valley's coal seams, we may use the results obtained till now regarding the methane absorption in hard-coal.

While in natural gas reservoirs where the methane under pressure fills the pores of host rock, in coal seams this is only in a small amount in free state in the rock's pores, the main part being physically adsorbed by Van der Waals bonds.

In coal seams, mainly in deep ones, the amount of trapped methane gas is about 30-60 m^3/t.

From point of view of the storage mechanism, at present three forms are accepted: ***free gas, physically or chemically bonded*** [3,5].

The quantity of free gas when the methane fills al the voids (pores, fractures, cleats) represents only 5 to 10 % of total gas content, depending on porosity, pressure and temperature.

The gas pressure may reach 30-40 bar, while the volume of pores able to store gas depending on pressure and moisture content vary from 0,01 to 0,11 m^3/t for coal and from 0,004 to 0,04 m^3/t for sandstone.

The largest share of gas in coal is stored in the form of physically or chemically bonded in adsorbed, absorbed and chemosorbed state reaching in many cases 90 % of total amount.

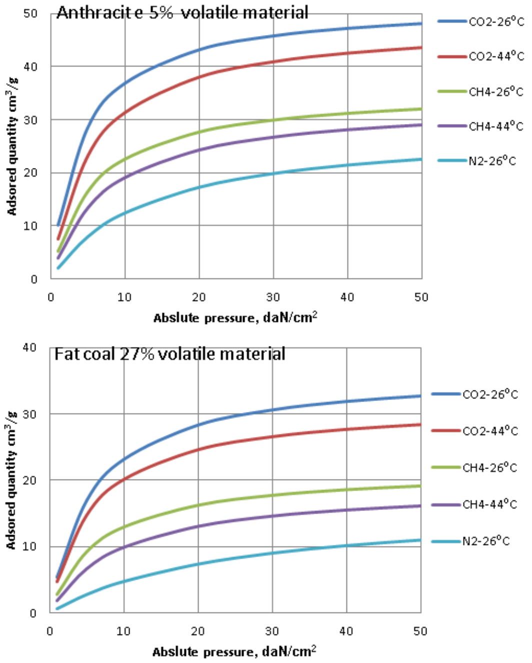


Fig. 2. Adsorption isotherms for dry coal as a function of pressure and volatile material content

In adsorbed state (in which we find about ¾ of total stored gas volume) the bond between gas molecules and the surface of solid matrix micro-pores walls is realized by the intermolecular attraction forces, called Van der Waals forces, and the gas is forming a thin layer around the coal molecules.

The most important aspect of this kind of bond is represented by its reversibility, the stored gas being easily released by the coal matrix facilitating its extraction.

In bonded state, the gas is present also in absorbed state, in which case, the molecules of gas penetrate among coal molecules, without chemically react with, forming a solid solution. The desorption of this quantity of gas is possible only if the coal is highly grinded.

In chemosorbed state, between the gas molecules and the coal molecules a chemical bond take place, and the release of the gas is possible only by special procedures, but because of the reduced share of the gas existing in this state (less than 3 %), it is not interesting in any aspect.

In order to have a correlation between the adsorption capacity of coal for methane and carbon dioxide, we can refer to the results of lab researches for these two gases as a function of volatile material content and absolute pressure (fig. 2).[3]

Analyzing the two graphs above, we can notice that:

- regardless the content of volatile materials, in the same conditions of pressure and temperature the adsorption capacity is 1.5 times greater for carbon dioxide than for methane;
- increasing content of volatile materials produces the decrease of the adsorption capacity regardless the type of gas in question.

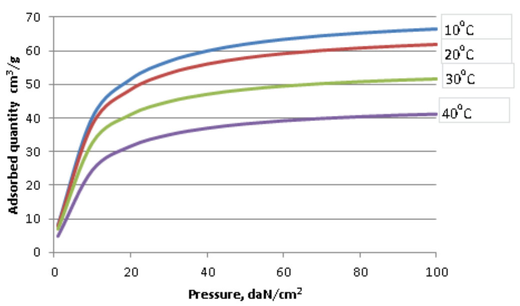


Fig. 3. Dependence of adsorbed gas volume on the pressure at different temperatures

The storing capacity, i.e. the adsorbed gas volume is dependent on pressure at a given temperature and can be described by the Langmuir's law [4] which states that when a gas is in contact with a solid an equilibrium state occurs between the gas and solid molecules, which is dependent on relative stability of the adsorbed (bonded) gas related to free state, the gas-solid system's temperature at the separation level and the pressure of the gas at same location.

The last two factors, i.e. the pressure and the temperature has contradictory effects, regardless the kind of gas, so we can increase the adsorbed volume by increasing the pressure and we can reduce it by increasing the temperature. (figure 3).

At a given temperature, the adsorption capacity depends on the pressure according to Langmuir's law, as in formula (2):

$$C_P = C_{P00} \frac{K_c P}{1 + K_c P} \tag{2}$$

In which:

- C_p – represents the adsorbed gas quantity (m^3/t);
- C_{P00} and K_c – coefficients depending on the nature of gas, temperature and the characteristics of the adsorbing surface;
- P – is the gas pressure (bar).

For this form of the Langmuir's law mathematical expression, the constants C_{P00} and K_c can be determined as a function of volatile material content, dependence which is presented in figures 4 and 5.

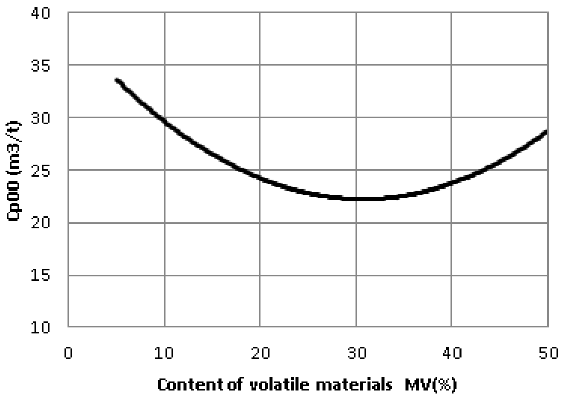


Fig. 4 Dependence of coefficient C_{P00} on the content of volatile materials

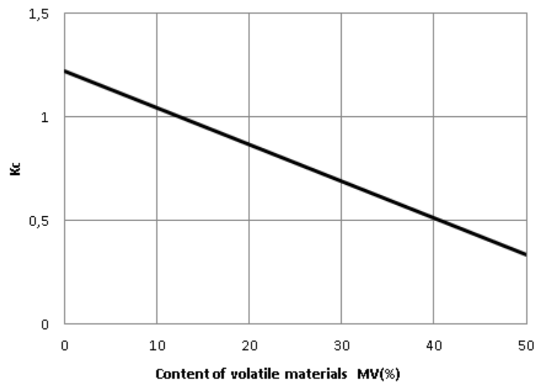
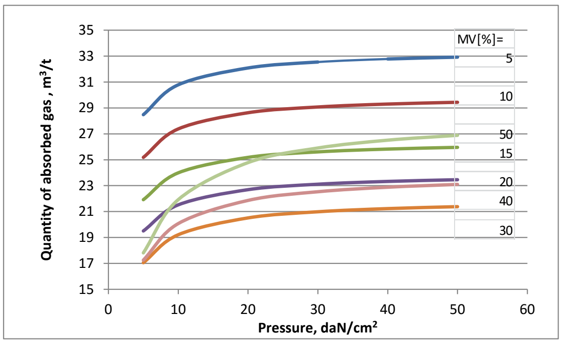


Fig. 5 Dependence of coefficient K_c on the content of volatile materials.

Apart from these two parameters, i.e. the pressure and the temperature, the researches revealed the existence of other parameters influencing the storing capacity, such as the nature of the gas, the content of volatile materials (the rank of coal), the petrographic composition of the coal, the moisture and the ash content.

Nature of the gas –from this point of view the coal presents a higher affinity for the carbon dioxide than for the methane or nitrogen (fig.2).

Content of volatile materials (rank of coal)- the minimal volume of adsorbed gas occurs when the content of volatile materials is in range of 20-40 %(fig.6 and 7) regardless the temperature and pressure.



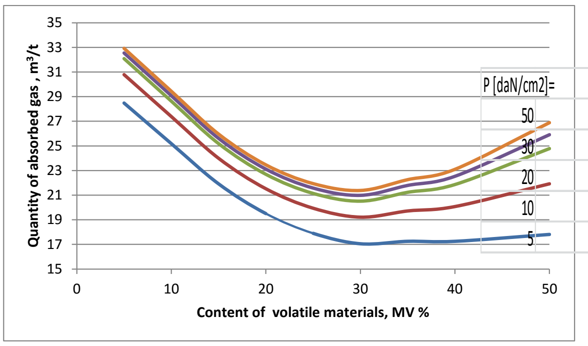


Fig. 6. Adsorption isotherms for coal at 30° C as function of pressure for volatile material content between 5% and 40 %

Fig. 7. Adsorption isotherms for coal at 30° C as function of volatile material content between 5% and 40% and pressure between 100 and 5000 kPa

Moisture content – the moisture content has an influence on the adsorption/desorption capacity of coal, in the sense of its decreasing with the increase of moisture content, this influence being illustrated in figure 8 ;

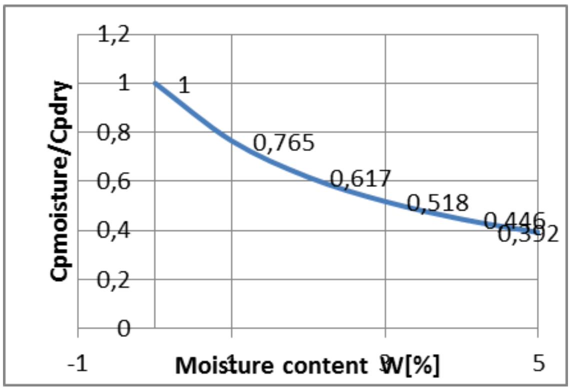


Fig. 8. The ratio wet/dry coal adsorption capacity

Ash content – ash content influence negatively the adsorption capacity, in the sense of its reduction with the ash content increase, because only organic material contributes to gas adsorption;

Petrographic composition – it influence the adsorption capacity, but it is difficult to be quantified, however it is known that higher exinite, resinite and fusite contents increases the adsorption capacity.

5. METHODS OF DETERMINING THE METHANE GAS CONTENT OF COAL SEAMS

Two category of methods are actually used for measuring or assessing the gas content of coal seams, as follows:

- direct methods, which are based on the measurement of the gas volume released by coal samples collected in sealed containers, in the process of forced desorption;
- indirect methods, based on empirical relations which correlates the storage capacity with sorption isotherms determined in laboratory.

While using direct method, the desorption is realized in special containers on coal samples as fresh as possible. During the desorption, the samples are maintained in the same temperature as in place, and the measured desorption rate allows the assessment of the initial quantity of gas in the sample. Periodically, the released gas is conducted to a measuring cylinder (figure 9) and eventually chemically analyzed. The remaining quantity of gas in the sample is determined after its grinding until the particle size is under 1 mm (usually 20 μm).

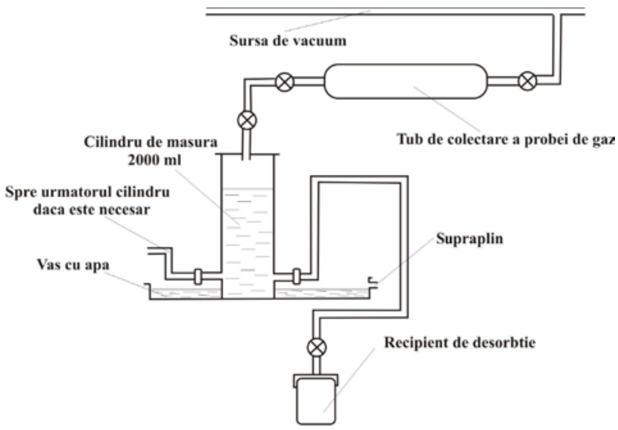


Fig. 9. Measuring equipment

The overall gas content is composed by many partial contents, which determination is made by different procedures. The gas lost during the sample collection (Q_1) is assessed from the free gas remaining in the container (Q_2), based on the necessary time for sample collection and container sealing, until the moment of measurement, period in which a quantity Q_2, has been released, and the quantity Q_3 is determined by collecting and measuring the gas released after grinding process.

In this way, the desorbed gas quantity from pure coal is given by the formula (3) :

$$Q = \left(\frac{Q_1 + Q_2}{M} + \frac{Q_3}{M^I} \right) \frac{1}{1 - 1.1c} \qquad [cm^3/g], \text{ or } [m^3/t] \tag{3}$$

In which:

M – mass of collected sample (g);

M^I – mass of grinded sample (g);

c – ash content (%)

In the case of lack of data related to the gas content of a coal seam, obtained by direct methods, which are difficult to be performed, we can use alternative methods, such as the method proposed by Kim [4], based on the analysis of adsorption capacity of different kinds of coal in seams located at different depths (figure 10).

In this respect, Kim proposes an empirical formula (4) in which the main parameters are the moisture content, volatile material content, the absorbed gas volume by the wet coal, the fixed carbon, seam thickness, and the temperature.

$$V = (100 - M - A)/100 \times [V_w / V_d]\,[K(P)^N - (b \times T)] \quad (4)$$

Where,

V - Volume of methane gas adsorbed (cm^3/g)

M - Moisture content (%)

A - Ash content (%)

$Vw/Vd = 1/(0.25 \times M + 1)$

Vw -Volume of gas adsorbed on wet coal (cm^3/g)

Vd - Volume of gas adsorbed on dry coal (cm^3/g)

The values of K and N depend on the rank of the coal and can be expressed in terms of ratio of fixed carbon (FC) to Volatile matter(VM)

$K = 0.8\,(F.C / V.M) + 5.6$

Where,

F.C - Fixed carbon (%)

VM - Volatile matter (%)

N -Composition of coal (for most bituminous coals, $N = (0.39 - 0.013 \times K)$)

b -Adsorption constant due to temperature change (cc/g/◦C).

$T = \text{Geothermal Gradient} \times (h/100) + T_o$

T - Temperature at given depth

To - Ground temperature

h - Depth (m)

For the case of Jiul Valley coal, the studies revealed that the gas volume which can be desorbed vary between 5 and 35 m^3/ton, the value depending on the location of the seam in the coalfield (western side having higher methane content), the depth of seam, the pressure and temperature in the sample collection point.

In these conditions, the carbon dioxide storing capacity in Jiu Valley's coal seams can be assessed based on the data related to the

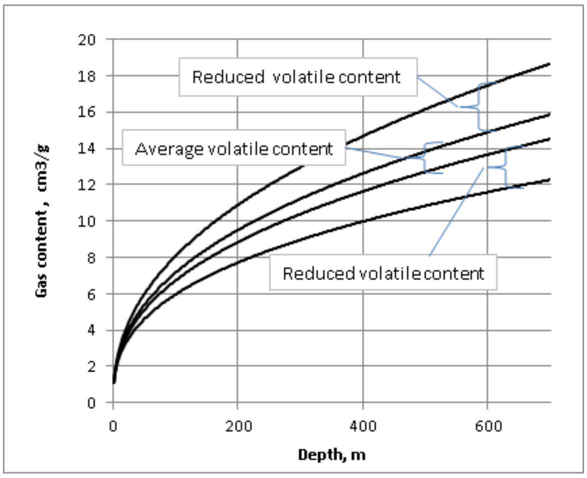


Fig. 10 Absorption capacity of gases in coal as a function of volatile material content and depth (according to Kim)

methane content using a multiplying factor of (1,5...2) /1 in the favor of CO_2. Using this approach, the theoretical storage capacity is assessed to 116.5 billion m^3 CO_2.

The determination of the real storage capacity implies complex laboratory and in situ studies, which allows the exact adsorption-desorption parameters for methane and carbon dioxide, for each relevant coal seam and for each perimeter supposed to be appropriate for CO_2 storage and performing injection drill tests for validating the laboratory tests. The main issue is to pay attention to both stages of the process, i.e. the CH_4 desorption and the CO_2 absorption.

6. EXTRACTION OF METHANE (CBM) BY CO_2 INJECTION IN JIUL VALLEY'S VIRGIN COAL SEAMS

The methane gas associated with virgin coal seams (CBM) represents valuable reserves of natural gas outside the conventional oil and gas producing reservoirs. It presents a lot of advantages, as follows: it is a clean energy resource, its extraction prior or simultaneously with coal mining avoids the release in the atmosphere of a GHG gas and loss of a valuable resource; beneficiation of CBM can increase the safety and profitability of coal mining.

In many cases, injection of CO_2 into a geologic formation can improve the recovery of hydrocarbons, adding value to the base products, which may compensate the costs involved by its capture and sequestration. On the other hand, the capture and sequestration of carbon dioxide contributes to reduce the emissions at the level of coal fired power plants.

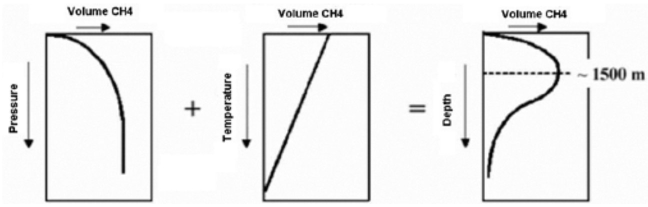


Fig. 11. The dependence of storage capacity on depth

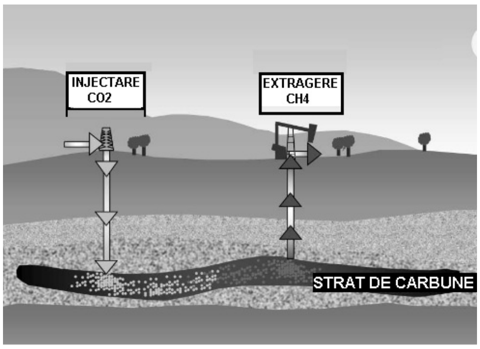


Fig. 12. Principle layout of the integrated system of carbon dioxide injection and methane recovery

The storage capacity, due to its dependence on temperature, pressure and rank of coal, reduced to the dependence on depth reveals an optimal depth as schematically shown in figure 11.

Taking into account all the available data and considering only the virgin seams in closed or under closure mining perimeters, we assessed the storing capacity of CO_2 at a minimal value of 114 Mt CO_2 .

This potential has been calculated for a minimal gas content of 5 m^3 CH_4/ t , and for the conversion to CO_2 a rate of 2 molecules of CO_2 adsorbed for one molecule of desorbed CH_4 (table 1).

In principle, the injection of carbon dioxide in coal seams integrated with CBM recovery implies to drill at least two wells from the ground to the coal seam, one for CO_2 injection and the second for methane recovery (figure 12).

Table 1 Storage potential of carbon dioxide in Jiul Valley's closed mining perimeters

Item \ coalfield	Lonea Pilier	Petrila Sud	Dâlja	Aninoasa	Bărbăteni	Câmpu lui Neag	Valea de Brazi	Total
Coal reserve (mil t)	125	80	160	100	130	65	100	750
Elevation ground level (m)	710	700	610	670	800	810	735	
Minimal depth of coal seams	-220	-350	-450	-200	-100		-50	
CBM estimate (mil m^3 CH4)	625	400	800	500	650	325	500	2800
CO2 storage potential estim. (Mt)	18,75	12	24	15	19,5	9,75	15	114

The release of methane from the coal matrix is based on the different affinity of coal, higher for CO_2 comparative with CH_4, the absorption capacity being 30 - 35 m^3CO_2/t at pressure over 5 - 8 MPa, one molecule of methane being replaced by 1,5 - 5 molecules of CO2, depending on available pressure.

This estimated capacity may be greater, if the methane content, or the absorption capacity will be higher in reality than those taken into consideration.

7. Conclusion

While the carbon dioxide from the coal fired power plants is responsible for about 80 % of the total amount of GHG emissions, it is evident that the first actions to be performed in view to reduce them is to be focused on this direction, mainly because the contribution of energy production sector in the total emissions is the most relevant.

From the point of view of CCS technology, it is demonstrated that the underground geologic structures are the most appropriate, due both to accumulated knowledge, high storing capacity and safety.

This possibility is relevant for the unexploited coal seams in Jiul Valley coalfield, taking into account that the main beneficiary of the mined out coal, the Paroseni power plant, is located in the middle of the coal basin, so the maximal distance from the source to the storing location is less than 20 km.

In plus, the implementation of an integrated project CCS – CBM will pay back the involved costs, by increasing the efficiency of the Energy Producing Complex.

While the capture, processing and transport of carbon dioxide are well studied, the storage in coal seams is a subject of specificity of different coal basins, and in this respect, the actual paper deals mainly with the aspects related to storage (sequestration), focusing on the storage capacity and the factors which influence it.

Future research is to be performed to acquire more knowledge in view to highlight some detail aspects, mainly related to the carbon dioxide absorption and methane release, being aware that the classical CBM recovery attempts in the Jiul Valley coalfield were unsuccessful because the low permeability of the coal.

This first estimation of the storing capacity for carbon dioxide based on the assessment of total methane content of coal seams, based on available theoretical approaches and experimental data is promising to continue the research in this issue.

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CERCETĂRI PRIVIND CREŞTEREA FERTILITĂŢII SOLURILOR TEHNOGENE. STUDIU DE CAZ

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1 Rezumat

The present paper enrols to the actual general tendency-on the European Union-to identify and implement of some measures and solutions to increase the performance of the ecological rehabilitation activities made in the areas affected by the mining activities. In this respect is the implemented experiment in the environment rehabilitation works of the Valea de Brazi Mine, Hunedoara County, of which location was chosen due to the shortened distance due to the deposit.Mainly, the experiment consists in ensuring the soil necessary for the emplacement of the no.8 pit with a quantity equal to 720 m^3 of old waste resulted from lumbering. Now, on the experimented surface it is observed a very good rise rate which concludes that this solution may be generalised in all the areas that disposes of similar deposits.

Introducere

Datorită particularităţilor sale specifice, activitatea de extracţie a substanţelor minerale utile din subteranul exploatărilor miniere sau din cariere are o influenţă negativă asupra mediului înconjurător acestora, prin crearea unor depozite de material steril rezultat de la executarea lucrărilor miniere de deschidere, din claubarea producţiei extrase sau din descopertă.

Acest material steril, denumit sol tehnogen, creează o serie de probleme atunci când se intenţionează reabilitarea ecologică a terenurilor afectate de către exploatarea minieră, după încetarea activităţii extractive din zonă. În termeni ecologici, se consideră că un ecosistem este afectat de către o activitate antropică, atunci când este depăşită capacitatea sa de regenerare naturală.

Partea experimentală

Oportunitatea de a experimenta o soluţie de fertilizare a solului tehnogen s-a creat odată cu demararea lucrărilor de închidere şi ecologizare a minei Valea de Brazi, situată în vestul bazinului carbonifer Valea Jiului.

Lucrările de reabilitare ecologică a suprafeţei se desfăşoară în prezent în cele două incinte miniere care au asigurat utilităţile necesare în subteranul minei, în perioada de activitate a acesteia, şi anume în incinta principală şi în incinta puţului de aeraj nr. 8.

În principal, reabilitarea ecologică a acestor incinte constă din dezafectarea-demolarea clădirilor care şi-au pierdut utilitatea şi care nu au fost solicitate pentru altă destinaţie de către comunitatea locală, cât şi ecologizarea terenului eliberat, prin executarea următoarelor activităţi principale: curăţirea terenului de materialele neacceptate, nivelarea acestuia cu mijloace mecanizate acolo unde este necesar, aplicarea substanţelor fertilizatoare, însămânţarea terenului şi plantarea de puieţi pe zonele înclinate, în special pe taluzurile haldei de steril.

Incinta minieră de la puţul de aeraj nr. 8 a dispus de o haldă de steril, care a fost amenajată conform soluţiilor tehnice cuprinse în proiectul tehnic aferent. Acţiunea de haldare a sterilului a început în anul 1987 şi s-a încheiat în anul 1994, când mina a intrat în faza de conservare/închidere. Halda ocupă o suprafaţă de 0,3 ha şi are un volum de cca. 4000 m^3. Din punct de vedere geografic, halda se încadrează între pârâurile Bilugu la vest şi Şurii la est, la altitudinea de 760 m.

Pentru evaluarea impactului haldei asupra factorilor de mediu locali, au fost prelevate probe de material de la o adâncime de 0 ÷20 cm. Acestea au fost adunate într-o probă mixtă (amestecată), iar de aici s-a extras prin ciuruire o cantitate de cca. 2 kg de material, cu o granulaţie mai mică de 20 mm. Acest material a fost analizat fizico-chimic, rezultatele încadrându-se în valorile maxime admise de către normele în vigoare.

Probele de sol martor luate din zonă au indicat un necesar de humus de 5 ÷ 10 % în zonele amenajate. Suplinirea acestui procent s-a încercat a se realiza cu o cantitate de 150 ÷ 300 m^3 compost la hectar. Acest compost, format pe cale naturală, are o vechime de aproximativ 40 ani şi a fost identificat într-un depozit de rumeguş din localitatea Buta, situată de cca. 8 km de halda de steril de la puţul de aeraj nr 8 Valea de Brazi. În acest depozit nu au mai existat depuneri de material de peste 10 ani. În acest interval de timp, rumeguşul rezultat de la prelucrarea lemnului în zonă s-a compostat pe cale naturală, nemaiprezentând pericolul de reacţie acidă. Acest fapt a eliminat necesitatea neutralizării compostului cu amendamente de calcar.

În prealabil implementării experimentului „in situ”, au fost determinate proprietăţile compostului menţionat în laboratorul Universităţii Petroşani. Au fost utilizate seminţe de plante cu o creştere rapidă (iarbă), semănate într-un amestec format din compostul studiat, amestecat atât cu materialul de haldă cât şi cu pământ normal, în proporţii volumice de 25, 50, 75 şi 100 %.

După trecerea a 7 zile şi apoi după 28 de zile s-au determinat o serie de parametri, care au fost comparaţi cu cei din proba 100 % pământ normal: desfăşurarea încălzirii, lungimea mlădiţei, greutatea probei proaspete, greutatea probei uscate şi greutatea cenuşii. Cu ajutorul acestei metode a putut fi stabilită influenţa diferitelor amestecuri de compost, durata de fermentare a compostului şi care este amestecul optim pentru dezvoltarea plantelor.

Foto 1 Dezvoltare iarbă în compost provenit de la Buta (7 zile de la însămânţare)

Foto 2 Dezvoltare iarbă în sol tehnogen provenit de la Valea de Brazi (7 zile de la însămânţare)

Foto 3 Dezvoltare iarbă în compost provenit de la Buta (28 zile de la însămânţare)

Foto 4 Dezvoltare iarbă în compost provenit de la Valea de Brazi (28 zile de la însămânţare)

Pe suprafaţa haldei de steril, amenajată din punct de vedere morfologic au fost executate următoarele lucrări pregătitoare:

-aplicarea pe suprafaţa amenajată a unui adaos de îngrăşăminte chimice complexe tip NPK: 540 kg îngrăşământ 15 : 15 : 15/ha;

-acoperirea suprafeţei haldei cu un strat de compost cu grosimea de 3 ÷ 5 cm;

-însămânţarea stratului de compost cu un amestec de iarbă 60 % şi trifoi 40 %, în cantitate de 400 kg/ha; însămânţarea s-a făcut în douî reprize, pe direcţii perpendiculare, astfel încât să se asigure o împrăştiere cât mai bună a seminţelor;

-greblarea solului pentru încorporarea seminţelor; adâncimea optimă de însămânţare a fost stabilită la 1 cm;

-irigarea solului s-a făcut cu stropi mici, pentru a se evita spălarea seminţelor şi a compostului;

-în lipsa precipitaţiilor stropirile au fost făcute o dată la trei zile, dimineaţa şi seara.

Ca şi în cazul experienţelor efectuate în condiţii de laborator, şi refacerea solului tehnogen al haldei de la puţul de aeraj nr. 8 a dat rezultate excelente. Conţinutul de humus, extrem de mic iniţial, a fost ridicat până la valori de 10÷25 % din valoarea existentă în zonele neafectate, prin adaos de compost. Implicit s-a înregistrat o creştere a capacităţii de schimb a solului. În prezent, procentul de răsărire pe suprafaţa ecologizată a haldei este foarte bun după cum se prezintă în imaginile următoare:




Foto 5 Halda de steril Valea de Brazi după reconstrucţia ecologică (28 de zile de la însământare)

Prin adaosul de îngrăşăminte chimice de tip NPK, conţinutul de elemente nutritive ale solului a fost ridicat la valori de 25÷50 % faţă de cel al solurilor neafectate existente în zonă.

Structura covorului vegetal rezultat în urma reconstrucţiei ecologice diferă de cea existentă în zonele neafectate, datorită predominanţei plantelor erbacee şi a trifoiului, cu sistem radicular foarte dezvoltat, eficient pentru soluri sărace.

Prin măsurile luate în cadrul lucrărilor de reabilitate ecologică, s-a iniţiat procesul de refacere a solului, care are posibilitatea să se autoîntreţină. Pentru a se evita întreruperea acestui proces este recomandabilă interzicerea păşunatului şi a circulaţiei localnicilor pe terenul ecologizat pentru o perioadă de cel puţin 2 ani.

În conformitate cu procedurile din domeniu aflate în vigoare în prezent, executantul lucrărilor de ecologizare de la halda puţului de aeraj nr. 8 are obligaţia de a monitoriza suprafaţa reconstruită ecologic pe o perioadă de 2 ani, care constituie garanţia de bună executare.

În zonele unde au loc lucrări de închidere şi ecologizare a unor obiective miniere care şi-au încetat activitatea extractivă şi unde există unităţi de prelucrare a lemnului situate la o distanţă rezonabilă se poate realiza compostul necesar pentru îmbunătăţirea calităţii solurilor tehnogene după metoda descrisă în continuare.

Pentru a obţine un compost de bună calitate, este necesară utilizarea unui amestec de materiale bogate în carbon (paie, rumeguş, turbă, carton, frunze de tei, de fag şi stejar), cu unele care au conţinut crescut de azot (resturi de legume, sânge uscat, gunoi de grajd, etc.), astfel încât să se asigure o bună permeabilitate.

În obţinerea compostului, o importanţă deosebită trebuie să se acorde gradului de umiditate a amestecului, cât şi unei bune aerări a compostului. Aerarea depinde atât de conţinutul de apă al structurii cât şi de structura şi dimensiunea materialelor utilizate. În acest caz este necesară amestecarea atentă a materialelor cu dimensiuni si structuri diverse, pentru a asigura o porozitate optimă.

În cazul unui amestec de dimensiuni mari, o aerare bună se asigură prin utilizarea unor tuburi groase de drenaj plasate vertical, la o distanţă de cca, 1,5 m, în centrul amestecului. Compostarea se mai poate realiza în silozuri, pe platforme tradiţionale sau pe secţiuni amenajate în aer liber.

Platforma reprezintă cea mai practică structură utilizată la obţinerea compostului nefiind necesară nicio construcţie specială, materialul compostat depozitându-se direct pe pământ sub formă de piramidă. Faţă de compostarea în siloz platforma necesită mai mult spaţiu, însă procesul de fermentare este mai eficient, deoarece adăugarea de material proaspăt se face lateral, fără a se perturba procesul de descompunere.

Odată adunat materialul necesar pentru realizarea unei platforme, se poate iniţia stratificarea acestuia, executând o amestecare atentă a diferitelor substanţe.

Primul strat se constituie dintr-un material mai grosier (ramuri şi alte materiale reziduale, rezultate în urma curăţatului pomilor), care va avea rolul unui grătar natural, pentru scurgerea apei în exces. Apoi urmează un strat de material mai fin şi un strat de pământ bine umectat, care după adăugarea gunoiului de grajd şi de compost maturizat, asigură amestecului încărcătura microbiană necesară procesului,

Se continuă în această ordine, alternând straturile de material organic (pământ amestecat cu substanţe animale şi vegetale bine umectate) cu gunoiul de grajd şi compostul bine maturat, ajungându-se la înălţimea dorită, după care platforma se acoperă cu paie, fân şi cu un strat de cca. 5 cm de argilă fină.

Durata procesului de compostare depinde de climă, de materialele utilizate şi de aranjarea corectă a platformei, în general fiind necesare cca. 6 luni. Compostul este considerat matur atunci când s-a transformat într-un amestec de pământ sfărâmicios, de culoare brun-închisă, cu un miros plăcut, neînţepător, fără insecte sau râme.

Forma şi dimensiunile platformei trebuie să fie alese în aşa fel încât să favorizeze procesele de fermentaţie aerobică ce stau la baza procesului de compostare.

În general, platforma nu depăşeşte 2 m lăţime şi 1,8÷2 m înălţime, lungimea stabilindu-se în funcţie de cantitatea de material compostat. Amplasarea trebuie să se facă într-un loc umbros, direct pe pământ. În plus, în funcţie de necesităţi, se adaugă elemente nutritive, în aşa fel încât să se corecteze eventualele carenţe ale solului.

Fabricarea compostului este procedeul prin care deşeurile menajere din bucătărie şi curte sunt transformate într-un compus bogat în nutrienţi. Prin reîntoarcerea nutrienţilor în sol, compostul reduce necesarul de fertilizatori chimici scumpi. Deşeurile de natură organică pot constitui până la 40 % din deşeurile menajere.

În vederea obţinerii unei putreziri optime şi a unui compost de calitate bună, este important să se macine materiile organice mari şi dure (de exemplu tăieturi de copaci) şi să se amestece cu substanţe organice mai fine, menajere sau din grădină. Astfel se asigură condiţii mai bune de viaţă pentru microorganismele care descompun şi transformă grămada de compost.

Procesul de compostare poate continua şi în perioada de iarnă, însă într-un ritm mai redus.

După ce s-a ales amplasamentul platformei, trebuie să se îndepărteze vegetaţia de pe aceea suprafaţă de teren şi să se afâneze zona. În acest fel, se va înlesni migrarea viermilor şi a altor animale mici care vor descompune deşeurile organice. Pe de altă parte, lichidul ce se scurge din grămadă şi apa de ploaie se evacuează mai uşor în sol, împiedicând stagnarea umidităţii la baza grămezii de compost.

Materiale acceptate pentru amestec:

-materiale verzi, bogate în azot, pâine, boabe de cafea, hârtie de filtru de cafea, coji de ouă, frunze aciculare ale plantelor verzi, flori, coji şi resturi de legume, iarbă, plante de casă, frunze, pliculeţe de ceai sau frunze de ceai, buruieni (înaintea formării seminţelor);

-materiale brune bogate în carbon, păr, scame, bălegar, grămezi de frunze uscate, paste, orez;

-rumeguş (lemn netratat);

-hârtie ruptă, ziare, cutii de carton, hârtie de împachetat;

-paie, fân;

-aşchii de lemn;

Materiale neacceptate: oase, cărbune, tăieturi de iarbă tratată chimic, cenuşă de cărbune, materie contaminată, produse lactate, plante bolnave sau infectate de insecte, grăsimi, alimenta grase, uleioase, resturi de peşte, sticlă, nămol, carne, metal, plastic, produse sanitare, coji de nucă, buruieni cu seminţe mature.

Concluzii finale

Utilizarea materialului compostat pe cale naturală în depozitele vechi de rumeguş de lemn sau create în mod special pe platformele descrise anterior, cât mai aproape de zona de punere în operă, are o acţiune semnificativă asupra solurilor tehnogene, rezultate de la activităţile desfăşurate de către exploatările miniere. Conţinutul de humus, extrem de mic iniţial, a fost ridicat până la valori de 10÷25 % din valoarea existentă în zonele neafectate, în paralel cu creşterea capacităţii de schimb a solului.

Structura covorului vegetal rezultat în urma reconstrucţiei ecologice diferă de cea existentă în zonele neafectate, datorită predominanţei plantelor erbacee şi a trifoiului, cu sistem radicular foarte dezvoltat, eficient pentru solurile sărace. Totuşi, din punct de vedere peisagistic, zonele reabilitate se încadrează foarte bine în peisajul autohton.

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DETERMINATION ON THE BASIS OF EXPERIMENTAL MEASUREMENTS OF THE EQUATIONS GOVERNING THE OPERATION CENTRIFUGAL PUMP ASSEMBLY - NETWORK IN ORDER TO SIMULATE OPERATING CONDITIONS ENCOUNTERED IN PRACTICE

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Abstract:
The paper aligns current global concerns regarding energy sustainability, focusing on issues of operational sustainability of water pumping system. After an overview of the current situation sectoral regulations and international, national and local issues of concern highlighted in this background is developed in an approach multidisciplinary research that integrates conceptual approaches, methodological and basic tools of the machines and networks hydraulics, energetics industrial installations in the spirit of ISO 50001 energetics management and sustainable development. The energetics system for the installation of a pumping groundwater mining, identification and analysis of major components, energy flows and performance of this system is the core of the article.

Keywords: turbo pumps, electric pumps, pump systems, hydraulic network, energy efficiency, sustainable use of water pumping systems.

1. Introduction

Methodological instruments used mainly include operational tools in sustainable water pumping systems and methods for quantifying the performance of energetics systems (energetics analysis methods / exergetic, economic and quantify the environmental impact). On these bases diagnoses the current state of the system are simulated operating conditions and establish areas of operation corresponding to a performance indicator aggregate energy cost, economic cost and the environmental cost, identifying measures / solutions to improve ahead, compatible with sustainable development.

2. Theoretical consideration

The pumping station, pumping aggregates ensures the circulation of water in the basin volume suction consumers who are connected to the network.

Figure 1 is the general case of a pump operating in a facility. The circulation of the fluid between the suction tank RA and the discharge RR is provided by the pump P through the suction tube draws CA and discharges through the discharge pipe CR. Additional gauges of pressure were positioned in the suction nozzle (1) and the discharge (2).

The flow rate of the fluid that is circulated by a pump units can be expressed by: the volumetric flow rate discharged, Q1 (m3 / s, m3 / h, L / s), the volumetric flow rate sucked Q2 (m3 / s, m3 / h, l / s), volume flow nominal Qn (m3 / s, m3 / h, l / s), volume flow optimally Qopt (m3 / s, m3 / h, l / s), maximum flow and minimum Qmax, Qmin .

The load of pump or pumping the total height H (m) is useful mechanical work submitted by the impeller to fluid or increase energy pumped fluid passage through paragraphs (1) and (2)

fig.1.

Power Pump is mechanical work of the pump in unit time consumed in order to circulate flow.

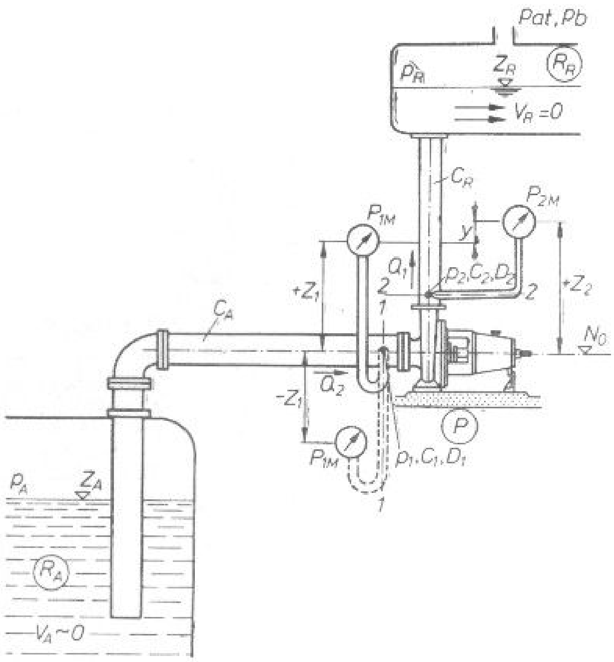

Fig.1. The operation of a pump in an installation

The unit of time, due to losses occurring in pumps ($\Delta P=\gamma\Delta Q\cdot\Delta H$) to achieve output power Pu, the pump must obtain a higher input power $P_p=\gamma\cdot Q\cdot H/\eta_p$, η_p –at the shaft - is the overall efficiency of the pump.

Speed and direction of rotation of the pumps. They are driven by electric motors in general, resulting from the relationship speed: $n = k\dfrac{60\cdot f}{p}(rot/\min)$

where f is frequency of the current in the network; k - the coefficient of sliding depending on the type of the motor (synchronous motors k = 1, and asynchronous motors 1<k); p - number of pole pairs of the motor.

3. Experimental results

Based on experimental measurements correlated with the performance specified in the leaflets pumps were established significant parameters summarized in Tables 1 and 2. I built with the utility EXCEL graphs of variation of significant parameters and I determined the equations of the curves corresponding results (Figures 2, 3 and 4).

Based on experimental measurements, correlated with information from literature and the available documentation, using the model previously described for analysis of electro LOTRU 100 yielded significant results regarding:

- The variation of pump parameters analzyed depending on time (fig.5.);
- Operating point network movement depending on the variable speed (fig.6.);
- Percentage change of characteristic parameters for varying speed (fig.7.);
- Percentage change in specific energy consumption depending on the method of adjustment (fig.8.);

Table 1. Characteristics experimentally determined

Pump flow rate - Q [mc/h]	0	5	10	15	20	25	30	35	40
Load of pump - Hp [m]	47.5	49	47.5	45	42.5	39	35	29	22.5
Load of Network - Hr [m] **speed control**	10	12	14	17	21	28	35	42	
Pump efficiency- etaP [%]	0	25	42	55	61	64	63.8	60	53
Pump efficiency+motor - etaP+M [%]	0	20	37	47	52	56	55.6	52	46
Power pump - Pp [kW]	2	2.5	2.8	3.1	3.8	4.1	4.22	4.5	4.8
Motor power - Pm [kW]	2.9	3.4	3.7	4	4.7	5	5.12	5.3	5.6
Load of Network - Hr + Hv [m] **adjustament tub**	20.4	22.5	24.2	26.5	30.1	34.5	42.7		

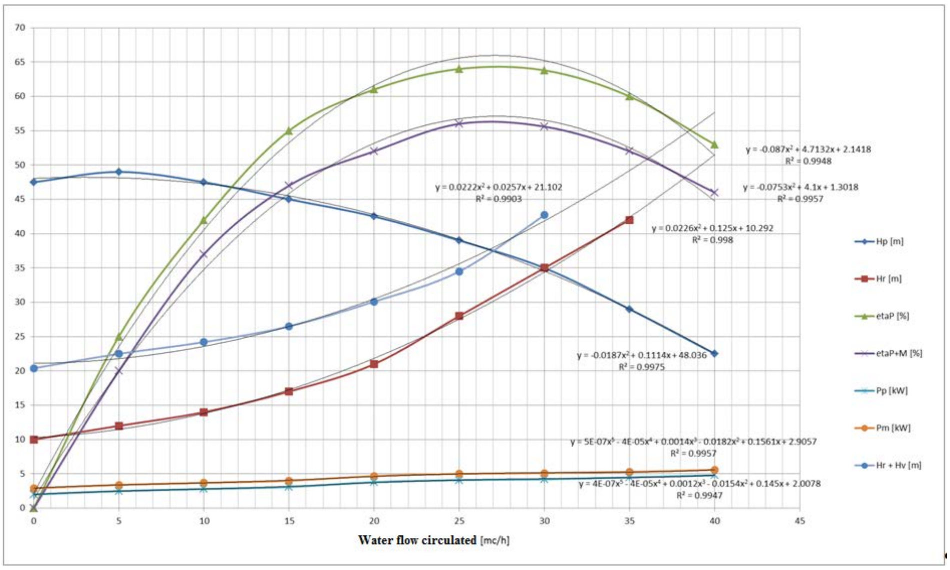

Fig.2. Trendline equation for pump and network characteristics

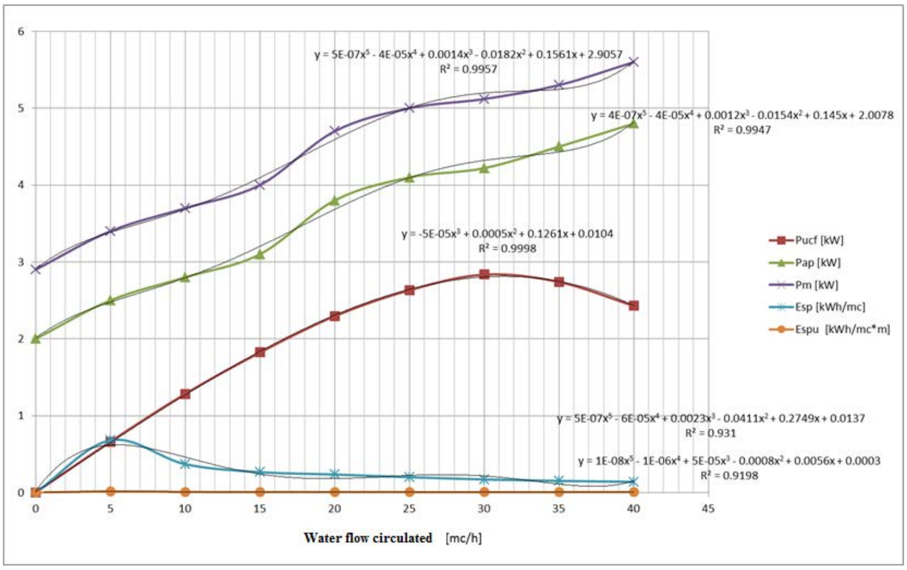

Fig.3. Trendline equations for energetics characteristics of the pump

Tabel nr.2. Characteristics energetics experimentally determined

Pump flow-Q [mc/h]	0	5	10	15	20	25	30	35	40
Load of Network - Hp [m]	47.5	49	47.5	45	42.5	39	35	29	22.5
The power output of stream water - Pucf [kW]	0	0.6615	1.2825	1.8225	2.295	2.6325	2.835	2.7405	2.43
Power at the pump shaft - Pap [kW]	2	2.5	2.8	3.1	3.8	4.1	4.22	4.5	4.8
Electrical motor power - Pm [kW]	2.9	3.4	3.7	4	4.7	5	5.12	5.3	5.6
Specific energy - Esp [kWh/mc]	0	0.68	0.37	0.266667	0.235	0.2	0.170667	0.151429	0.14
Specific energy util-Espu [kWh/mc*m]	0	0.013878	0.007789	0.005926	0.005529	0.005128	0.004876	0.005222	0.006222

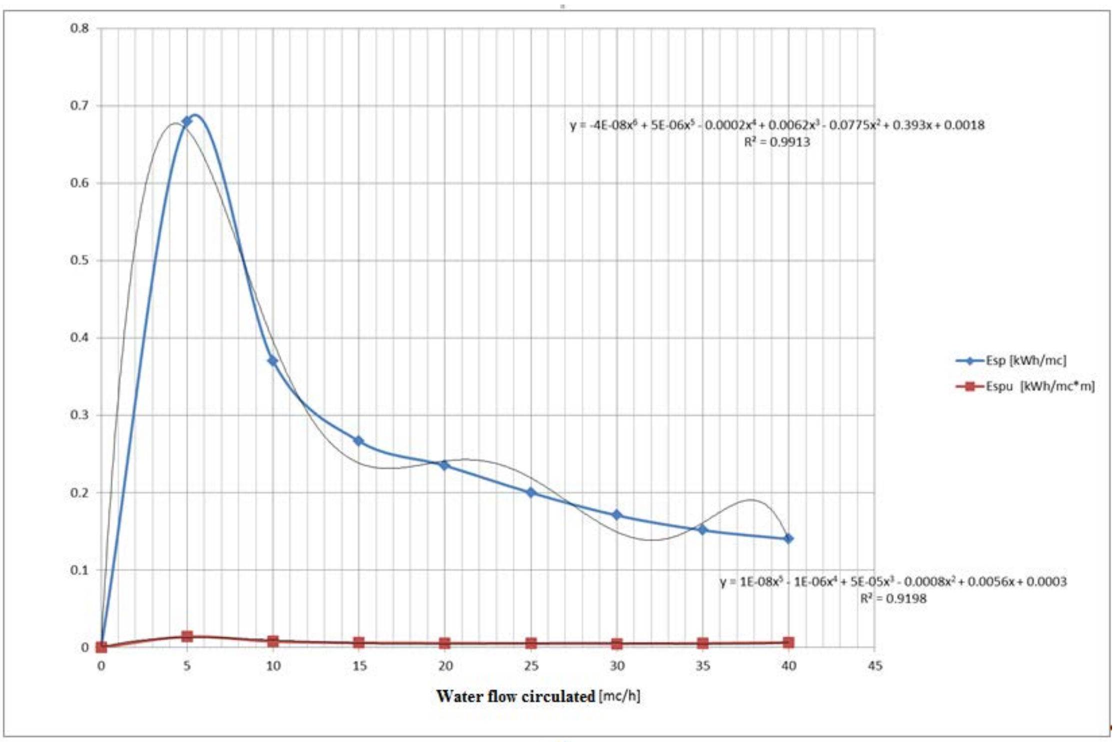

Fig. 4. Trendline equations to specific energies, using a refined model regression

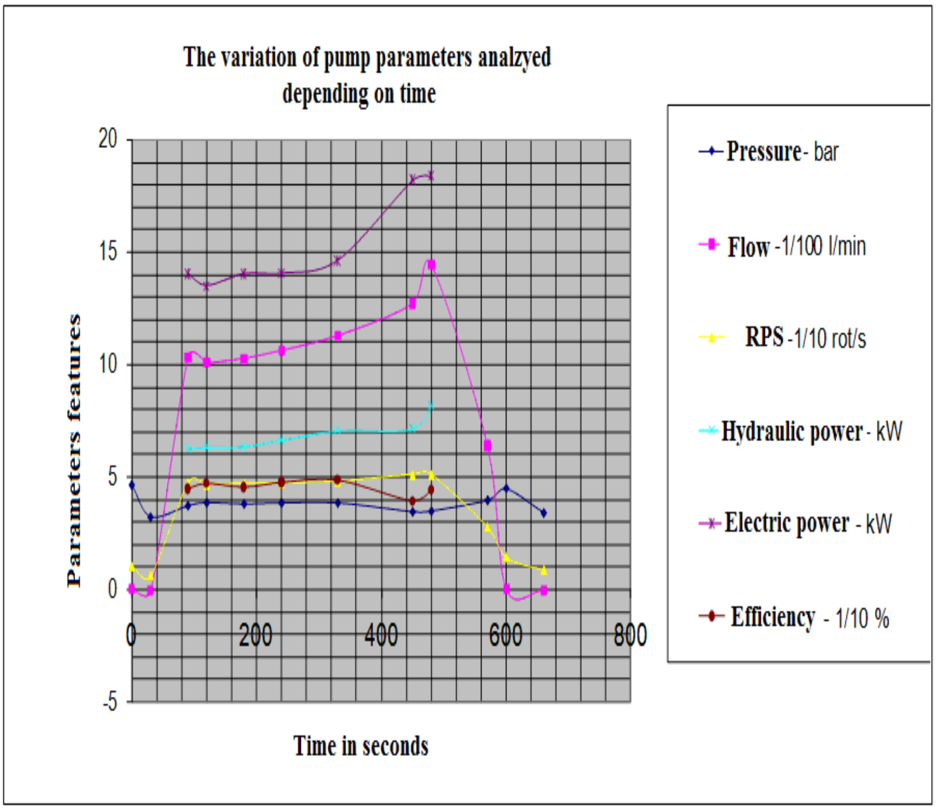

Fig.5. The variation of pump parameters analzyed depending on time

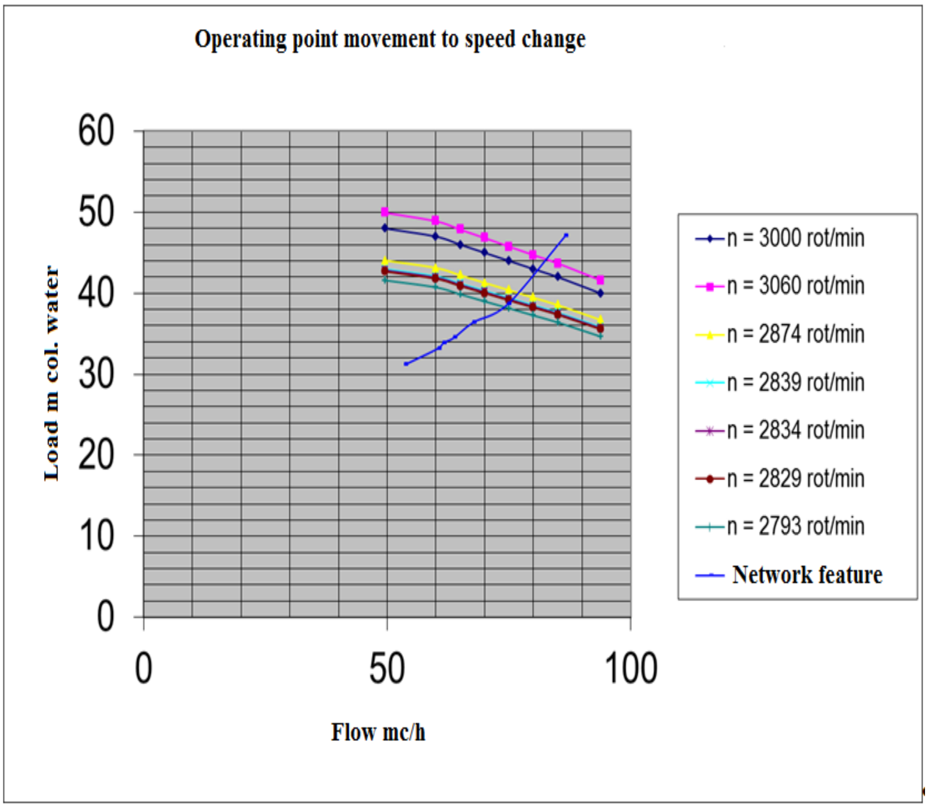

Fig.6. Operating point network movement depending on the variable speed

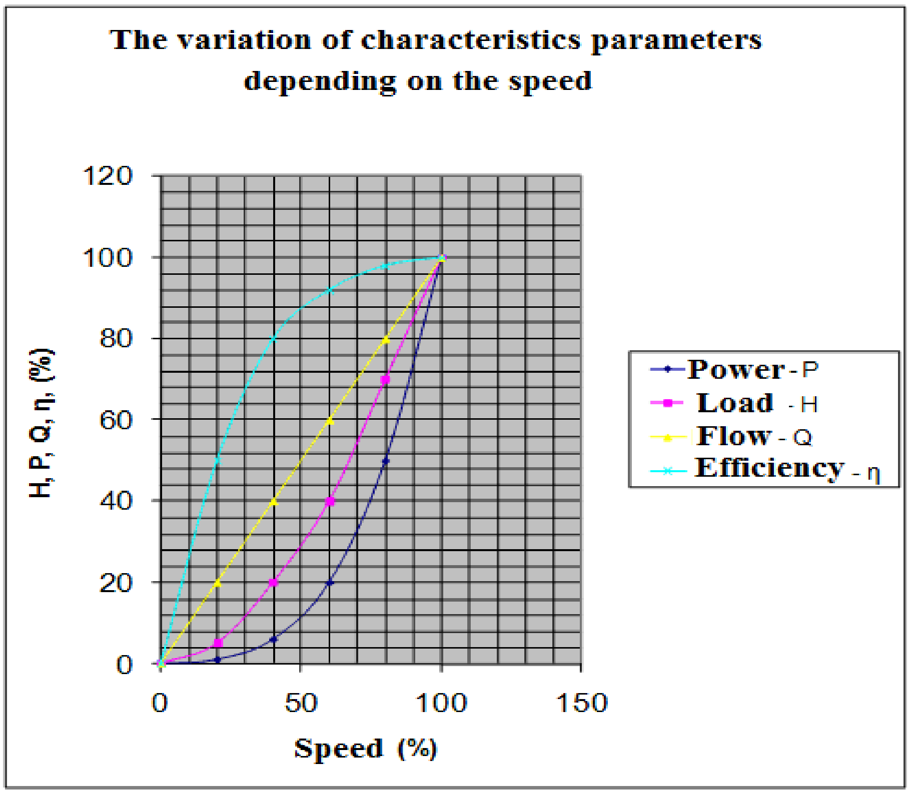

Fig.7. Percentage change of characteristic parameters for varyingin specific energy consumption

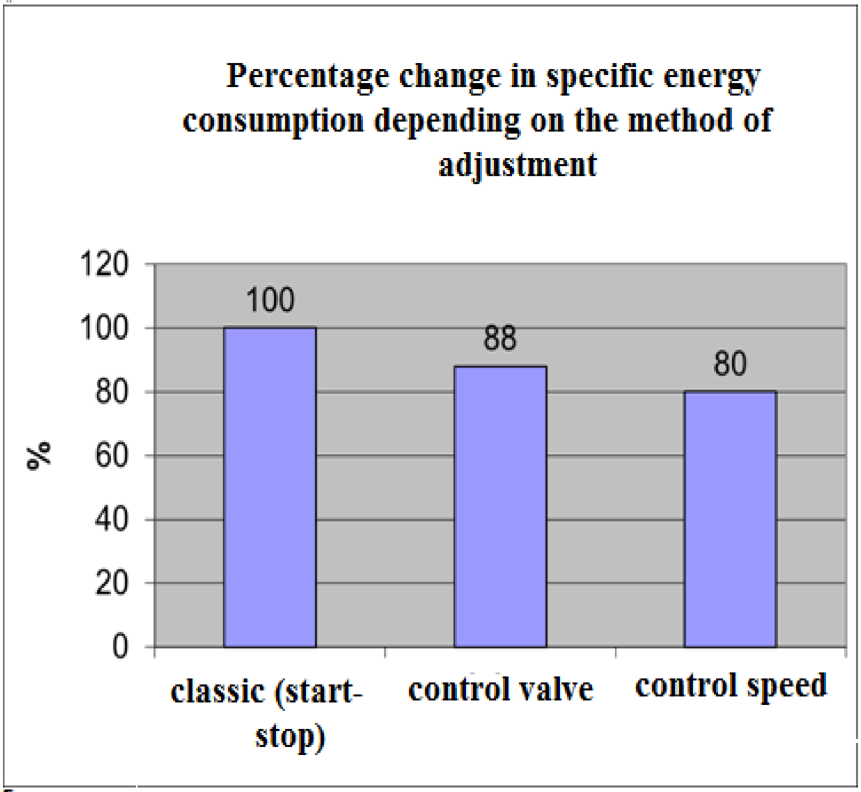

Fig.8. Percentage change speeddepending on the method of adjustment

4. Conclusions

It analyzed aggregate flow adjustment in pump systems with the following methods described in detail:

• changing pump performance curves (internal control);

• changing characteristics of installations (external adjustment);

adaptation of different working groups pumps (in series or parallel operation working pumps).

It drew charts variations versus time of characteristic parameters electropump, moving the operating point to the network for varying speed, the percentage change in the characteristic parameters for varying speed and the percentage change in specific energy consumption depending on the method of adjustment.

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SELECT THE ELECTRICAL APPARATUS FOR USE IN EXPLOSIVE GAS ATMOSPHERES FROM DETERMINING REABILITY

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Abstract:

Where electrical apparatus is to be installed in areas where flammable gases may be present in the atmosphere, protective measures are applied in order to reduce the likelihood of explosion due to ignition by arcs, sparks or hot surfaces, produced either in normal operation or under specified fault conditions.

1 TERMS AND DEFINITIONS

explosive atmosphere

- mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour, mist or dust, in which after ignition, combustion spreads throughout the unconsumed mixture group (of an electrical apparatus for explosive atmospheres)

- classification of electrical apparatus related to the explosive atmosphere for which it is to be used

Electrical apparatus for use in explosive gas atmospheres is divided into two groups:

– group I: electrical apparatus for mines susceptible to firedamp;

– group II: (which can be divided into subgroups): electrical apparatus for places with an explosive gas atmosphere, other than mines susceptible to firedamp

– group III: (which can be divided into subgroups): electrical apparatus for use in places with an explosive dust atmosphere, other than mines susceptible to firedamp

maximum surface temperature

- highest temperature which is attained in service under the most adverse operating conditions (but within recognized tolerances) by any part or surface of the electrical apparatus, which would be able to produce an ignition of the surrounding explosive atmosphere

The most adverse conditions include recognized overloads and fault conditions recognized in the specific standard for the type of protection concerned.

The relevant surface temperature may be internal and/or external depending upon the type of protection concerned.

type of protection

- specific measures applied to electrical apparatus to avoid ignition of a surrounding explosive atmosphere

flameproof enclosure “d”

- type of protection in which the parts which can ignite an explosive atmosphere are placed in an enclosure which can withstand the pressure developed during an internal explosion of an explosive mixture and which prevents the transmission of the explosion to the explosive atmosphere surrounding the enclosure

increased safety “e”

- type of protection applied to electrical apparatus in which additional measures are applied so as to give increased security against the possibility of excessive temperatures and of the occurrence of arcs and sparks in normal service or under specified abnormal condition

intrinsic safety “i”

- type of protection based upon the restriction of electrical energy within apparatus and of interconnecting wiring exposed to an explosive atmosphere to a level below that which can cause ignition by either sparking or heating effects

pressurization “p”

- technique of guarding against the ingress of the external atmosphere into an enclosure by maintaining a protective gas therein at a pressure above that of the external atmosphere

encapsulation “m”

- type of protection in which the parts which could ignite an explosive atmosphere by either sparking or heating are enclosed in a compound in such a way that this explosive atmosphere cannot be ignited

oil immersion “o”

- type of protection in which the electrical apparatus or parts of the electrical apparatus are immersed in a protective liquid in such a way that an explosive atmosphere which may be above the liquid or outside the enclosure cannot be ignited powder filling “q”

- type of protection in which the parts capable of igniting an explosive atmosphere are fixed in position and completely surrounded by filling material to prevent the ignition of an internal explosive atmosphere

type of protection “n”

- type of protection applied to electrical apparatus such that, in normal operation and in certain specified abnormal conditions, it is not capable of igniting a surrounding explosive atmosphere

2 REQUIREMENTS FOR SELECTING THE ELECTRICAL APPARATUS FOR USE IN EXPLOSIVE GAS ATMOSPHERES

Electrical installations in hazardous areas shall also comply with the appropriate requirements for installations in non-hazardous areas. However the requirements for non-hazardous areas may be insufficient for installations in hazardous areas.

Electrical apparatus and materials should be installed and used within their electrical ratings for power, voltage, current, frequency, duty and such other characteristics where non-conformity might jeopardize the safety of the installation. In particular, care should be taken to ensure that the voltage and frequency are appropriate to the supply system in which the apparatus is used and that the temperature classification has been established for the correct voltage, frequency, etc.

In order to facilitate the selection of appropriate electrical apparatus and the design of suitable electrical installations, hazardous areas are divided into zones 0, 1 and 2 according to EN 60079-10.

Electrical apparatus should, as far as is reasonably practicable, be located in non-hazardous areas. Where it is not possible to do this, it should be located in the least hazardous area practicable.

All electrical apparatus and wiring in hazardous areas shall be selected and installed in accordance with CEI 60079-14 and the additional requirements for the particular type of protection.

Apparatus shall be installed in accordance with its documentation. Care should be taken to ensure that replaceable items, such as lamps, are of the correct type and rating. On completion of the erection, initial inspection of the apparatus and installation shall be carried out in accordance with EN 60079-17.

Assurance of conformity of apparatus is made by using certified apparatus to provide the necessary assurance that apparatus meets the requirements of the appropriate standard.

In order to select the appropriate electrical apparatus for hazardous areas, the following information is required:

– classification of the hazardous area;

– temperature class or ignition temperature of the gas or vapour involved;

– where applicable, gas or vapour classification in relation to the group or subgroup of the electrical apparatus;

Of the types of protection listed in EN 60079-0, the apparatus subgroup is only required for protection types “d” (flameproof enclosures) and “i” (intrinsic safety). The apparatus subgroup is also required for certain apparatus with protection types “n”, “e” or “o” (oil immersion).

– external influences and ambient temperature.

Selection according to Ex classified zones

Apparatus for use in zone 0

Electrical apparatus and circuits can be used in zone 0 if they are in accordance with EN 60079-11 (intrinsic safety “ia”), EN 60079-18 (encapsulation "ma") and with the requirements from EN 60079-26.

Apparatus for use in zone 1

Electrical apparatus can be used in zone 1 if it is constructed in accordance with the requirements for zone 0 or one or more of the following types of protection

Flameproof enclosures “d” according to EN 60079-1

Pressurized enclosures “px” or "py" according to EN 60079-2

Powder filling “q” according to EN 60079-5

Oil immersion “o” according to EN 60079-6

Increased safety “e” according to EN 60079-7

Intrinsic safety “ib” according to EN 60079-11

Encapsulation “mb” according to EN 60079-18

Apparatus for use in zone 2

The following electrical apparatus may be installed in zone 2:

electrical apparatus for zone 0 or zone 1; or

electrical apparatus designed specifically for zone 2 (for example type of protection “n” according to EN 60079-15, pressurized apparatus "pz", intrinsic safety "ic", encapsulation "mc"), or

c) electrical apparatus complying with the requirements of a recognized standard for industrial electrical apparatus which does not, in normal operation, have ignition-capable hot surfaces; and

1) does not, in normal operation, produce arcs or sparks, or

2) in normal operation produces arcs or sparks but the values, of the electrical parameters (U, I, L and C) in the circuit (including the cables) do not exceed the values specified in EN 60079-11 with a safety factor of unity.

The assessment shall be in accordance with the specification for energy limited apparatus and circuits given in EN 60079-15.

Selection according to the ignition temperature of the gas or vapour

The electrical apparatus shall be so selected that its maximum surface temperature will not reach the ignition temperature of any gas or vapour which may be present.

Symbols for the temperature classes which may be marked on the electrical apparatus have the meaning indicated in table 1.

Table 1 – Relationship between the temperature classes, surface temperatures and ignition temperature

Temperature class of electrical apparatus	Maximum surface temperature of electrical apparatus °C	Ignition temperature of gas or vapour °C
T1	450	>450
T2	300	>300
T3	200	>200
T4	135	>135
T5	100	>100
T6	85	>85

If the marking of the electrical apparatus does not include an ambient temperature range, the apparatus shall be used only within the temperature range –20°C to +40°C.

If the marking of the electrical apparatus includes an ambient temperature range, the apparatus shall only be used within this range.

Selection according to apparatus grouping

Electrical apparatus of types of protection “e”, “m”, “p” and “q” shall be of apparatus group II.

There are nevertheless occasions when some of these types of protection, which are normally of apparatus group II, can be allocated within subgroups IIA or IIB (to accommodate discharge of stored energy, static electricity, etc.).

Electrical apparatus of types of protection “d” and “i” shall be of apparatus group IIA, IIB or IIC and selected in accordance with table 2.

Electrical apparatus of type of protection “n” shall normally be of apparatus group II but, if it contains enclosed break devices, non-incentive components or energy limited apparatus or circuits, then the apparatus shall be group IIA, IIB or IIC and selected in accordance with table 2.

Electrical apparatus of type of protection “o” shall be of apparatus group IIA, IIB or IIC for certain apparatus and selected in accordance with table 2.

Table 2 – Relationship between gas/vapour subdivision and apparatus subgroup

Gas/vapour subdivision	Apparatus subgroup
IIA	IIA, IIB or IIC
IIB	IIB or IIC
IIC	IIC

3 External influences

Electrical apparatus shall be selected and installed so that it is protected against external influences (e.g. chemical, mechanical, vibrational, thermal, electrical and humidity) which could adversely affect the explosion protection.

Precautions shall be taken to prevent foreign bodies falling vertically into the ventilation openings of vertical rotating electrical machines.

The integrity of electrical apparatus may be affected if it is operated under temperature or pressure conditions outside those for which the apparatus has been constructed. In these circumstances, further advice should be sought.

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Study on the accuracy of volume determination using interpolation methods

Lăsconi Adrian Constantin

Keywords: Interpolation methods, digital terrain model (DTM), volume calculation, surface modeling.

Three-dimensional representation of the topographic surface resulted from land surveys, involves using a mathematical algorithm that generates in a precise way the measured land forms. Since we cannot determine the spatial position (XYZ) of each surface point using measurements, we must use an interpolation method and uniform distribution of the existing points. Using a computerized three dimensional representation we can generate a digital terrain model. The digital terrain model (DTM) is a three-dimensional digital representation of the terrain, which uses the *x* and *y* coordinates and the elevation z. The resulting model is a mathematical approximation of the topographic surface. Digital terrain models can be used in volume calculation, contours representation and it is used in several Geographic Information Systems (GIS) applications that requires a spatial representation of the topographic surface.

The present study aims to determine the volume of geometric solids, whose mathematical formula is known, and then compared with the volumes resulted by using computer interpolation methods using the Surfer software. Interpolation methods are included in the program and the most used are: ''Triangulation with linear interpolation'', ''Natural Neighbor'', ''Inverse distance'', ''Kriging Method''.

After determining volumes through computerized method with all the interpolation methods listed, a comparison between them and the mathematical volumes obtain with known formula will be made. The method that will achieve the more appropriate result to those obtained using the mathematical formula, will be declared the most accurate and the most recommended for volumes calculation.

This interpolation method can be used for volumes calculation resulting from surveying: stocks, excavations, but also to display the terrain surface in a close three dimensional representation.

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JIU VALLEY IN THE SUSTAINABLE DEVELOPMENT

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Abstract

Jiu Valley, a mono-industrial area, where mining was the main activity of the inhabitants , underwent many transformations in recent years. Restructuring the mining industry, the large number of layoffs has led to rapid increase in unemployment and decline in living standards of the inhabitants of Petrosani Depression .

In these circumstances, from the local authorities have identified tourism development as a complementary activity / alternative to local economy.

Keywords : mountain environment , tourism , mining, unemployment

1 INTRODUCTION

In the south of Hunedoara county, in a triangle proved to be golden , on the border between Transylvania, Banat and the Romanian Country, lies an area known generically under denu - groom " Jiu Valley " and geographi-cally that " Petrosani Depression " region that has earned the reputation as the " Land of black Diamond " (fig. nr. 1.).

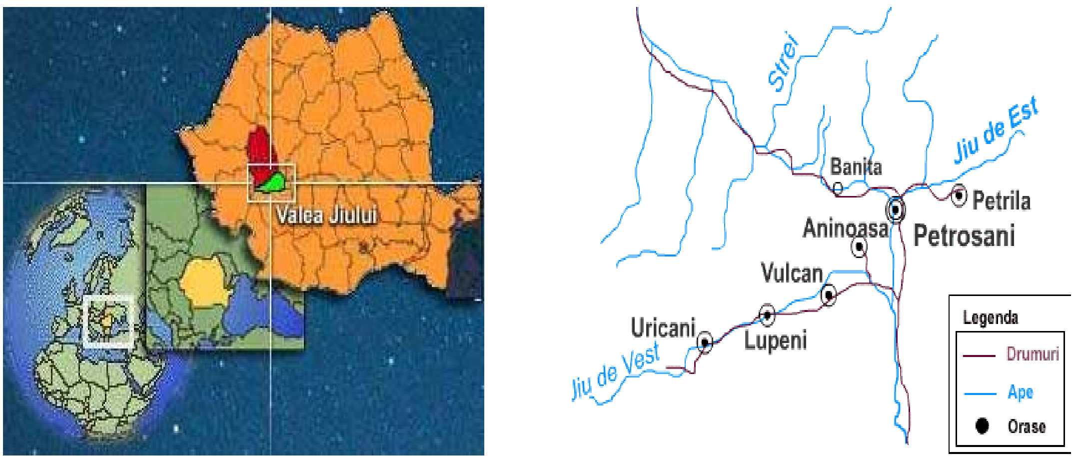

Fig. no. 1. Valea Jiului location and map

2 REASON

Jiu Valley - a region made up of three municipalities: Petrosani,Lupeni, Vulcan and three cities : Petrila, Uricani, alder, with a

total population of 120 734 inhabitants, the main economic activity was the coal mining industry in the years after 1990 suffered transformations in economic, social and demographic changes resulting from the restructuring of this activity sector.

Besides mining sector restructuring , the reference faced available - saw and activities related to mining or provide services to the mining sector, which has led to diponibilizări from these activities, leading to a high rate of unemployment in the area.

The main effects of restructuring were felt in particular by rising une-mployment and generated by this decline in living standards of residents .

So the level of June 2015 CEA Hunedoara have registered a total of 3825 track of your unemployed in the Jiu Valley , that which represents an une-mployment rate of around 3.17 % (fig. nr. 2.).

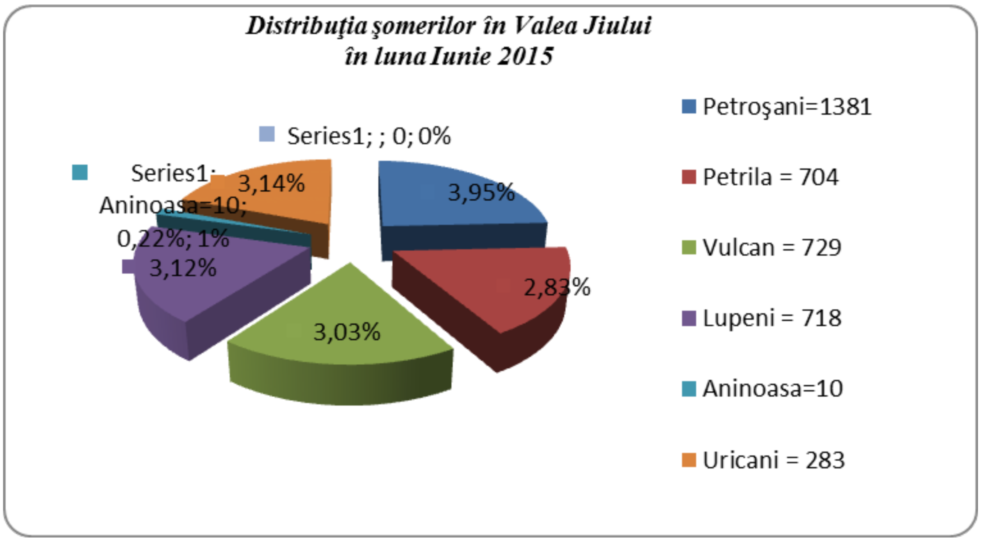

Fig. no. 2 Distribution of unemployed in the Jiu Valley in the month of June 2015

In addition to official figures , representing the unemployed receiving monthly allowance , there is the reality of everyday reflected in the image of more than 8,000 people who are looking for a job, they nefigurând on no evidence and therefore without income monthly guaranteed that which is a percentage of between 6.5 - 8 % of the Jiu Valley .

Side effects will be even higher as the treatment of active and passive unemployment measures is poor.

In these circumstances, local authorities assigned to this area, identi-fied the complex mountain environment as complementary / alternative to zonal economy

Geographical breakdowns , environmental componennte mountainous area of interest , showing the average complexity , structure and value for tourism, weave between them and the cultural and historical potential ,as-pects and contrasts landscape varied and attractive crests that are based valleys crossed by rivers interesting and leisure opportunities , the dense network of communication routes that allow access to all targets of interest as well as tourist centers , recommends the mountain environment in the area Jiu Valley as a good absorber of redundant mining labor , and not only as a weapon in the fight against unemployment.

The main strengths of the Jiu Valley are :

- a natural mountain environment - still generous and well wooded with a rich biodiversity;
- mountainous rural population dynamic and healthy with a good percentage of youth still agricultural , adapted - the key to development ;
- economic and cultural traditions are partial preserved;
- minor degree chemicalization in mountain agriculture and agri-food quality, ecological type .
- All these factors , coupled with positive implications of ecotourism such as :
- support agricultural occupations , those crafts , food and leisure travelers ;
- better exploitation of agricultural products that can be made directly available to tourists ;
- raising living standards for the rural population ;
- local population stability by diversifying the use of labor potential;
- It recommends the Jiu Valley , the area conducive best practice in terms of ecotourism .
- Highlighting the potential of natural , cultural , economic and human resources are the subject of complex programs designed longterm , in support of sustainable development.
- Conduct programs at the regional level, by which to follow:
- conducting training courses;
- granting allowances for the unemployed falling before the expiry of unemployment;
- hiring unemployed over 45 or single breadwinners of the family;
- new graduates of educational institutions;
- creating new jobs through lending to small and medium enterprises;
- provision of consultancy and assistance to start self-employment or starting a business;
- temporary employment of labor in public works of community interest;
- related to the following priority axes and areas of intervention (Table . 1):

Table 1 Portofolio projects and identifyingfunding sources

Nr. crt.	Project title	Value (euro)	Source of funding		
			Operational Program	Priority Axis	Area of intervention
0	1	2	3	4	5
1	Realization of road infrastructure Babii.-Merişor	10.000.000	Regional Operational Programme	Priority 2 : Improvement of regional and local transport	2.1 . Rehabilitation and modernization of county roads and urban streets , construction / rehabilitation of ring roads

0	1	2	3	4	5
2	Modernization DJ 664Vulcan-county limit GJ	2.000.000	Regional Operational Programme	Priority 2 : Improvement of regional and local transport	2.1 . Rehabilitation and modernization of county roads and urban streets , construction / rehabilitation of ring roads
3	Modernization area Pasul Vulcan	20.000.000	Regional Operational Programme	Priority 5 : Sustainable development and promotion of tourism	5.2. Creation, development, modernization of tourism infrastructure for the exploitation of natural resources and increasing tourism services
4	Rehabilitation of DJ 709 F and area road infrastructure Parâng	4.484.000	Regional Operational Programme	Priority 2 : Improvement of regional and local transport	2.1 . Rehabilitation and modernization of county roads and urban streets , construction / rehabilitation of ring roads
5	Rehabilitation neighboring roads, alleys and city streets (Uricani)	6.000.000	Regional Operational Programme	Priority 2 : Improvement of regional and local transport	2.1 . Rehabilitation and modernization of county roads and urban streets , construction / rehabilitation of ring roads
6	Realization and development of rural tourism infrastructure in the Campusel - Sârba	16.000.000	Regional Operational Programme	Priority 5 : Sustainable development and promotion of tourism	5.2. Creation, development, modernization of tourism infrastructure for the exploitation of natural resources and increasing tourism services

0	1	2	3	4	5
7	Infrastructure for sustainable tourism in the tourist area Parang (Petrosani	10.556.000	Program Operaţional Sectorial de Mediu	Priority 1 Expansion and modernization of water and wastewater	Expansion and modernization of water and wastewater
8	Rehabilitation tourist resort Straja, landscaping recreation area and access routes Braita	3.000.000	Regional Operational Programme	Priority 5 : Sustainable development and promotion of tourism	5.2. Creation, development, modernization of tourism infrastructure for the exploitation of natural resources and increasing tourism services

- Priority Axis 1 - Human Resources Development

- *Area of Intervention 1.1.- Adaptation of the working population in the region, the new requirements of the business,* materialized by:
    - implementation of programs / retraining in occupations needed for new economic sectors developed in the region;
    - adapting curricula of secondary and higher education to the new vision of development of the area;
    - development of civic responsibility and involvement in projects run by government, at the local level;
    - training and management skills ;

- Priority Axis 3 – Infrastructure development in the region
    - *Area of Intervention 3.1. Transport infrastructure,* materialized by:
    - completion road – Câmpu lui Neag - Herculane;
    - rehabilitation of the access road to DN 7A Petrosani – Voineasa;
    - restoring the old way " of poştalioanelor " linking Haţeg Depression and Depression Petrosani through Merişor – Dealul Babii - Vulcan ;
    - further modernize roads, alleys and sidewalks;
    - *Area of Intervention 3.2. – Branches of utilities,* materialized by:
    - preparation of feasibility studies for the development of projects of development of the various utility branches;
    - modernisation of street lighting systems;
    - improving living conditions by restoring housing and utilities;

- Priority Axis 4 – Development of the area as a national and regional tourist attraction
    - *Area of Intervention 4.1. – Recovery tourism potential*, materialized by:
    - rehabilitation access road infrastructure to tourist attractions in the Jiu Valley;
    - development of an amusement park, theme in the Jiu Valley;

- rehabilitation existing accommodation facilities and arrangement new ones at a quality level as high as possible;
- arrangement and expanding areas suitable for winter sports: ski slopes, lift facilities for people installing equipment for lighting at night, in winter;
- arangement a rural area-specific view practice agritourism ;

- Area of Intervention 4.2. – Insurance and travel services competitive materialized by:
- formation professional workforce to ensure specific services;
- encouraging tourism companies to obtain quality certificates;
- arrangement new mountain refuges;
- capitalization crafted creation through tourism, crafts, folk archi-tecture and folk manifestations zone;
- Area of Intervention 4.3 – Activities to promote the area, materialized by:
- to promote a positive image of the Jiu Valley, to attract tourists, tour operators and investment;
- realization billboards, flyers, catalogs main attractions at the Jiu Valley;
- arrangement a thematic tourist route with an emphasis on traditio-nal recipes, crafts and craftsmen
- development tourist information centers and maintaining a website of the Jiu Valley region as a means to promote tourism;

- Priority Axis 5 – Environmental protection

- *Area of Intervention 5.1* – Solving environmental sector materialized by:
- integrated waste management (collection, transport, storage and recycling) at regional level;
- sustainable economic -development logging;
- ecological rehabilitation land in areas affected by intense economic activity ;

- and accessing funding sources for the development of projects viable and will result in the Depression as the Jiu Valley area favorable economic development by replacing dependence region of the mining industry.

3 CONCLUSION

Ecotourism as economic and social activity must become a component of sustainable tourism in the mountain, the 10 principles for sustainable tourism development can be applied in this case:

- ✓ sustainable use of tourism resources (optimal exploitation, conservation, protection);
- ✓ reducing the consumption and wastage of interest;
- ✓ preserving the diversity of natural, cultural and social development of rural areas;
- ✓ integrating tourism in national development planning and strategy, regional and local especially (general infrastructure development and technical - municipal)

- ✓ involvement of local communities in the tourism sector by supporting the initiative groups for developing and supporting local supply, protecting the environment and cultural assets;
- ✓ specialists and public consultation in the development of tourism and the local economy to avoid conflicts of interest between government policy and the local tourism entrepreneurs and population;
- ✓ sustainable development of tourism should be maintained through training, skills development, training civic appropriate sociological and ecological;
- ✓ promoting ecotourism marketing in the tourism market study of local and regional area or nationally and internationally;
- ✓ research and monitoring of ecotourism and actions to protect and conserve the environment and tourism resources.

Positive impacts generated by ecotourism will be felt in the macro - economic, whereas the Jiu Valley will be developed in terms of tourism can be promoted as a tourist region of national interest.

Rural territory with its environment - natural and built resources related travel, is the support and the raw material for ecological tourism, sustainable exploitation falls within the concept of sustainable tourism

Ecotourism has implications for local tourist maximize resources and raise the living standards of inhabitants bad in socio - economicdevelopment of the quality of rural and community in general.

Not least in protecting and preserving the natural and built environment in the context of economic activities on ecological principles (sustainable)

Acknowledgments

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CRITICAL STUDY IN MATHEMATICAL APPROACH OF DATA PROCESSING IN EXPERIMENTAL RESEARCH ON THE PHENOMENON OF ORGANIZATIONAL STRESS

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Abstract :

This paper proposes four regression methods of processing experimental data to the phenomenon of organizational stress. The four regression methods are: the method of linear regression, polynomial regression method, the exponential regression method and logarithmic regression method. Depending on the processing method we obtain an index R whose value can vary depending on the method. The method that gets the lowest number R is the method with the highest degree of reliability in researching the phenomenon of organizational stress. Data-processing methods are much more numerous/ diverse, but we stopped on these four herein. The database used for the study includes staff, decision makers, from EM Lonea (Mine Lonea) and was collected in the field in August 2015.

Using mathematical regression formulas, we establish the laws of variation of the phenomenon of stress within the organization Lonea Mine, Hunedoara County in Romania and the confidence in each law of variation. Depending on the value of this ratio resulted from each method of regression, comparing each other, we address in critical manner which of the laws of variation caused by a particular method of regression is closer to the truth.

Key words :

Mathematical regression, mining, organizational stress, law of variation, compared criticity

1 Introduction. General concept of stress

Regardless if we want or not, we have to face with stress throughout our lives. It is a common phenomenon but still we do not know how to guard against stress and its effects. We experience anger, panic, apathy, we are tired, frustrated or fearful; rapid conclusion is: we are stressed. And nothing is wrong: all of the above are masks of stress.

As etymology, stress as a concept comes from English and means "constraint, suffering" but also has the sense of burden, stress, tension, being taken from physics, as excessive constraint supported by a building material. In the modern sense we are interested in the study limits (psychological and medical) to which man can face adversity.

Scourge of Humanity, we used to look at stress as something purely negative, although he has a positive component. Stress, as an expression, and also as reality is so little understood. The absence of stress is death, it means the absence of any physically and mentally response to environmental stimuli.

Following physiological research, scholar defines the general adaptation syndrome as mental stress and identifies three phases in the development and installation of the:

a)- alarm phase, with exacerbated symptoms, which generally mobilizes the body , to meet the demands of extreme situations. This in turn has two components: the shock phase and offensive phase.

b)- resistance phase as a systemic set of defense mechanisms, given by prolonged action of noxious stimuli to which the organism has developed defense by personal means. In this phase identifies the "cross-resistance": once became resistant to one type of stress, the body increases its resistance threshold for other types of stress. This phase occurs if stress is compatible with adaptation agent. The signs of alarm phase disappear, increasing resistance above the normal.

c)- exhaustion phase when the body can no longer handle defense, adaptation is no longer possible and usually ends with the death of the organism. At this stage adaptation, the energy needed at a given time is exhausted, so the signs of alarm reappear, only now they are irreversible, and if the stressor action continues, death occurs.

The length of the body resistance of the second phase varies from one organism to another, but limited. Although we tend to think that once produced adaptation things go back to normal, it is not. The energy required continuous adaptation is exhausted at a time, leaving the body without resources.

2 Define and characterize the organizational stress

A particular stress is organizational stress. In literature, organizational stress is defined as an emotional reaction type, cognitive and behavioral, due to aggressive and harmful aspects of the work (referring here to the working environment, organizational climate). Another definition, called stress as "those physical and emotional responses, harmful, occurring when work demands do not match capabilities, resources and needs of the person, which may damage or injury to health".

Organizational stress occurs in any organization, regardless of the number of employees, workplace or other specific features. Discrepancy between work demands and individual capacity to adapt characterize organizational stress, feeling of helplessness in solving, increasing at a high level.

- It is a category of mental stress, involving responses both physiological and emotional (psychological, emotional appear first, then installing the physiological ones)

- Both physiological and emotional responses and then cognitive - behavioral ones arise from the characteristics of the job.

3 Arguments, Methodology, Research area.

In this paper, to study the issue of organizational stress for its quantification, and establishing a parameter variation laws, will assess the results of a questionnaire of organizational stress, consists of 7 chapters with 132 items (Chapter I -12 items, items Chapter II -18, -10 items Chapter III, Chapter IV - 44 items, Chapter V - 11 items, Chapter VI- 16 items , Chapter VII - 21 items), which addresses issues related to the profession plus biographical information (13 items), a total of 145 items. They collected a total of 52 valid tests, 77 tests, the organization's employees Lonea Mine Hunedoara county, respectively decision makers. It will construct eight functional matrices for each chapter plus a functional matrix for biographical information. Each functional array will consist of rows and columns, to each the number of lines is 52 (the number of available tests), and number of columns being given to the number of items.

Arrays function will be: chapter I M1 (52x12), chapter II M2 (52x18), chapter III M3 (52x10), to Chapter IV M4 (52x44) ... Chapter VII M7 (52x21) for biographical information M8 (52x13). These arrays will contain marked answers with values from 1 to 5 to each item in the chapter given by each subject interviewed deciding factor.

As a principle and method we apply this critical study only 1 item of Chapter IV: "The source of tension within your services" and only 1 item of Chapter VI: "The measure you feel you can manage the situation at your place of work ". Working for all items of the 8 chapters the paper it would work too extended. We want to establish a method of quantifying this phenomenon of organizational stress and principles for determining the law of variation to each item, for all 52 subjects interviewed decision makers by using multiple method of math regression: polynomial, logarithmic, exponential and linear, is sufficient to apply only for two items, each from a different chapter. It will be sufficient to establish the principle and method of determining the law of variation as well as the confidence, depending on the mathematical regression method. Each of the mentioned regression method will give a distinct variation law with a different degree of confidence R. Mathematical regression method that will give the variation law and the best confidence R, it will be considered for that item as the most faithful to the truth and the law of variation of the most accurate organizational stress phenomenon.

Each interviewees will answer each item with answers graded from 1 to 5 representing chapter IV 1 = definitely not the source of tension, 2 = generally not the source of tension, 3 = neutral, 4 = usually is source of tension 5 = categoric is source of tension, and chapter VI: 1 = I have no opinion, 2 = disagree pronounced disagreement 3 = moderate, 4 = moderately agree, 5 = strongly agree pronounced. As was done for other items within the 8 chapters.

4 Interpretation of results

For Chapter IV ”the source of tension within your service" We apply these regression methods for item nr.28 "changes (adding new tasks, due to lack of staff and personnel qualification) in job requirements" of whose values are shown in Figures 1, No.2 and No.3, and the four laws of variation resulting from mathematical regressions are in Figure No.4-law variation using polynomial regression, figure No. 5-law variation using logarithmic regression, figure No. 6-law variation using exponential regression, Figure No. 7-law variation using linear regression.

Highest coefficient R is the resulted one and is shown in Figure No. 3, resulting from the determined law variation of the phenomenon for item No. 2 in chapter I, using polynomial regression.

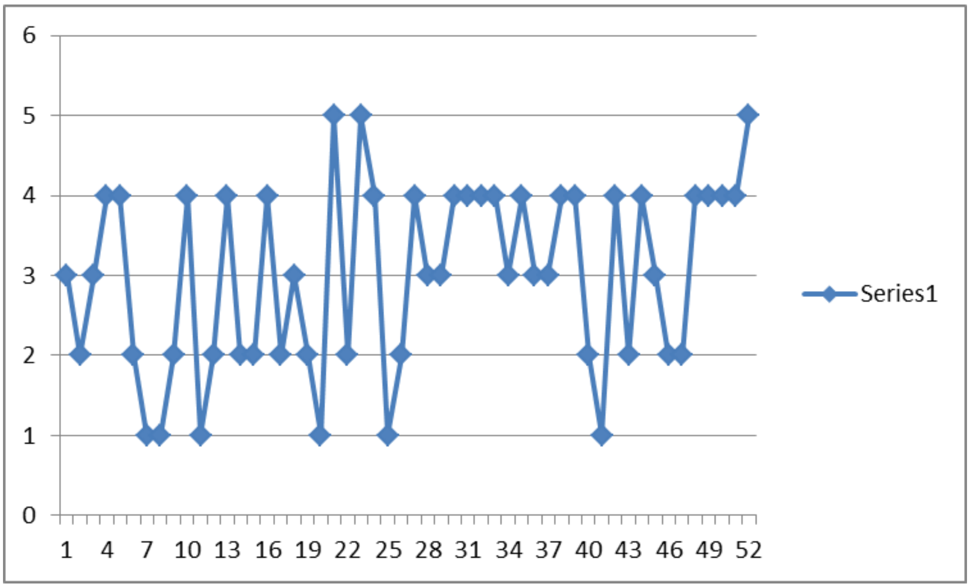

Fig.1

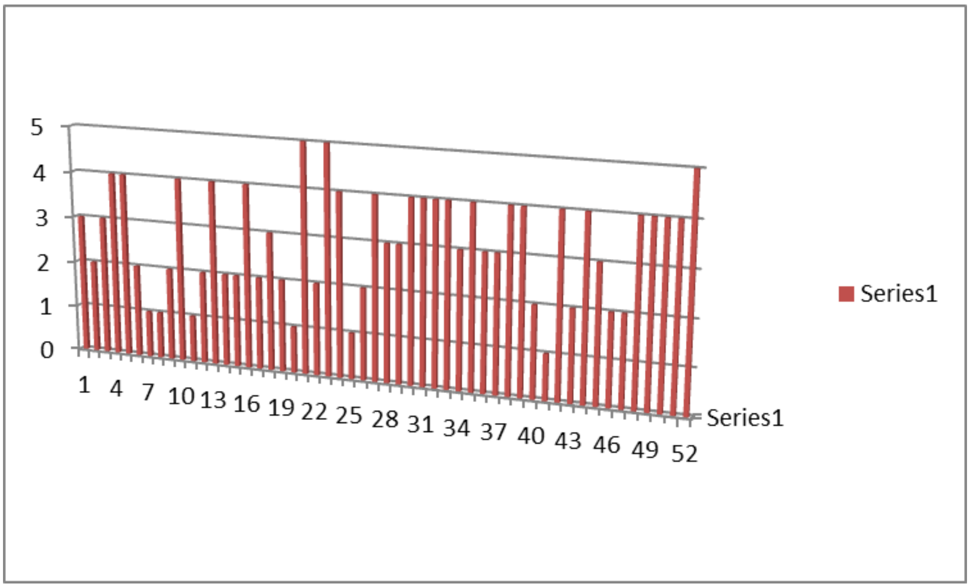

Fig.2

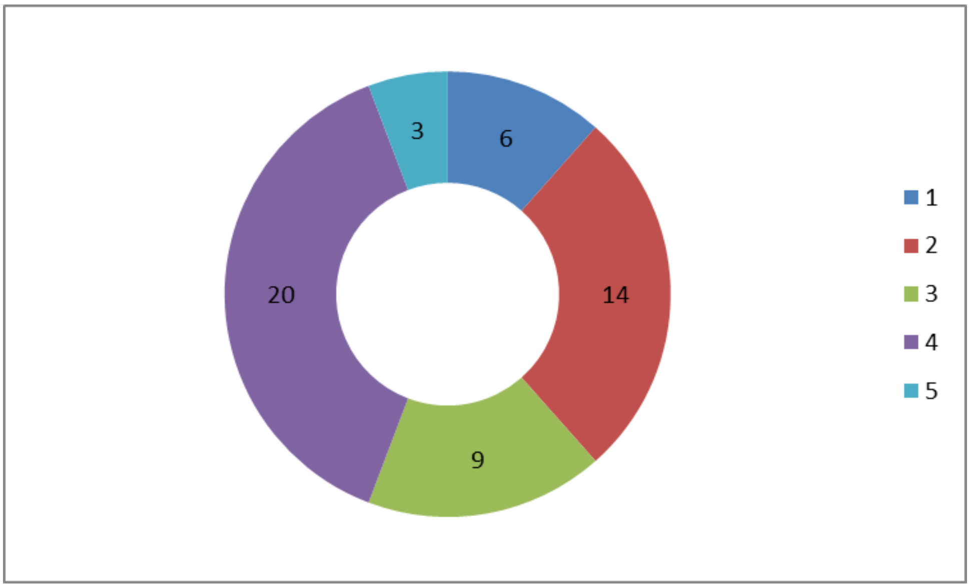

Fig.3

To Figures No.1, No.2 and No.3 are visualized responses of 52 subjects interviewed stakeholders, under Item No. 28 of Chapter IV, with grades from 1 to 5.

If we calculate by using the perfect weighted square mean, the coefficient of quantification of the phenomenon characterized by the item No. 28 of Chapter IV, for the 52 subjects interviewed decision makers Mine Lonea organization we get:

C4.28= [6x(1x1) + 14x(2x2) + 9x(3x3) + 20x((4x4) + 3x(5x5)] / [6x1 + 14x2 + 9x3 + 20x4 + 3x5] = 538 / 156 = 3,4487

This ratio number in conjunction with the graphs below, indicate an upward trend, increasing the source of tension at work of the 52 subjects interviewed stakeholders. C4.3 This coefficient was noted as C4.28, where C4 = Chapter IV, and 28 to item No. 28.

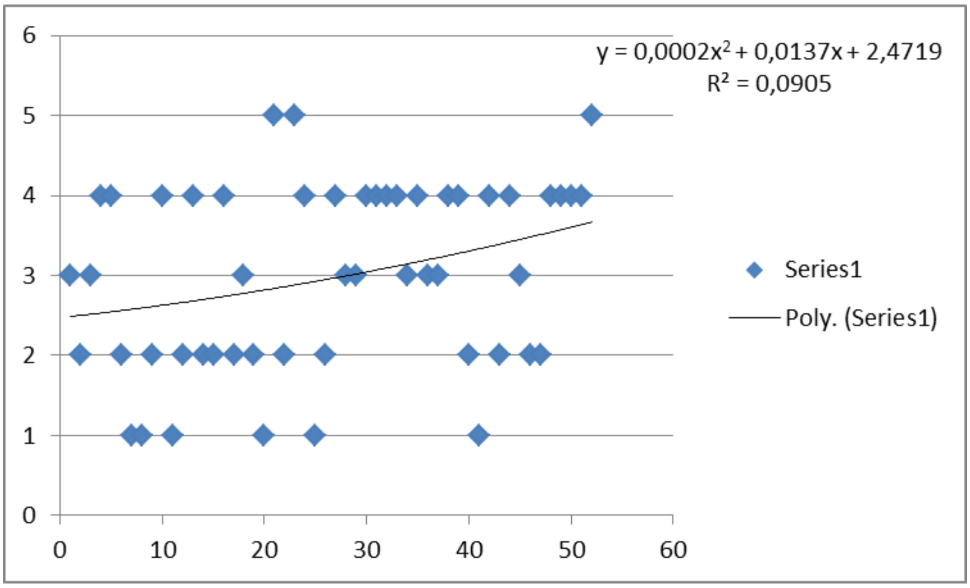

Figure 4The law of variation of the phenomenon determined by mathematical regression polynomial type for the item 28 of Chapter IV

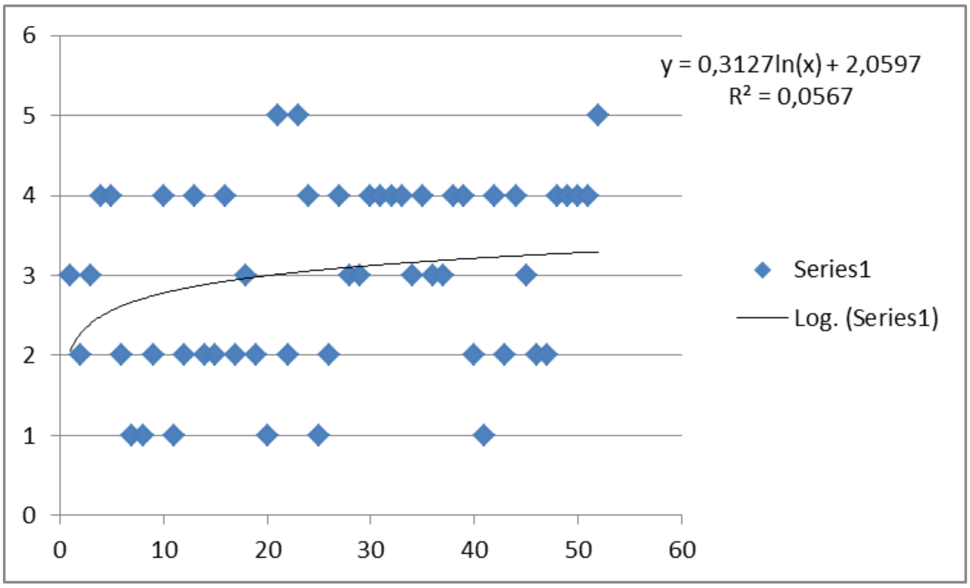

Figure 5The law of variation of the phenomenon determined using the logarithmic regression mathematical for item 28 of Chapter IV

In the case of this item, the lowest rate of confidence for the variation law of the phenomenon of stress is obtained by mathematical logarithmic regression method.

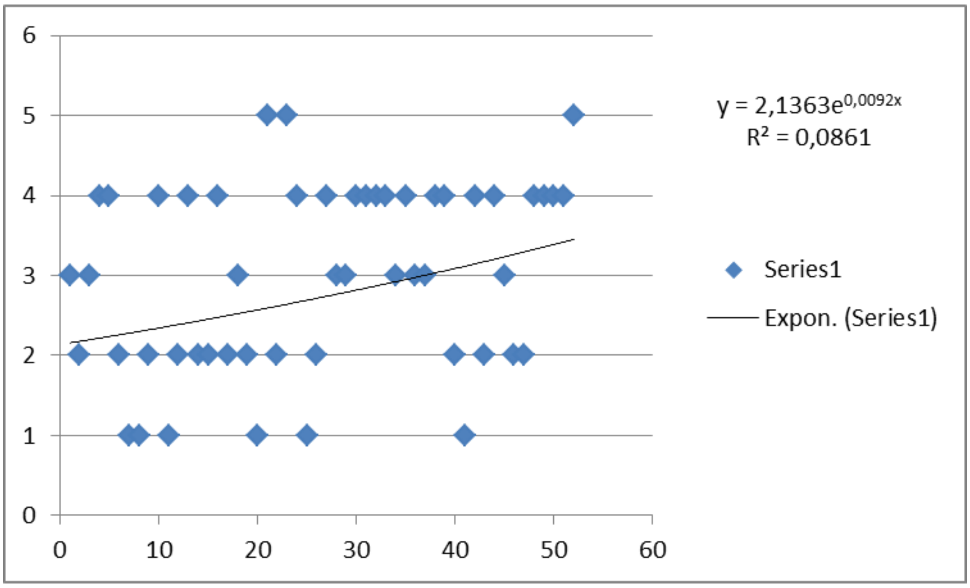

Figure 6The law of variation of the phenomenon determined using mathematical exponential regression to item 28 of Chapter IV

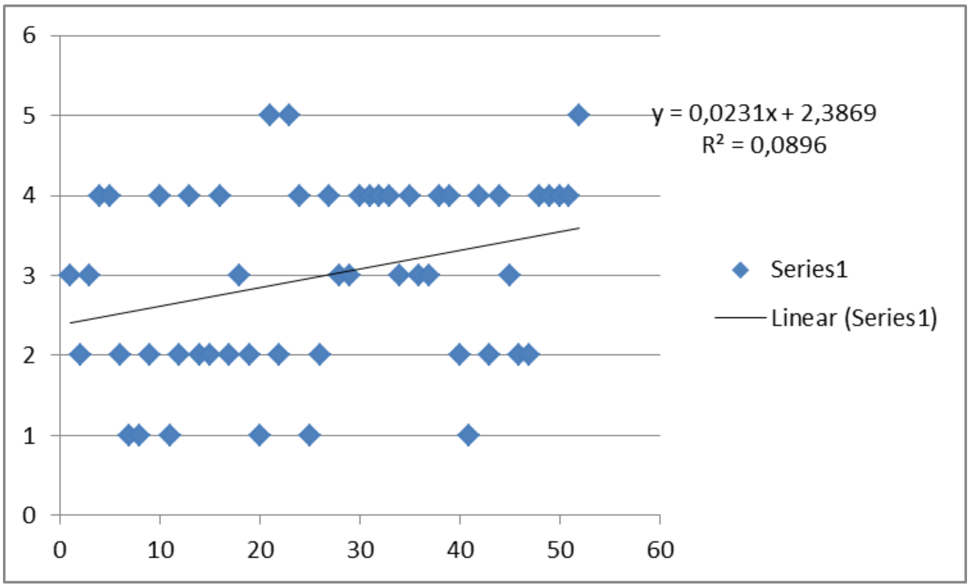

Figure 7 Law of variation of the phenomenon determined using mathematical linear regression to item 28 of Chapter IV.

For Chapter VI "The measure you feel you can manage the situation at your place of work" We apply these methods regression item nr.3- "If you know what you want from your job, you find out that job that satisfy your desire ', which amounts to answers marked from 1 to 5 are represented and viewed in different ways in Figures 8, 9 and 10, and the four laws of variation resulting from mathematical regressions Figure nr.11- are law of variation using polynomial regression, figure no.12 law of variation using the logarithmic regression, figure no.13-law of variation using exponential regression, figure- no.14 law of variation using linear regression.

Highest coefficient R is the one resulted and shown in Figure No. 11, as a result from determining the law of variation of the phenomenon to item No. 3 of Chapter VI, using polynomial regression.

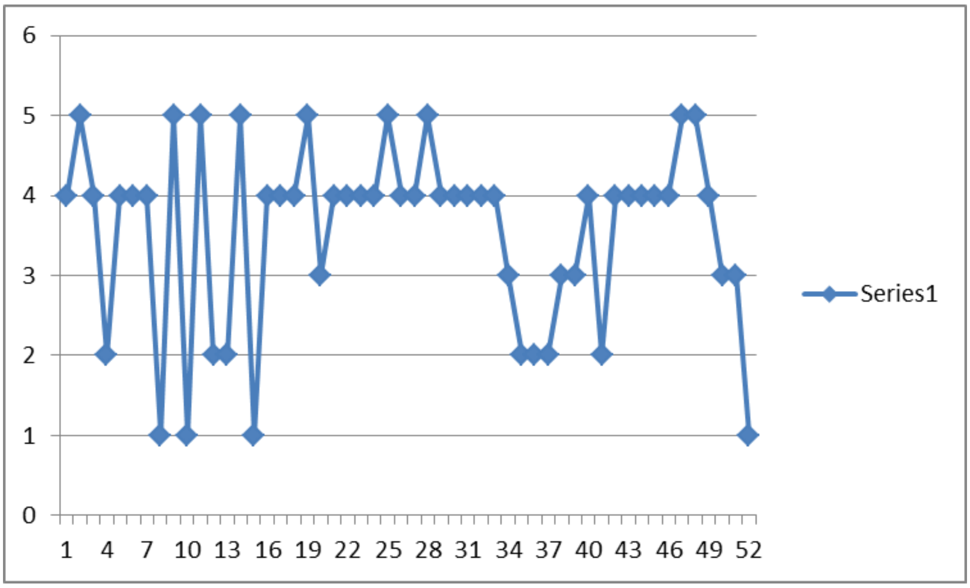

Figure nr.8-Chapter VI Item 3

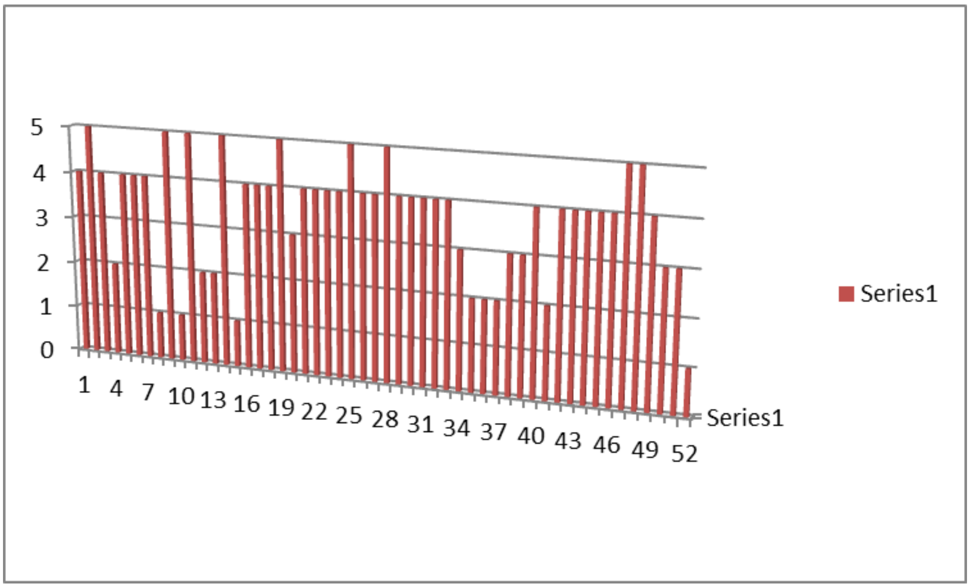

Figure nr.9 Chapter VI Item 3

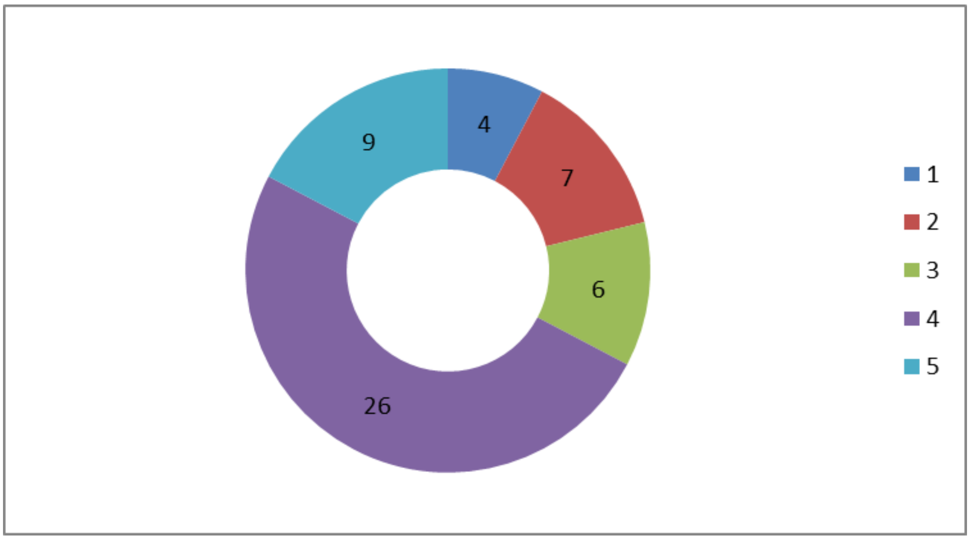

Figure nr.10

Figures 8, 9 and 10 view the responses of 52 subjects, interviewed decision makers to item No. 3 of Chapter VI, with grades from 1 to 5

If we calculate by using the perfect weighted square mean, the coefficient of quantification of the phenomenon characterized by item No. 3 of Chapter VI, for the 52 subjects interviewed decision makers Mine Lonea organization gets:

C6.3= [4x(1x1) + 7x(2x2) + 6x(3x3) + 26x((4x4) + 9x(5x5)] / [4x1 + 7x2 + 6x3 + 26x4 + 9x5] = 727 / 185 = 3,9297

This ratio in conjunction with the graphs below indicates the downward trend, the subjects regarding the situation in the workplace rule. It noted that rate of C6.3: C6 = Chapter VI, and 3 to item No. 3.

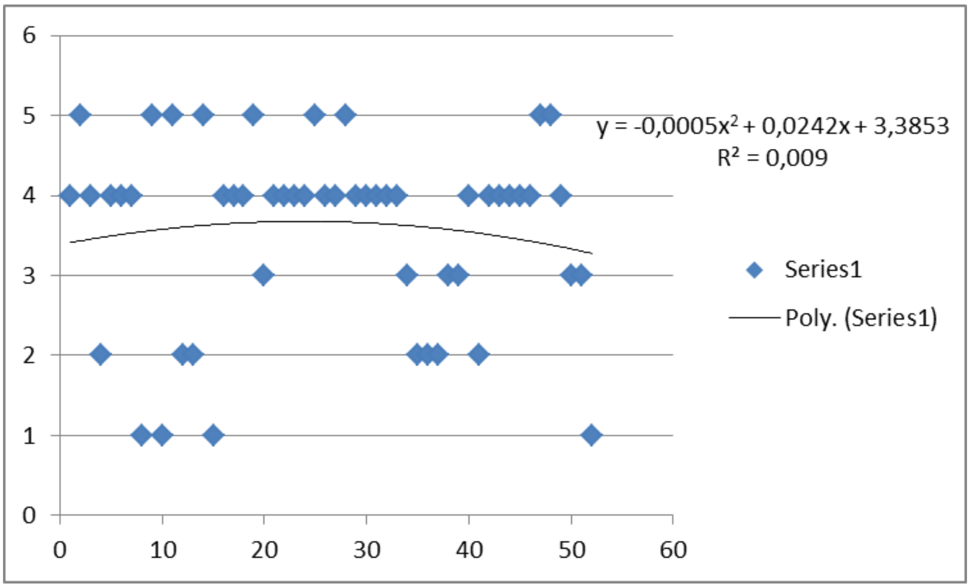

Figure No. 11 Law of variation of the phenomenon determined by using mathematical regression polynomial type for the item No. 3 of Chapter VI.

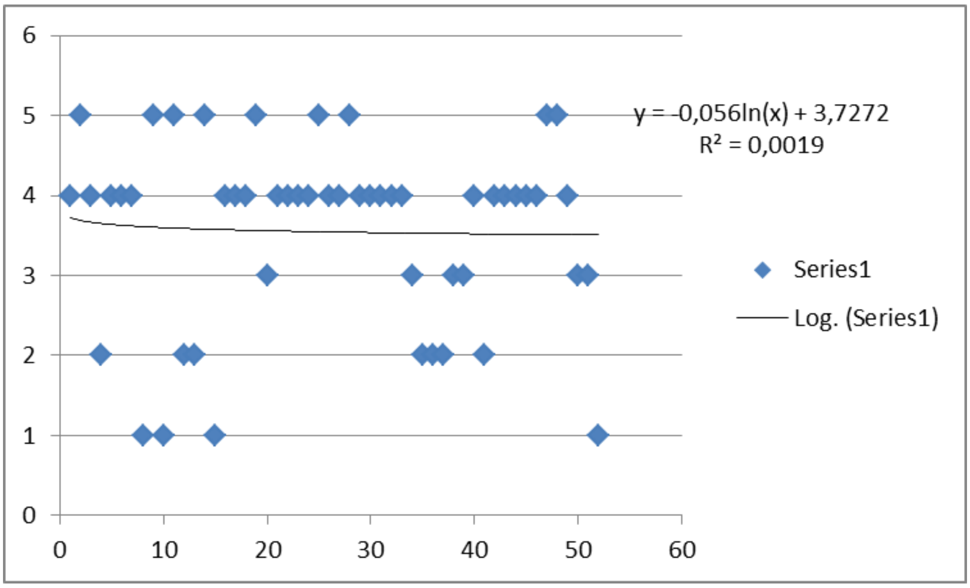

Figure No.12 Law of variation of the phenomenon determined using the logarithmic regression mathematical for item No. 3 of Chapter VI.

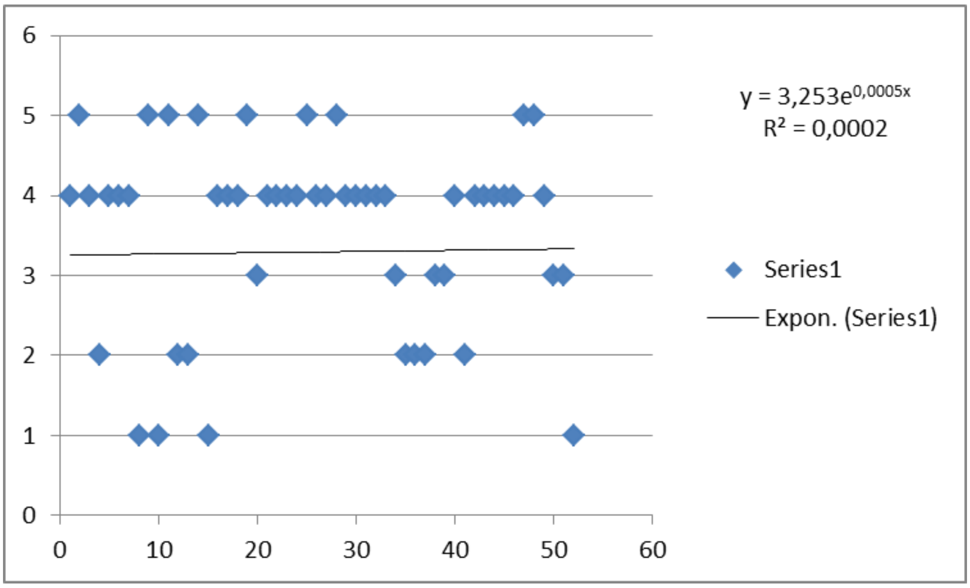

Figure No.13 Law of variation of the phenomenon determined using mathematical exponential regression to item No. 3 of Chapter VI.

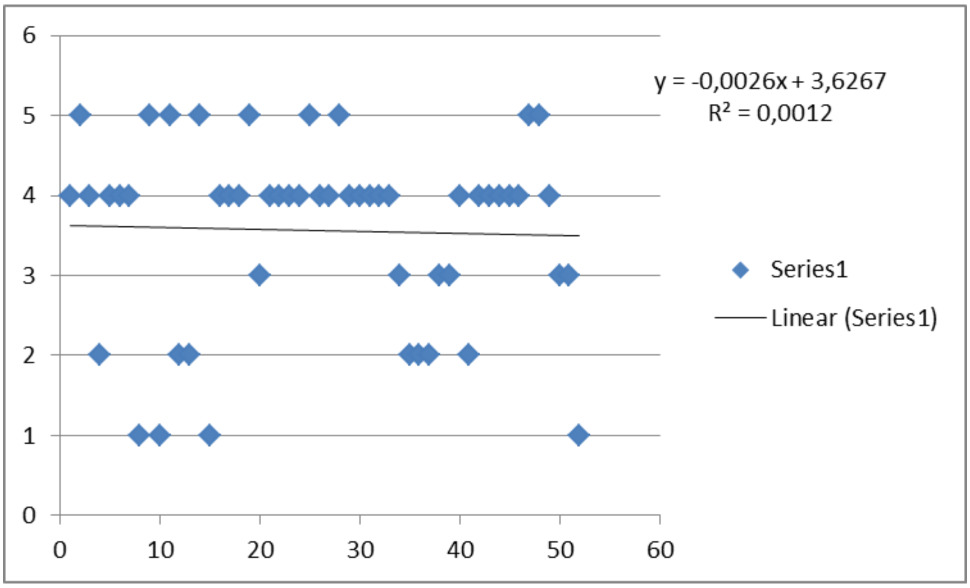

Figure No.14 Law of variation of the phenomenon determined using mathematical linear regression to item No. 3 of Chapter VI.

We note in this case that the law of variation of the stress phenomenon for item No. 3 of Chapter VI, determined by mathematical exponential regression has the lowest rate of confidence.

5 Conclusion

Determination as accurate quantification as can get of the phenomenon, organizational stress, establish a level and a value scale, thereby lead to the possibility of improvement, counteraction as much as possible destructive effects / negative performance of individual operating in a organization, and in personal.

Stress as phenomenon can be quantified using mathematical formulations. You can use the law of variation measurements using different mathematical regressions types: polynomial, logarithmic, exponential and linear type. You can make these quantifications and using weighting methods: geometric type, least squares type, perfect squares type, harmonic weighting etc.

It is to choose that variation law that gives the highest confidence rate. The purpose consists in the most accurate determination of this phenomenon, the math processing and presentation in a form as more "palpable and material" to be able to undertake the most appropriate measures and adequately as possible to optimize in terms of stress as a phenomenon the individual environment. We refer to both the organizational environment in which the individual carries on its activity as well as the personal.

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THE EVALUATION OF THE COMPLEX VENTILATION NETWORKING OF PETRILA MINE DUE TO IT'S STAGE CLOSURE

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ABSTRACT

The basis of human society development is to ensure raw materials and materials required for the development of all industrial sectors, both horizontally and vertically. An important part of raw materials are obtained by mining activities. The most difficult mining activity includes underground mining of useful minerals. The most dangerous activity in the underground exploitation of minerals, refers to underground coal exploitation under the presence of gassy atmosphere. To maintain optimal security in underground coal exploitation, there is necessary to optimize the ventilation system. In this paper, there is presented an analysis of Petrila mining unit ventilation network using computer technology for simulating situations which may occur in the ventilation systems during the closure process.

KEYWORDS: ventilation, modeling, solving, simulation, closure

1. INTRODUCTION

The Earth's population increase entails an increase in primary energy consumption worldwide. In 2010, the oil consumption exceeded 4000 million tons, coal consumption exceeded 3500 million tons of oil equivalent and the natural gas consumption exceeded 3800 million tons of oil equivalent [4].

At European level, from the total hard coal production of 125 billion tons, Poland holds the supremacy with 77 billion tons, representing 61.6 %.

In Romania the main coal field is in Jiu Valley. Jiu Valley coal field is located in the south-western part of Romania, within an inter-mountain valley and it is the main hard coal supplier from Romania [1].

The industrial exploitation of hard coal began in the second half of the 19th century. During its best time period, coal was extracted from 14 mining units, with a total production of ≈ 11 million tons/year. Nowadays, hard coal is hoisted from 7 mining units, of which 3 mines are comprised in the conservation-closure program, producing a total of ≈ 3 million tons of hard coal per year.

2. VENTILATION NETWORK OPTIMIZATION

In order to cope with the restructuring process, the undermined coal bed exploitation method has been introduced, method which has increased the underground risk factors. In order to maintain a proper safety level, the optimum distribution of air flows for each branch is required, as ventilation is the primary protection measure in underground mining. In this regard, there have been used specialized software and advanced IT equipment in order to solve the ventilation networks [2, 3].

In order to achieve proper conditions for working underground, there has to be ensured the primary protection, namely the ventilation. The aeration of mine workings – ventilation, aims to achieve three main objectives:

- Ensuring the concentration of oxygen required by the staff working underground;

- Diluting the explosive and/or toxic gases from the mine workings network;

- Taking over the heat released in the network of mine workings, due to human activity and geothermal gradient.

In order to achieve a proper ventilation at the level of each mine working, there is required to optimize the air flows on each branch of the ventilation network. In this regard, the solving of the ventilation network at the level of a mine is required.

3. PETRILA MINE UNIT VENTILATION NETWORK

Petrila mine unit ventilation network has been extremely complex. Nowadays, due to subjective causes – explosions or objective causes-depletion of useful mineral substances reserve, it is subjected to closure. Therefore, the ventilation network comprises two shafts for fresh air input: Center Shaft and New Shaft with Skip. Also, it comprises a ventilation shaft with the related ventilation station (Ventilation Shaft), whilst also includes underground mining works arranged in five horizons (horiz. -250; horiz. -200; horiz. -150; horiz. ±0; horiz. +150). These mine workings consist of cross-sectional galleries, directional galleries, diagonal galleries, numbering cross-sectional galleries, inclined plane, coal faces, connection risings.

The entire network comprises 126 junctions (nodes) and 154 branches.

4. MINE VENTILATION NETWORK SOLVING

In order to solve such a complex ventilation network was used the Hardy Cross method for successive approximations. This method lays ground for Canadian specialized software, CANVENT [5]. Using this software there could be performed the ventilation network solving and the optimization of air flow repartition at branch level.

Solving the ventilation network of Petrila mine unit required several steps to be performed, namely:

- Marking the junctions (nodes) of the ventilation network on the spatial map of the mine;

- Collecting geodesic coordinates for the identified junctions;
- Inputting the geodesic coordinates of the existing junctions and branches into the database of the software – Figure 1;

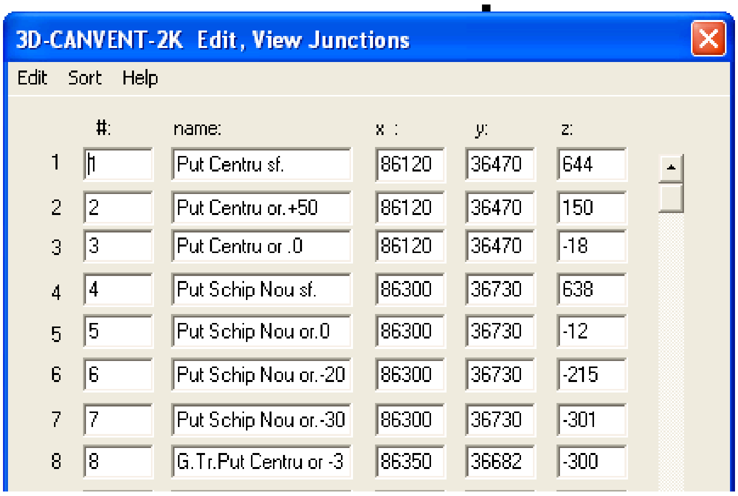

Figure 2: Geodesic coordinates specific for the ventilation network

- Carrying out specialized measurements „in situ”:
    - o Measurements regarding the aerodynamic parameters of the mine workings;
    - o Measurements regarding the geometric parameters of the mine workings;
    - o Measurements regarding the physical parameters of air.
- Calculating the aerodynamic resistances related to each branch;
- Inputting the values of specific parameters of the ventilation network into the database of 3D-CANVENT – Figure 2

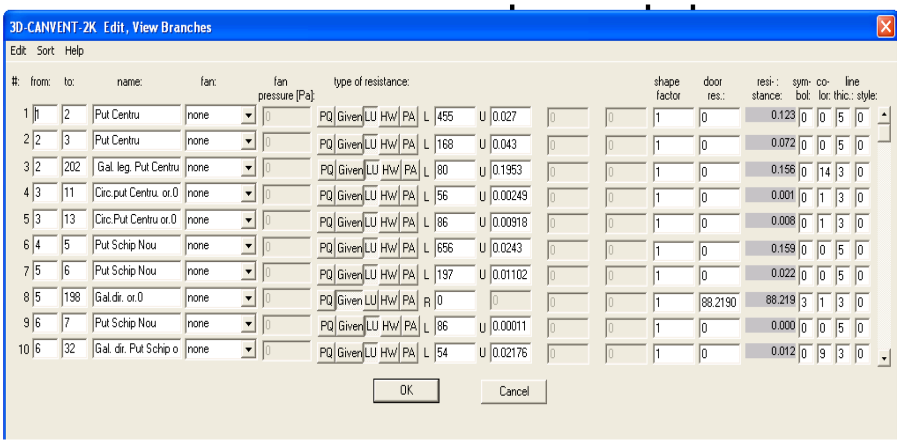

Figure 3: Parameters specific for the ventilation network

- 2D or 3D representation of the ventilation network;
- Balancing the ventilation network;
- Solving the ventilation network. This phase identifies the direction and optimal repartition of air flows over each branch – Figure 3;
- Results obtainment

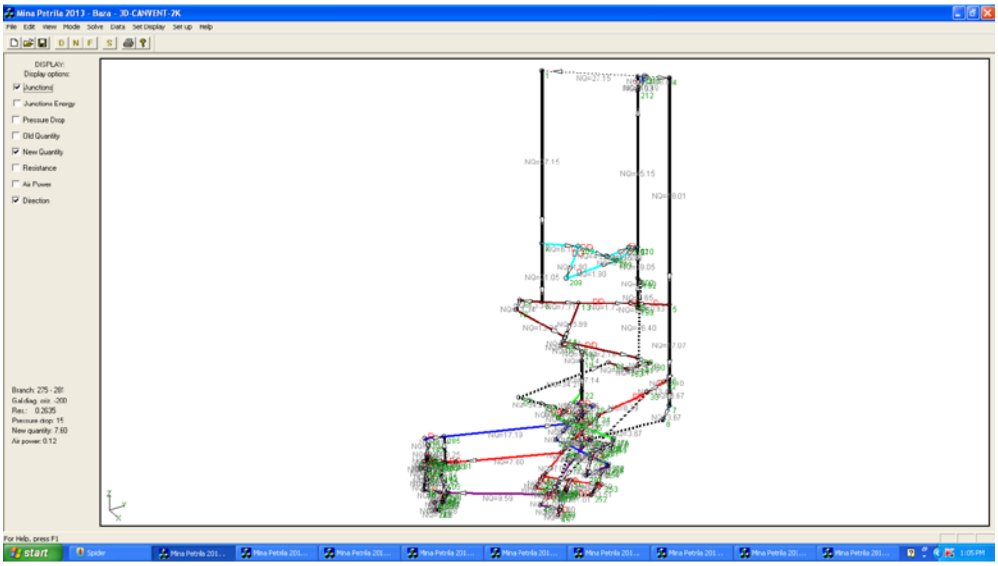

Figure 4: Petrila mine unit ventilation network

In this final phase, the data regarding the graphical solving of the ventilation network are available electronically or in paper.

Ventilation network of Petrila mine unit was updated in 2014. For solving the ventilation network, the entire ventilation network of Petrila mine unit was taken into account.

The current update of Petrila mine unit ventilation network has been performed in relation with the previously solved ventilation network. Also, it was taken into account the fact that the undermined coal beds 434E and 434W are mined in a single field 434 at sublevel II, under horizon -150, and that the undermined coal faces 431 and 433 are mined in a single field 433 at sublevel V – floor, horizon -250.

In order to update the ventilation network were removed the following circuits and mine workings: circuit related to undermined coal bed no. 237W, seam 3, Bl. II, horizon -250; circuit related to undermined coal bed no. 238, seam 3, bl. II, sub-horizon -250; circuit related to undermined coal bed no. 239, seam 3, bl. II, horizon -250; circuit related to undermined coal bed no. 331, seam 3, bl. II, horizon -250; circuit related to undermined coal bed no. 333, seam 3, bl. II, sub-horizon -200; circuit related to undermined coal bed no. 434W, seam 3, bl. II, sub-horizon -150; circuit related to undermined coal bed no. 434E, seam 3, bl. II, sub-horizon -150; circuit related to undermined coal bed no. 336, seam 3, bl. II, sub-horizon -150; main cross-sectional gallery horizon -250; cross-sectional gallery horizon – 250; rising 433, between horizon -250 and -215 elevation; cross-sectional gallery 433 horizon -200; cross-sectional gallery 434 horizon -150; directional gallery W, horizon -200, PO 15 circuit horizon -100.

Also, there have been inserted into the ventilation network: circuit related to undermined coal bed no. 433, seam 3, bl. II, horizon -250; circuit related to undermined coal bed no. 434, seam 3, bl. II, horizon -150; rising 434, between horizon -250 and -200; cross-sectional gallery 434 horizon -200; cross-sectional gallery 433 horizon -200; cross-sectional gallery 434 horizon -150.

At the same time have been placed ventilation constructions on the following locations: main cross-sectional gallery -250; cross-sectional gallery no. 237 horizon -250; cross-sectional gallery 433 horizon -250; directional gallery W, horizon -250; cross-sectional gallery 434, horizon -200; connection gallery coal face 434, sublevel II, sub-horizon -150; directional gallery W, horizon -150; inclined plane 336-337; cross-sectional gallery no. 336, horizon -200; cross-sectional gallery no. 237, horizon -200;

diagonal gallery, horizon -150; cross-sectional gallery no 336, horizon -150; connection gallery horizon -250 to plane -300-250; directional gallery E, horizon -200; cross-sectional gallery horizon +150.

Compared to the previously solved ventilation network, the following results were obtained:

- Air flow on the fresh air supply circuit at horizon -250, main cross-sectional gallery significantly decreased with 2.44 % from 13. 92 m^3/s to 13.58m^3/s.
- Air flow at the level of the undermined coal bed no. 433 is 3.71 m^3/s.
- Air flow at the level of the undermined coal bed no. 434 is 3.23 m^3/s.
- Air flow at level of horizon -200, mai cross-sectional gallery significantly increased with 62.12 % from 9.03 m^3/s to 14.64m^3/s.
- Air flow at level of horizon -150, main cross-sectional gallery substantially increased with 204.87 % from 6.36 m^3/s to 19.39m^3/s.
- Air flow at level of horizon - 100, main cross-sectional gallery substantially increased with 82.54 % from 1.26 m^3/s to 2.30 m^3/s.
- On the main return air exhaustion circuit, horizon -100 ÷ horizon +0, air flow moderately increased with 23.37 % from 27.73 m^3/s to 34.21 m^3/s.
- At mine level, on the Ventilation Shaft, air flow moderately decreased with 12.47 % from 51.8 m^3/s to 45.15 m^3/s.
- At the level of the main ventilation station, air flow moderately decreased with 24.5 % from 61.93 m^3/s to 46.48 m^3/s.
- In terms of short-circuiting, on the Ventilation Shaft, air flow significantly decreased with 87.15 % from 10.35 m^3/s to 1.33 m^3/s.

5. SIMULATIONS PERFORMED ON THE VENTILATION NETWORK

CANVENT software for solving ventilation networks allows the simulation of changes which may occur in the ventilation network. Therefore, in the ventilation network of Petrila mine subject to closure were simulated the following situations:

Simulation no. 1 – Closure of undermined coal bed no. 433, seam 3, block II, sublevel V, horizon -250 and setting into the general depression of undermined coal bed no. 433, seam 3, block II, sublevel I, horizon -250.

Simulation no. 2 – Closure of undermined coal bed no. 434, seam 3, block II, sublevel II, sub-horizon -150 and setting into the general depression of undermined coal bed no. 434, seam 3, block II, sublevel III, sub-horizon -150

Simulation no. 3 – Closure of ventilation circuit no. 336, seam 3, block II, between horizons: -100 and -200.

Simulation no. 4 - Closure of ventilation circuit no. 433, seam 3, block II.

Simulation no. 5 - Closure of ventilation circuit no. 434, seam 3, block II.

Simulation no. 6 – Closure of productive horizons, between horizons -250, -200 and -150.

Simulation no. 7 – Closure of Blind Shaft (PO) 15 between horizons -250 and ±0.

Simulation no. 8 – Closure of horizon ±0 connections.

For exemplification is presented Simulation no.1 - Closure of undermined coal bed no. 433, seam 3, block II, sublevel V, horizon -250 and setting into the general depression of undermined coal bed no. 433, seam 3, block II, sublevel I, horizon -250.

In order to perform this simulation, there have been removed 6 branches related to undermined coal bed 433, seam 3, block II, sub-level V, horizon -250, respectively there have been inserted 9 branches related to undermined coal bed 433, seam 3, block II, sub-level I, sub-horizon -250.

Changes conducted within this modelling are presented in Figure 4.

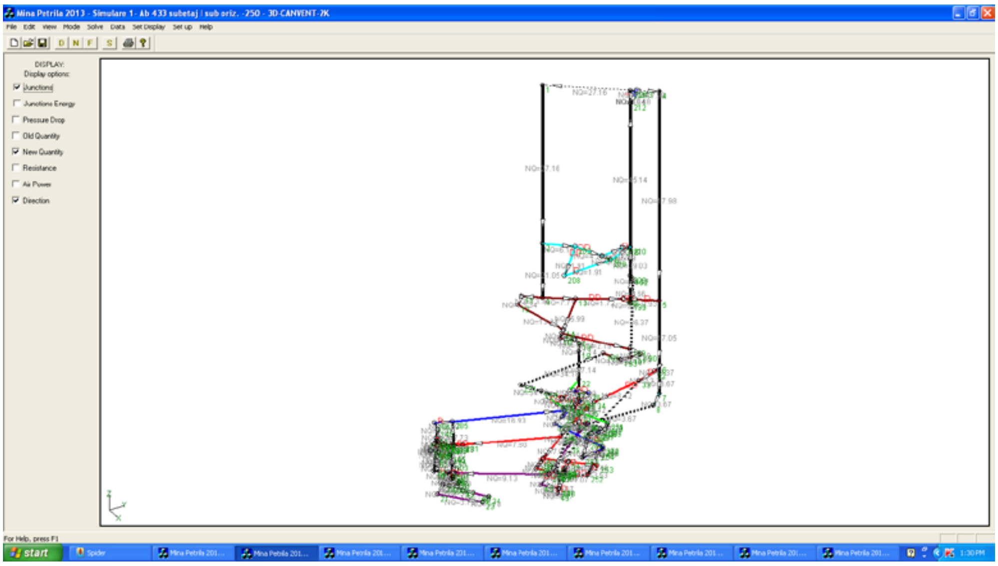

Figure 5: Ventilation network - simulation 1

Compared to the ventilation network updated in 2014, the following results were obtained:

- Air flow on the fresh air supply circuit at horizon -250, main cross-sectional gallery insignificantly decreased with 2.87%, from 13.58 m^3/s to 13.19 m^3/s.
- Air flow at the level of the undermined coal bed no. 433 insignificantly increased with 1.88%, from 3.71 m^3/s to 3.78 m^3/s.
- Air flow at the level of the undermined coal bed no. 434 insignificantly increased with 2.47%, from 3.23 m^3/s to 3.31 m^3/s .
- Air flow at level of horizon -200, main cross-sectional gallery insignificantly increased with 1.64%, from 14.64 m^3/s to 14.88 m^3/s.
- Air flow at level of horizon -150, main cross-sectional gallery insignificantly decreased with 19.39 m^3/s to 19.17 m^3/s.
- Air flow at level of horizon - 100, main cross-sectional gallery insignificantly increased with 1.13%, from 2.30 m^3/s to 2.34 m^3/s.
- On the main return air exhaustion circuit, horizon -100 ÷ horizon +0, air flow insignificantly decreased with 0.09%, from 34.21 m^3/s to 34.18 m^3/s.
- At mine level, on the Ventilation Shaft, air flow insignificantly decreased with 0.09%, from 45.15 m^3/s to 45.14 m^3/s.
- At the level of the main ventilation station, air flow remained the same 46.48 m^3/s.
- In terms of short-circuiting, on the Ventilation Shaft, air flow insignificantly increased with 0.75%, from 1.33 m^3/s to 1.34 m^3/s.

6. CONCLUSIONS

Solving ventilation networks using computational techniques is a giant step forward which allows the optimization of ventilation management and real-time visualisation of the network's changes.

The ventilation network used for exemplification belongs to Petrila mine unit and comprises 2 shafts, 1 ventilation shaft, horizons and many mine workings (cross-sectional, directional, diagonal galleries, inclined planes, connection risings and coal faces).

Solving the ventilation network of Petrila mine unit has been performed using CANVENT software and required 10 main steps for reaching this objective. The application of CANVENT software allowed the performance of eight simulations in the ventilation network of Petrila mine unit, of which simulation no. 1 was presented, and which represent changes which may occur in the ventilation system during the closure process.

The method for solving the ventilation network using computational techniques, allows modelling and solving ventilation networks, as well as any other simulation of changes which may occur in the ventilation system, regardless of its' complexity.

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POSIBILITATI DE REABILITARE A TERENURILOR AFECTATE DE EXPLOATARILE MINIERE DE SUPRAFATA DIN ZONA DORBOGEI -TURCOAIA

Mihai-Nicolae TIBA

1 PREZENTAREA GENERALA A ZONEI TURCOAIA

Turcoaia este localitatea situata in judetul Tulcea, Dobrogea. Comuna Turcoaia este situata in partea de nord-vest a judetului Tulcea, pe malul drept al Dunarii .Pe teritoriului administrativ al comunei Turcoaia, se aflau doua cariere : - Cariera Iacob deal, cea mai mare din tara si - Cariera Turcoaia denumita si Fantana Manole.

ClimaClima se manifesta printr-un regim temperat cu pronuntat continentalism unde verile sunt secetoase, iar iernile sunt friguroase si lipsite de umiditate. Temperatura medie anuala variaza intre 10.5°C si 11°C. Vara, in iulie, se inregistreaza temperaturi medii cuprinse intre 22°C, iar iarna, in ianuarie, mediile termice se inscriu cu valorile intre -1,9°C si -1,5°C.Apele•Principalele rauri din Dobrogea de Nord sunt: Taita(57 km), Telita(48 km), Slava(38,3 km), care se varsa in Lacul Razim si raurile Cerna, Aiorman, Jijila-Sarniar, care se varsa in Dunare. •Lacurile din aceasta zona se impart dupa geneza:- limane maritime (situate pe tarmul lacului Razim): Babadag, Agighiol, Sarinasuf, Tuzla;- limane fluviatile: Peceneaga, Traian;- lacuri situate pe albia unor brate parasite ale Dunarii: Beibugeac, Slatina, Sarat, Carpina.Rezervatii naturale•In Podisul Dobrigei de Nord exista patru rezervatii forestiere, trei rezervatii botanice, doua rezervatii paleontologice si o rezervatie mixta, dar si Parcul National Muncii Macin:•- Padurea Valea Fagilor de le Luncavita (154 ha);•- Dealul Pietrosul de la Agighiol (167m, 9,70 ha);•- Dealul Bujoarele de la Turcoaia (207m, 8ha);•- Rezervatia mixta capul Dolosaman de la Jurilovca (56m, 125ha);•- Rezervatia Nationala Muntii Macin (1132 ha).

2 PREZENTAREA CARIEREI SI A HALDEI TURCOAIA

Lucrari miniere de exploatarePentru exploatarea zacamantului de granit se aplica metoda de exploatare in cariera, in trepte descendente cu dislocarea masei miniere cu explozivi plasati in gauri de sonda forate descendent, incarcarea masei miniere din frontul de exploatare cu excavatoare cu cupa si transport auto la statia de concasare – sortare mobila sau la halda de steril.

Lucrari de haldareProdusele reziduale rezultate din activitatea de exploatare a granitelor industriale si de constructii din perimetrul analizat sunt reprezentate de rocile sterile existente in acoperisul masivului de granit.Rocile sterile rezultate din cariera Turcoaia au provenit din lucrarile de deschidere si pregatire (descopertarea campului minier si partial din saparea acceselor necesare deschiderii treptelor de exploatare) si din procesarea zacamantului.Haldarea rocilor sterile provenite de la descoperta s-au realizat pe intreaga suprafata, pozitionata in partea de sud a amplasamentului in partea stanga a organizarii de santier, pe terenuri neproductive.Haldarea rocilor sterile provenite din fluxul tehnologic de prelucrare a agregatelor minerale este pozitionata in partea de sud est a amplasamentului avand organizarea de santier pe latura din stanga.

Etapele reabilitarii biologice ale unei halde de sterilMetoda de reabilitareEtapele specifice reabilitariiI. Reabilitarea tehnicaa)Recuperarea si conservarea solului decopertatb)Decopertarea, transportul si depunerea materialului sterilc) Construirea haldei de sterild) Stabilizarea haldeie) Depunerea solului conservat pe halda stabilizataf) Ameliorarea solului antropic de pe haldeII. Reabilitarea ecologicaa) Cultivarea forestiera a haldeib) Cultivarea agricola a haldei

Propunerea mea privind reintegrarea functionala a terenurilor afectate de la Turcoaia se pliaza pe specificitatea structurii haldate, actionand in sensul personalizarii solutiilor si metodologiei de reabilitare. Asadar trebuie urmarit, pe langa caracteristicile tehnice ale construirii, atat specificul economiei regionale (potential eolian) cat si integrarea placuta in peisajul local (estetica reamenajarii), toate acestea sugereaza faptul ca metoda de reabilitare recomandabila este de natura ecologica, economica si durabila. Solutia propusa consta in realizarea unui parc eolian in exteriorul arealului forestier de pe halda Turcoaia.Consider deosebit de util acestui proiect de reintegrare functionala, asocierea unui centru de cercetare, in vederea asigurarii unei adaptari continue la metodele metodologiile cele mai noi in domeniu

3 IMPLEMENTAREA ENERGIEI EOLIENE, ENERGIE REGENERABILA – O SOLUTIE DURABILA PENTRU REABILITAREA ECONOMICA A ZONEI DE HALDARE A CARIEREI TURCOAIA

Potentialul tarii noastre in domeniul producerii de energie verde este astfel:producerii de energie verde este astfel:-65% biomasa65% biomasa-17% energie eoliana17% energie eoliana- 12% energie solara12% energie solara- 4% microhidrocentrale4% microhidrocentrale- 1% fotovoltaica + 1% geotermala- 1% fotovoltaica + 1% geoterma

Legenda:I. Delta Dunarii (energie solara);II. Dobrogea (energie solara si eoliana);III. Moldova (campie si podis - microhidro, energie eoliana si biomasa);IV. Muntii Carpati (biomasa, microhidro, energie eoliana);V. Podisul Transilvaniei (microhidro);VI. Campia de Vest (energie geotermala);VII. Subcarpatii (biomasa, microhidro);VIII. Campia de Sud (biomasa, energie geotermala si solara).

Energia Eoliana

Puterea vantului este conversia energiei vantului intr-o forma folositoare, cum ar fi electricitatea, folosind turbine de vant. La sfarsitul anului 2010, capacitatea mondiala instalata a generatoarelor eoliene era de 198 GW. Energia eoliana este produsa in ferme mari de eoliene, conectate la reteaua de electricitate, dar si prin turbine individuale folosite pentru producerea de energie electrica in locuri izolate.

4 TRANSFORMAREA IMPACTULUI NEGATIV ASUPRA MEDIULUI INCONJURATOR AL HALDEI EXTERIOARE TURCOAIA, INTR-UN IMPACT POZITIV, PRIN AMENAJAREA UNUI PARC EOLIAN

In prezent folosinta actuala a terenurilor este de depozitarea sterilului. Potentialul viitor in conditiile nerealizarii parcurilor eoliene este legat de resursele naturale.In cazul neimplementarii planurilor, amplasamentul studiat isi va pastra actuala folosinta, fiind incorect exploatata si in neconcordanta cu actuala intentie in ceea ce priveste dezvoltarea durabila a comunei Turcoaia si cu cerintele actuale de valorificare din punct de vedere economic a resurselor din zona, respectiv a potentialului eolian al zonei.

Flora de pe amplasamentSpeciile observate apartin unor familii caracterizate prin organe vegetative carnoase ce acumuleaza apa, frunze prevazute cu peri sau tepi pentru reducerea evapotransiratiei si pentru captarea apei din atmosferaFauna in zona amplasamentuluiEste reprezentata de specii de rozatoare specifice: popandaul, orbetele, harciogul mic, dihorul de stepa prezent doar in Dobrogea, la care se adauga reptile de origine submediteraneana: soparla dobrogeana, gusterul, vipera cu corn, broasca testoasa de uscat, insecte.

IMPACTUL ESTIMAT ASUPRA FACTORULUI DE MEDIU AERIMPACTUL ESTIMAT ASUPRA FACTORULUI DE MEDIU AER

Sursele de emisie a poluantilor atmosferici sunt surse la sol, deschise (cele care implica manevrarea materialelor de constructii si prelucrarea solului) si mobile (utilaje si autocamioane). In timpul functionarii obiectivului propus nu exista surse de poluare a aerului in timpul functionarii obiectivului.

IMPACTUL PRODUS ASUPRA SOLULUI SI SUBSOLULUILa realizarea acestui proiect sunt posibile decopertari minime, cu un impact redus asupra solului.In timpul constructiei, impactul asupra solului va fi determinat de:- degradarea solurilor ca urmare a depunerilor particulelor in suspensie rezultate pe parcursul excavarilor si a constructiilor;-praful de ciment, diversele metale, uleiurile si lubrifiantii pot contamina solul din jurul zonei afectate si solul de-a lungul drumurilor de acces;Dupa construire, obiectivul nu produce poluare asupra solului si subsolului.IMPACTUL PRODUS ASUPRA BIODIVERSITATIIImpactul asupra biodiversitatii locale in timpul constructiei obiectivului se manifesta in special datorita decopertarilor pentru constructia fundatiilor turnurilor si a drumurilor de acces, a prafului produs de lucrarile de santier si datorita zgomotului produs de utilajele folosite.Constructia parcului eolian nu va afecta integritatea Parcului National Muntii Macinului, situandu-se la limita acestuia.

RECOMANDARI

Varfurile palelor centralelor eoliene se vor vopsi in culori vii pentru a evita lovirea acestora de catre pasari.Turnurile se vor semnaliza cu lumina rosie intermitenta, cu interval mare de timp intre doua aprinderi.Este interzisa deversarea apelor uzate rezultate din desfasurarea activitatilor de constructie in spatiile naturale existente in zona. Pentru muncitori se vor folosi WC-uri ecologice.In cazul unor posibile deversari accidentale de ape uzate, uleiuri sau combustibili proveniti de la utilajele folosite, se recomanda colaborarea cu firme specializate in depoluari.Este interzisa depozitarea materialelor sau circulatia autovehiculelor pe spatiile verzi, cu exceptia celor destinate pentru organizarea de santier.Refacerea cu sol fertil a suprafetelor afectate, incepand de la baza turnurilor, astfel incat sa nu ramana teren neintegrat in circuitul agricol, in afara celui prevazut in proiect.Amplasarea turbinelor se va face astfel incat la limita perimetrului amplasamentului, nivelurile de zgomot si vibratii sa se incadreze in limitele impuse prin standardele in vigoare.Activitatea de prevenire a incendiilor trebuie sa fie sustinuta de masuri adecvate conform legislatiei in vigoare si recomandarilor producatorului.

CONSIDERATII FINALE

Efectul benefic al producerii de energie electrica prin metode nepoluante nu poate fi contestat, deoarece aceasta metoda asigura producerea de energie eliminand emisiile poluante specifice altor metode.Turbinele eoliene nu produc nici un fel de poluare asupra factorilor de mediu in perioada de functionare deoarece energia eoliana este o energie verde.Amplasarea in zona nu afecteaza in mod semnificativ flora sau fauna din zonelor protejate (parcuri, rezervatii etc.).Amplasarea turbinelor eoliene in vecinatatea unor asezari umane este recomandata in literatura de specialitate, deoarece pasarile migratoare ocolesc aceasta zona in mod normal, iar zonele de cuibarit si hranire sunt alese in afara zonelor locuite.Turbinele eoliene vor contribui la dezvoltarea economiei locale.

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CONSIDERATII GENERALE PRVIND FOLOSIREA STERILULUI MINIER PENTRU STABILIZAREA CHIMICA SI FIZICA A SOLURILOR SI CA ADAOSURI IN MATERIALE DE CONSTRUCTII.

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drd. ing. Gherghelaş Androo Paul

REZUMAT:

In urma activitatii extractive si de procesare, rezulta o cantitate insemnata de deseuri miniere, sub forma de steril mineral. Aceste deseuri sunt depozitate in mare parte in iazuri de decantare sau halde miniere. Compozitia chimica a materialului depozitat in halda depinde de la o exploatare la alta, in functie de tipul de zacamant si geneza acestuia precum si de compozitia chimica si mineralogica a zacamantului. Un alt factor important in chimia steriului aflat in depozite, reprezinta modul si tehnica de procesare a mineralelor. Pentru o buna perioada de timp pe plan mondial, depozitele de steril au fost considerate deseuri fara posibilitate de utilizare ulterioara. La ora actuala, se urmareste realizarea unor programe de cercetare mondiale pentru a se putea determina posibilitatea utilizarii sterilului minier in varii domenii. Principalul domeniu spre care se tinteste este cel al constructiilor, ca materie prima la fabricarea betoanelor, mortarului sau în reteaua de infrastructura. O alta ramura unde au fost efectuate cercetari este posibilitatea folosirii materialelor sterile ca sursa pentru fertilizarea terenurilor. Prin aceste metode terenurile ocupate de depozite pot fi degajate in totalitate.

CUVINTE CHEIE: *halda, steril, constructii, adaos*

ABSTRACT:

Following mining and processing activity, results a significant amount of mining wastes, in the form of sterile mineral. These wastes are stored largely in mining tailing ponds or heaps. The chemical composition of the sterile material depends from one mining site to another, being in direct realtion to the type of deposit and its genesis, as well as chemical and mineralogical composition of the deposit. Another important factor influencing the chemistry of the deposit is the mineral processing technique. For long time worldwide, tailings deposits were considered waste deposits, without the possibility of future use. Currently, the aim is to achieve and determine though global research programs the possibility of using mining waste from mine tailing in various domains. The main focuse area is that of construction, where mining waste can be used for the production of concrete, or in infrastructure stabilization. Another area where research has been conducted, is the possibility of using mining waste as a source of fertilization. Through these methods, terrains occupied by deposits can be entirely cleared.

KEYWORDS: *tailing, sterile, construction, admixture*

1 Introducere

Romania este o tara care dispune de cantitati semnificative si tipuri variate de resurse minerale, cum ar fi minereuri cu conținut aurifer, argint, magneziu, cupru, minereuri feroase si polimetalice, smd.

Deşeurile extractive sunt definite în Directiva privind managemetul deşeurilor din industria extractiva după cum urmează: "Deşeuri rezultate din prospectare, din extracţia, tratarea şi depozitarea resurselor minerale şi din exploatarea în cariere."

In urma activitatii extractive si de procesare, rezulta o cantitate insemnata de deseuri miniere, sub forma de steril mineral. Conform institutiilor de statistica Europene, activitatea miniera si extractive din Europa genereaza peste 50% din totalul deseurilor industriale. Cea mai mare cantitate din aceste deseuri este depozitata in halde si iazuri de decantare. (Castro-Gomes et ale, 2011). Pentru o buna perioada de timp pe plan mondial, depozitele de steril au fost considerate deseuri fara posibilitate de utilizare ulterioara. La ora actuala, se urmareste realizarea unor programe de cercetare mondiale pentru a se putea determina posibilitatea utilizarii sterilului minier in varii domenii. Procesarea sterilelor minerale solide si obtinerea de subproduse utilizabile economic are importanta majora, atat din punct de vedere economic cat si din punct de vedere al managementului mediului, avand un impact major asupra protejarii mediului inconjurator. La nivel modial cat si national au fost efectuate cercetari care au urmarit dezvoltarea de tehnologii de procesare a sterilelor miniere, in vederea obtinerii de produse care pot fi valorificate.

2 Caracterizarea deseurilor rezultate in urma exploatarilor miniere

In urma operatiiunilor de preparare, rezulta deseuri miniere care se consituie in general in material steril. Acesta se afla in aceasta faza in suspensie in apa. Acest amestec se introduce intr-un bazin de decantare in vederea sedimentarii fazei solide.

Tipuri de depozite in industria miniera:

- După modul de transport si stocare:
  - depozitare şi stocare în stare uscată – *halde*;
  - depozitare în amestec de apă – *iazuri de decantare.*

In continuare vom descrie problemele si caracteristicile reziduurilor miniere in faza solida.

În România, de-a lungul timpului, au fost construite, ca urmare a activităţilor miniere, 64 de iazuri de decantare, care ocupă o suprafaţă de aproape 1350 ha şi înmagazinează peste 350 milioane m3 de steril. (Fodor, 2006).

Efectele negative generate asupra mediului înconjurător de construirea şi exploatarea iazurilor de decantare si haldelor sunt: distrugerea şi ocuparea unor mari suprafeţe de teren; poluarea apelor de la suprafaţă sau din subteran cu elemente chimice dizolvate sau cu suspensii de particule solide antrenate din diguri de către apele de ploaie sau de infiltraţii; poluarea aerului cu gaze rezultate din mineralele conţinute în iazuri sau produse prin oxidarea şi arderea acestora; distrugeri materiale şi de vieţi omeneşti datorită pierderii stabilităţii etc. (Fodor, 2006) Utilizarea aproape universală a iazurilor de decantare ca metodă principală de stocare a sterilului şi de tratare a apelor poluate din industria minieră, provine fără îndoială de la faptul că acestea pot îndeplini mai multe funcţii, totul reprezentând un sistem de depozitare şi tratare a sterilului şi a apelor destul de ieftin.

Atunci când se abordează problema securităţii iazurilor de decantare, anumite aspect fundamentale tebuie luate in considerare: stabilitatea fizică, adică ruperea digului în urma unor mecanisme de alunecare, scufundare, eroziune etc; urmatorul aspect priveşte stabilitatea chimică, aceea care se referă la creşterea acidităţii apei; ultimul aspect urmareste infiltrarea de material toxic.

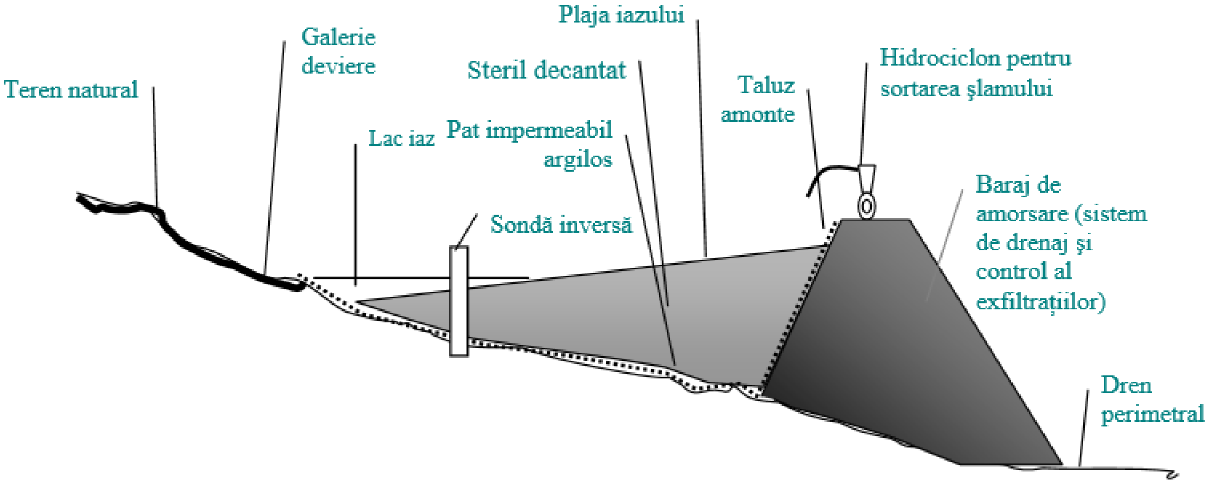

Figure 1: Elemententele principale ale unui iaz de decantare – Victor Raduca, 2010

De asemenea, problemele şi pericolele asociate haldelor de roci sterile generate de exploatările miniere, includ următoarele: instabilitatea taluzurilor, generarea de ape acide şi descărcarea de substanţe toxice care pot conduce la contaminarea apelor de suprafaţă şi subterane din aval, poluarea cu praf şi eroziunea, degradarea terenurilor.

Există două concepte generale de remediere a zonei ocupate de depozitele de steril steril:

a) remedierea in situ,
b) relocarea completă.

Relocarea completă este recomandata atunci cand volumele ce trebuiesc dislocate sunt relativ mici, iar raportul dintre volumul de deşeuri şi aria contaminată este de asemenea mic.

Dacă relocarea este una din soluţiile care pot fi adoptate, vor fi analizate raporturile dintre costuri şi beneficii.

În astfel de cazuri, trebuie avute in vedere urmatoarele aspecte:

- ca distanţa dintre halda care urmează a fi relocată şi noul amplasament să nu fie semnificativă;
- condiţiile tehnice iniţiale şi de infrastructură pentru relocare sunt mai mult sau mai puţin îndeplinite, adică relocarea nu va atrage costuri suplimentare foarte ridicate în conexiune cu măsura de remediere propriu-zisă (de exemplu, pentru construcţia drumului), iar disconfortul populaţiei ca urmare a relocării este în limite acceptabile.

3 Tipuri de deseuri miniere si utilizarea acestora in constructii

Utilizarea reziduurilor miniere ca material de constructii pentru taluzurle drumurilor, autostrazilor, raurilor si indiguiri, in schimbul utilizarii materialelor naturale ori a materialelor de constructii, a crescut in ultimii ani. (Yellishettya et ale, 2008). De asemenea, reziduurile miniere sunt folosite la scara larga pentru imbunatatiri funciare precum si pentru umplerea exploatarilor de suprafata dezafectate. (Skarzynska, 1995b).

Materialele de constructii traditionale, precum materialele refractare, cimentul, betonul, blocurile de pavaj etc, sunt produse din resurse naturale existente. Metodele de productie afecteaza in masura mai mare sau mai mica mediul, datorita exploatarii continue a resurselor naturale. Mai mult, diverse substante toxice sunt eliberate in atmosfera in timpul procesului de fabricare.

Diferite cercetari au fost efectuate la nivel modial cu privire la utilizarea reziduurilor miniere ca adaosuri in material de constructii. Dintre acestea amintim urmatoarele:

Reziduu de cariera – este un reziduu rezultat din producerea agregatelor prin zdrobirea acestora in unitatile de concasare. Reziduu de cariera poate fi utilizat ca substitut pentru nisipul folosit in materialele de constructii. Utilizarea deșeurilor carieră ca un substitut de nisip în materiale de constructii ar rezolva problemele de mediu cauzate de epuizarea surselor naturale de nisipuri de rau, sa. (Ilangovana et al., 2008). Reziduu de cariera poate fi o alternativa cu impact economic pozitiv asupra costului general de constructie. Acest aspect este puternic influentat de distanta de transport.

De asemenea, reziduu de cariera este folosit si in constructiile de drumuri, iar Safiuddin et al. (2007) au raportat ca adaosul de reziduu de cariera nu afecteaza lucrabilitatea, rezistanta si modulul elastic al betonului. Safiuddin et al (2000a,b) au produs betoane de inalta rezistenta inlocuind partial in fabricarea acestuia, nisipul cu reziduu de cariera. Ho et al. (2002) a inclus reziduu de cariera in betonul autocompactant pentru a studia imbunatatirea proprietatii de autocompactare. Deasemenea, Felekoglu (2007) a aratat ca o cantitate reonabila de reziduu de cariera poate fi utilizat in betoanele autcompactante fara a afecta rezistenta a compresiune a acestuia. Asadar, utilizarea cu success a acestui material in betoanele de inalta performanta si autocompactante, poate transforma acest rezisduu intr-o resursa valoroasa.

Reziduu minier, in mod special deseul format din roca, are adeseori proprietati asemanatoare cu rocile folosite ca agregate. Acest lucru face porțiuni ale rocilor sterile generate de industria miniera sa poata fi folosite ca substitut al agregatelor de cariera. Este important de retinut că trebuie a fi folosite numai roci sterile cu concentrații scăzute de contaminanți. (Yellishettya et. Al, 2008)

Studii de caz au fost intocmite cu privire la utilizarea directă și după zdrobire și sortare a reziduurilor sterile. Extracția cărbunelui generează cantități mari de deșeuri miniere și mai multe fracții de deșeuri pot fi utilizate pentru producția de agregate. (Bäckström)

Mai multe grupuri de cercetare au studiat posibilitatea de a produce produse ceramice dintr-o varietate de deșeuri minerale solide (Fin și Heising 1968, Kluth, 1984; Treime-Stevens, 1995). In cadrul West Virginia University s-a dezvoltat un procedeu de obținere a cărămizilor de construcție pornind de la deșeuri miniere și steril. Universitatea Stanford a studiat posibilitatea de a folosi steril silicios din iazul de decantare a unei mine de aur din California ca materie primă pentru ca cărămizi (Mining Journal, 2000).

De asemenea, Colorado School of Mines a efectuat numeroase investigații în vederea obținerii cărămizi de construcție din diverse iazuri de mină, situate pe intreg Colorado (BöVING și Herold, 1967). Dean și colab. (1986) au investigat utilizarea sterilului rezultat din exploatarea mineralelor si obtinerea cuprului, pentru a face cărămizi de construcție. Ei observă că prin utilizarea acestui material în activități economice, problemele socio-economice ale închidere a minelor pot fi atenuate. Posibilitatea utilizari sterilului minier de haldă în producerea de blocurilor de caramida a fost investigat ca parte a cercetării intensive în vederea valorificării deșeurilor în 1970 (Collins și Miller, 1979).

Cupru, plumb, zinc și minereu de fier steril din diverse surse americane au fost folosite pentru a produce blocuri cimentate. Investigații în Statele Unite ale Americii, Canada și Marea Britanie au arătat că sterilul și deșeurile miniere au potențial de utilizare în fabricarea de materiale de constructii, sticla, ceramica ș.a. (Hansen et al., 1968).

În India, unele exemple sunt fabricarea sticlei prin utilizarea de cuarț și feldspat din deșeuri miniere. (IBM, 2002, Kumar, 2000).

Mai multe studii ale Universitatii de Stat din Montana, Statele Unite ale Americii, au aratat ca blocuri de beton realizate cu adaosuri de steril rezultat din exploatarea depozitelor de aur, amestecate cu cenușă de termocentrala și ciment de portland, au prezentat caracteristici fizico-mecanice avansate fata de betonul standard (Trinity-Stevens, 1995).

În mod similar, blocuri de beton realizate cu adaosuri de materiale rezultate in urma interventiilor de reciclare si ecologizare a haldelor de steril minier din metale comune din zona Melbourne, Australia (Struthers, 1999), au prezentat rezistente la forte de compresiune superioare fata de blocuri convenționale.

Williams (1996) au făcut, de asemenea, o trimitere cu privire la tendințele în utilizarea deșeurilor miniere și a deșeurilor metalurgice in constructii. Deșeuri miniere sunt uneori privite ca o resursă și poate fi potrivit ca agregate pentru construcția de drumuri și materiale de construcții. Există propuneri de a le utiliza pentru a face beton. Cu toate acestea, volumul lor este atât de mare încât este greu de a vedea mai mult de o mică parte din acestea fiind folosite în acest mod. De asemenea, acestea ar trebui să fie folosite cu grijă, în special în industria construcțiilor deoarece contaminanții regăsiți în deșeuri miniere, uneori s-ar putea crea probleme de mediu pe termen lung (Struthers, 1999).

4 Utilizarea reziduurilor miniere in stabilizarea solurilor argiloase

Pământurile cu umflări și contracții mari, întâlnite sub denumirea de pământuri expansive sau contractile, reprezintă o mare provocare pentru inginerii constructori și inginerii geotehnicieni din întreaga lume. Costurile asociate daunelor provocate de fenomenele de umflare-contracție a argilelor active asupra construcțiilor se ridică la miliarde de euro anual.

Sol expansiv este un termen aplicat în mod general pentru a descrie orice pământ care, în special în situația schimbării regimului hidrostatic, prezintă potențial de variație a volumului, așadar pot exista solicitări suplimentare în teren. (Al-Rawas et. Al, 2006)

Figure 2: Fisuri cauzate de scaderea nivelului hidric într-un sol bogat argilă.

Photo courtesy of Yuna Mika.

Fenomene repetitive de contracție-umflare a argilelor active pot duce la costuri mari de reparație a daunelor provocate construcțiilor, iar, în unele cazuri, pot chiar să ducă la necesitatea demolării clădirii, atunci când costul reparației depășeste valoarea construcției.

5 Metode de Îmbunătățire a Terenului de Fundare prin adaosuri

Pământurile ale caror proprietăți inginerești nu prezintă siguranță pentru amplasarea construcțiilor inginerești sunt, în general, cele care conțin fracțiuni mari de argilă, în special argile montmorillonitice, deoarece acestea pot suferi variații mari de volum atunci când sunt supuse unui proces de uscare-umezire.

Diferite tipuri de tratare mecanică sau stabilizare chimică sunt disponibile pentru a reduce sau elimina complet potențialul de variație de volum a pământurilor cu umflări și contracții mari.

Dintre metodele de tratare amintim: pre-umezirea solului, controlul umidității, stabilizarea chimică, controlul compactării in situ, înlocuirea solului problematic, utilizarea elementelor de armare.

O investigare riguroasa trebuie efectuata preliminar alegerii metodei de imbunatatire a pamantului de fundare, pentru a alege solutia cu randamentul maxim, corelat cu utilizarea ulterioara a constructiei si parametrii geotehnici care se doresc a fi atinsi dupa imbunatatire. Fiecare procedura necesita aplicarea unei metodologii specifice si este recomandată o documetare considerabila anterior aplicatii solutiei pentru a cunoaste limitarile fiecarei proceduri in parte.

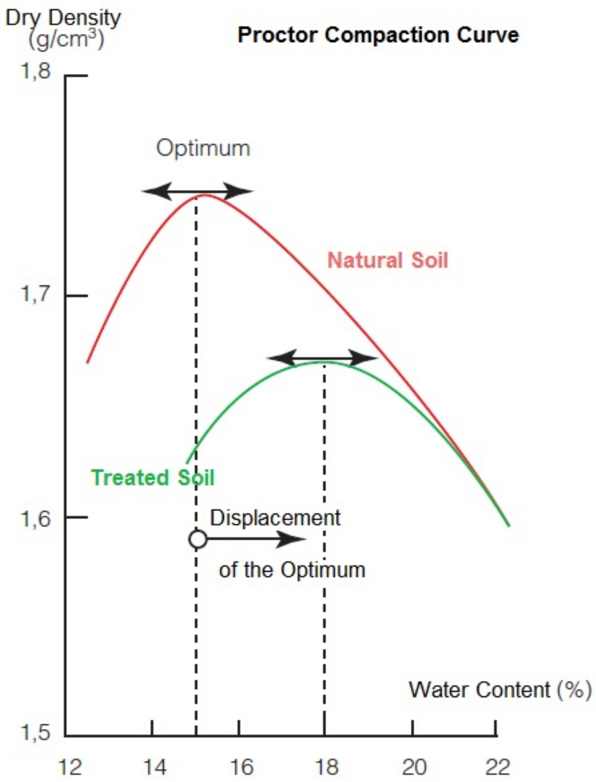

Figure 3: Curba de compactare Proctor

5.1 Reziduu de cariera

Sabat și Das (2009) au stabilizat un anumit tip de sol expansiv folosind praf rezultat din exploatarea in carieră și de var pentru consolidarea stratului de baza al unui drum rural pentru trafic cu volum redus. Proprietățile testate au fost de compactare (Proctor standard), UCS, CBR și Ps. Aceasta metoda s-a dovedit a fi eficienta din punct de vedere economic in conditiile unui trafic cu volum redus.

5.2 Praf de marmura

Praful de marmură este deșeul / pulberea produsă în timpul tăierii și lustruirii marmurei. Swami (2002) și, Palaniappan și Stalin (2009) sa stabilizat sol expansiv folosind praf de marmură și au constata ca proprietățile solului expansiv au fost in mod semnificativ îmbunătățirea. Zhang și colab., (2013)

Gupta și Sharma (2014) au studiat efectul cenușii de termocentrala, nisipului și prafului de marmură asupra compactarii și valorile CBR ale solului expansiv. nu a fost de aproximativ creștere de 200% a CBR pentru proba de sol saturat cu sol -52.36%, nisip-22.44%, cenușă zburătoare -13.2% si marmura praf de 12%.

5.3 Var - Lime Stone Dust

Al-Azzo (2009) a studiat efectul stabilizator al varului asupra proprietăților mecanice ale solului argilos expansiv. Diferitele procente de var adăugat au fost 2, 4, 6, 8 și 10% . S-a constatat a reducere in plasticitatea argilei și a scădere semnificativă a coeficientului de expansiune.

5.4 *Reziduu minier de halda* - **Ramesh et al. (2013)**

A studiat proprietățile amestecurilor de sol expansiv – reziduu minier de iaz de decantare, cu și fără var, luand in considerare inclusiv efectul perioadei de conservare și a găsit îmbunătățire a proprietăților mecanice ale solului expansiv.

6 Concluzii

Impactul activității miniere de exploatare este de o complexitate deosebită şi are o acţiune directă cu efecte negative asupra factorilor de mediu, dar şi asupra confortului comunităţii locale. Aceste activitati se defășoară pe perioade indelungate și afectează arii extinse. Impactul produs asupra mediului, se rasfrange atat local cât și zonale, cu efecte pe termen lung, acumulate pe parcursul întregii perioade de exploatare, dar şi după încheierea acesteia.

Pentru o buna perioada de timp pe plan mondial, depozitele de steril au fost considerate deseuri fara posibilitate de utilizare ulterioara. La ora actuala, se urmareste realizarea unor programe de cercetare mondiale pentru a se putea determina posibilitatea utilizarii sterilului minier in varii domenii și deci redarea ulterioara a zonelor afectate in circuitul natural.

Gasirea metodelor potrivite de valorificare a deseurilor miniere are un efect pozitiv atat asupra mediului cat si asupra climatului economic.

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Aspecte privind modul de aplicare al legii civile în litigiile cu privire la exproprierea pentru cauză de utilitate publică

Coandreş Ciprian

Abstract

Legea 33/1994 privind exproprierea pentru cauză de utilitate publică defineşte cadrul legal prin care statul este îndrituit sub rezerva edificării unor lucrări de utilitate publică să priveze persoanele fizice/juridice de atributele dreptului de proprietate asupra imobilelor. În timp, aplicarea acestor dispoziţii legale a suscitat numeroase dezbateri doctrinare şi a generat numeroase litigii, aspectele de drept disputate vizând în esenţă – procedura şi formalismul juridic al exproprierii, aspecte legate de calitatea procesual activă a persoanei expropriate, cuantificarea prejudiciului şi definirea noţiunii de despăgubire. Sub acest aspect, al practicii judecătoreşti, vom analiza în cele ce urmează două hotărâri ale Înaltei Curţi de Casaţie şi Justiţie, pronunţate la nivelul anului 2014 şi care dezleagă în mod diferit probleme de drept similare.

Cuvinte cheie: expropriere pentru cauză de utilitate publică, jurisprudenţa Înaltei Curţi de Casaţie şi Justiţie, expropriere de fapt, Legea 33/1994 privind privind exproprierea pentru cauză de utilitate public, despăgubire

Preliminarii

Prin Decizia nr. 254/28.01.2014 pronunţată în DC 1523/97/2010 şi Decizia 1221/10.04.2014 pronunţată în DC 1524/97/2010, Înalta Curte de Casaţie şi Justiţiei, în soluţionarea a două acţiuni în constatare generate de aplicarea Legii 33/1994 privind exproprierea pentru cauză de utilitate publică, s-a pronunţat în mod diferit, obiectul acţiunilor introductive fiind identic, doar persoana reclamantului fiind diferită în aceste acţiuni civile. Vom rezuma în cele ce urmează fondul dedus judecăţii în cele două litigii, instituţiile juridice incidente şi elementele de diferenţiere dintre cele două hotărâri din perspectiva atributului instituţional de uniformizare a practicii judecătoreşti pe care Înalta Curte de Casaţie şi Justiţie îl exercită.

Prin acţiunea ce a făcut obiectul DC 1523/97/2010, introdusă la 01.10.2010, reclamantul M.I. a chemat în judecată SC HIDROELECTRICA SA Bucureşti prin Sucursala Hidrocentrale Haţeg şi a solicitat instanţei următoarele:

Să constate că M. I. este în calitate de moştenitor al lui J. I. (bunic) al lui M. A. (tată) şi al defunctei M. C.

- n. J. (mamă), proprietar al suprafeţelor de teren ocupate abuziv din anul 1990 de către pârâta SC HIDROELECTRICA SA şi expropriate pentru cauză de utilitate publică declarată prin HG 392/2002, suprafeţe individualizate în CF 145 Subcetate – nr. cadastral 2112,2113, CF 735 Subcetate - nr. cadastral 1911, 2057/1, 2132, 2133, 2134, 2059/2, CF 210 Subcetate - nr. cadastral 1910 Să fie obligată pârâta SC HIDROELECTRICA SA, prin Sucursala Hidrocentrale Haţeg în calitate de expropriator, într-un termen stabilit potrivit art. 30 din Legea 33/1994, la plata unei despăgubiri aferente terenului ocupat, compusă din:

valoarea reală a terenului afectat de lucrările de amenajare hidroenergetică a râului Strei,_la un preţ de 9 euro/mp, echivalent în lei la data plăţii efective prejudiciul suferit prin lipsa de folosinţă a terenului pe perioada 1990-2010, respectiv contravaloarea produselor şi a recoltei care s-ar fi obţinut pe acest teren potrivit cu natura şi destinaţia acestui teren din cartea funciară

Acţiunea introductivă a fost soluţionată în fond în sensul obligării pârâtei SC Hidroelectrica SA la plata cu titlu de despăgubire a sumei de 264.409 lei(echivalent a 62.656 euro) reprezentând valoarea terenurilor expropriate şi suma de 94.707 lei, reprezentând prejudiciul creat reclamantului pentru lipsa folosului agricol pe perioada 2002-2010 inclusiv.

Împotriva acestei sentinţe a fost declarat apel de către pârâta SC Hidroelectrica SA, cale de atac ce a fost admisă în parte, în sensul modificării sentinţei de fond sub aspectul limitării folosului de agricol pentru perioada 2007-2010(faţă de 2002-2010 cum stabilise instanţa de fond).

Decizia Curţii de Apel Alba Iulia a fost atacată cu recurs de ambele părţi litigante, soluţia Înaltei Curţi de Casaţie şi Justiţie prin DC 254/28.01.2014 fiind de a respinge recursurile declarate şi în consecinţă de a menţine decizia Curţii de Apel Alba Iulia. Astfel, la finalizarea tuturor etapelor jurisdicţionale soluţia pronunţată în cauză a fost de a obliga pârâta SC Hidroelectrica SA la plata cu titlu de despăgubire a sumei de 264.409 lei(echivalent a 62.656 euro) reprezentând valoarea terenurilor expropriate şi suma de 42.092 lei, reprezentând prejudicial creat reclamantului pentru lipsa folosului agricol pe perioada 2007-2010 inclusiv.

Prin acţiunea ce a făcut obiectul D 1524/97/2010, introdusă la 01.04.2010, reclamanta B.M. a chemat în judecată SC HIDROLELECTRICA SA Bucureşti prin Sucursala Hidrocentrale Haţeg şi a solicitat instanţei următoarele:

Să se constate că BM este în calitate de succesoare a soţului B. A., proprietară a suprafeţelor de teren ocupate abuziv din anul 1990 de către pârâta SC HIDROELECTRICA SA şi expropriate pentru cauză de utilitate publică declarată prin HG 392/2002, suprafeţe individualizate în CF 579 Subcetate – nr. cadastral 593/1, CF 816 Subcetate - nr. cadastral 1934/2, 1935/2, CF 890 Subcetate - nr. cadastral 674/1, 676/2, CF 1000 Subcetate - nr. cadastral 586, 587, CF 1137 Subcetate - nr. cadastral 470, 713, 930, 932, 934, 936 Să fie obligată pârâta SC HIDROELECTRICA SA, prin Sucursala Hidrocentrale Haţeg în calitate de expropriator, într-un termen stabilit potrivit art. 30 din Legea 33/1994, la plata unei despăgubiri aferente terenului ocupat, compusă din:

valoarea reală a terenului afectat de lucrările de amenajare hidroenergetică a râului Strei,_la un preţ de 9 euro/mp, echivalent în lei la data plăţii efective prejudiciul suferit prin lipsa de folosinţă a terenului pe perioada 1990-2010, respectiv contravaloarea produselor şi a recoltei care s-ar fi obţinut pe acest teren potrivit cu natura şi destinaţia acestui teren din cartea funciară

Acţiunea introductivă a fost soluţionată în fond în sensul obligării pârâtei SC Hidroelectrica SA la plata cu titlu de despăgubire a sumei de 244.377 lei reprezentând valoarea terenurilor expropriate şi suma de 77.971 lei, reprezentând prejudiciul creat reclamantei pentru lipsa folosului agricol pe perioada 2002-2010 inclusiv.

Părţile în litigiu au declarat apel împotriva acestei sentinţe, Curtea de Apel Alba Iulia pronunţându-se prin DC 61/2013 în sensul admiterii apelurilor şi schimbării în parte a sentinţei pronunţată de tribunal, în sensul acordării despăgubirilor într-un cuantum majorat, potrivit categoriei de folosinţă a terenului(arabil) respectiv 550.261 lei şi limitării folosului agricol pentru perioada 2007-2010 – 87.920 lei.

Înalta Curte de Casaţiei şi Justiţie a fost investită cu soluţionarea recursurilor declarate de părţile litigante şi s-a pronunţat prin Decizia 1221/10.04.2014 în sensul admiterii căilor de atac cu consecinţa casării deciziei recurate şi trimiterii cauzei la instanţa de apel în vederea rejudecării.

Rezumând, finele juridic al celor două cauze civile după epuizarea căii de atac a recursului şi pronunţarea unor soluţii de către Înalta Curte de Casaţiei şi Justiţie, rezultă următoarele evidenţe:

prin Decizia nr. 254/28.01.2014, cel mai înalt for jurisdicţional din România a respins recursurile promovate şi a menţinut soluţia de fond, respectiv constatarea calităţii de proprietar şi persoană îndreptăţită la despăgubiri pentru reclamant şi obligarea pârâtei SC Hidroelectrica SA la plata unei despăgubiri reprezentate de valoarea imobilului expropriat şi prejudicul creat prin lipsa de folosinţă a terenurilor pe o perioadă anterioară de 3 ani de la momentul promovării acţiunii

prin Decizia 1221/10.04.2014 , la 3 luni de la decizia amintită mai sus, Înalta Curte de Casaţie şi Justiţie îşi infirmă propria jurisprudenţă, admite recursurile promovate şi trimite cauza la instanţa de apel în vederea rejudecării enunţând în esenţă ca în rejudecare să fie avute în vedere următoarele: reclamantul nu a făcut dovada proprietăţii terenurilor expropriate, reclamantul nu a uzat de calea Legii 1/2001 sau a Legii 18/1991 şi nu au fost respectate dispoziţiilor art. 26 din Legea 33/1994 cu privire la despăgubire şi cuantificarea acesteia.

Aspecte cu privire la aplicarea Legii 33/1994 de către Înalta Curte de Casaţie şi Justiţie în soluţionarea litigilor civile generate de exproprierea pentru cauză de utilitate publică

Reiterând sintetic cele dezvoltate anterior, amintim că aspectele factuale care au generat ivirea litigiilor civile sunt date de ocuparea fără drept de către statul roman, în cursul anului 1990, a unor terenuri proprietate privată. Terenurile au făcut obiectul unor amenajări hidroelectrice, iar apoi retroactiv prin HG 392/2002 s-a declarat caracterul de utilitate publică al lucrărilor şi a fost declanşată post factum procedura de expropriere a terenurilor ocupate, procedură care nu a fost finalizată până în prezent prin despăgubirea celor afectaţi şi lipsiţi proprietatea terenurilor.

Soluţiile pronunţate în cauzele civile analizate sunt antagonice prin: aplicabilitatea în cauze a dispoziţiilor Legii 18/1991 şi a Legii 1/2000, abordările conceptuale ale Legii 33/1994, interpretarea noţiunilor de expropriere de fapt şi despăgubire corelativ cu jurisprudenţa CEDO în cauza Burghelea contra României, aplicarea eronată a dispoziţiilor legale ce guvernează activitatea secţiilor din cadrul Înaltei Curţi de Casaţie şi Justiţie potrivit Legii 304/2004 privind organizarea judiciară.

În primul rând se impune să amintim contradicţiile flagrante strecurate în considerentele Deciziei 1221/10.04.2014 cu privire la aplicabilitatea Legii 18/1991 şi a Legii 1/2000. Astfel, iniţial dezlegând o excepţie de inadmisibilitate cu privire la acţiunea introductivă, instanţa statuează "Înalta Curte constată ca nefondate argumentele pârâtului(n.a SC Hidroelectrica SA) în sensul că reclamanta putea beneficia de dispoziţiile din Legea 1/2000 întrucât această normă este anterioară exproprierii şi nu poate produce efecte ultraactiv " pentru ca apoi să reţină " nu s-a dovedit în cauză că autorul reclamantei sau succesori ai acestuia s-au adresat comisiei speciale constituite în temeiul Legii nr. 18/1991, respectiv 1/2000 pentru obţinerea titlului de proprietate asupra terenurilor în litigiu". Apreciem că instanţa în deliberarea sa şi în cântărirea argumentelor de fapt şi drept a omis să observe că aplicarea în timp a Legii 18/1991 şi a Legii 1/2000 se întinde până la data de 1 ianuarie 1990 şi ca atare nu pot fi incidente în cauză dispoziţiile legale amintite în condiţiile în care preluarea fără just titlu a fost iniţiată de statul roman ulterior datei de 01.01 1990.

De asemenea, instanţa reţine cu titlu critic, ca temei al casării cu trimitere, că "reclamanta nu a făcut dovada proprietăţii asupra terenului de pe urma căruia a solicitat despăgubirile aferente, motiv pentru care se constată că decizia instanţei de apel a fost dată cu încălcarea prevederilor art. 2 din Legea 33/1994, conform cărora pot fi expropriate bunurile imobile proprietatea persoanelor fizice sau juridice". Mai mult, în interpretarea art. 26 din Legea 33/1994 instanţa apreciază că reclamantului nu i se cuvin despăgubiri pentru lipsa de folosinţă a terenului întrucât la momentul declarării exproprierii (n.a 2002) "nu mai avea posesia terenurilor în litigiu". Aceste argumente sunt inapte juridic şi lipsite de logică raportat la evidenţele factuale

ale cauzei întrucât reclamantul/proprietarul expropriat nu a putut face dovada posesiei efective datorită faptului că a fost lipsit de acest atribut al dreptului de proprietate chiar prin forţa arbitrară a statului, prin preluarea imobilelor într-o primă etapă, fără titlu şi formalizând juridic o situaţie post factum, ca efect al HG 392/2002- prin expropriere. Apreciem că prin această susţinere Înalta Curte de Casaţie şi Justiţie lipseşte de conţinut noţiunea de despăgubire prevăzută de art. 26 din Legea 33/1994 şi înţelegerea pe care CEDO prin cauza Burghelea contra României o dă acestei instituţii – justeţea şi proporţionalitatea despăgubirii raportându-se atât la valoarea intrinsecă a imobilului cât şi la veniturile ce puteau fi obţinute din cultivarea acestor terenuri. Amintim aici că în cauza Burghelea/România, statul roman a fost condamnat de către Curtea Europeană a Drepturilor Omului, întrucât nu a realizat justa şi prealabila despăgubire potrivit dispoziţiilor constituţionale şi ale Legii 33/1994. În soluţionarea acestei cauze instanţa europeană a invocat pentru prima oară noţiunea de expropriere de fapt şi a definit această ficţiune juridică ca fiind situaţia în care statul preia/foloseşte fără titlu imobile proprietate privată şi nu realizează despăgubirea celui lezat în dreptul său de proprietate.

Din punct de vedere al prerogativelor instituţionale exercitate de Înalta Curte de Casaţie şi Justiţie, pronunţarea celor două hotărâri este în antagonie cu rolul şi scopul acestui for jurisdicţional în paradigma de funcţionare a justiţiei civile în România. Astfel, legiuitorul consacră în mod expres prin dispoziţiile art. 26 din Legea 304/2004 că în situaţia în care una din secţiile din cadrul Înaltei Curţi de Casaţie şi Justiţie consideră necesar să revină asupra propriei jurisprudenţe este obligată să suspende cauza şi să sesizeze Secţiile Unite în vederea lămuririi aspectelor jurisprudenţiale. Prin urmare, câtă vreme exista o practică constantă la nivelul secţiei civile, ea nu putea fi reanalizată decât de către Secţiile Unite ale Înaltei Curţi de Casaţie şi Justiţie, iar mai apoi cauzele să fie soluţionate în baza acestor orientări/lămuriri jurisprudenţiale.

Concluzii

Analiza celor două cauze, surprinzătoare prin antagonismul soluţiilor pronunţate relevă câteva concluzii:

- în prezent dreptul substanţial şi dreptul procedural român nu cunoaşte remedii juridice pentru a îndrepta aceste regretabile inconsecvenţe jurisprudenţiale la nivelul Înaltei Curţi de Casaţie şi Justiţie
- la o nouă revizuire a dispoziţiilor legale incidente se impune de lege ferenda ca legiuitorul să completeze şi să sancţioneze procedural încălcarea dispoziţiilor art. 26 din Legea 304/2004

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ASPECTE LEGISLATIVE PRIVIND APLICAREA LEGII FONDULUI FUNCIAR IN CAZUL EXPLOATARILOR MINIERE LA ZI

Tivig Dumitru Filip, Mariana Negru

Rezumat

Exploatarea zăcămintelor de substanțe minerale utile s-a făcut din cele mai vechi timpuri in exploatări de suprafață si in subteran. In ultima suta de ani exploatările miniere la suprafață au obținut un randament si o productivitate ridicata odată cu dezvoltarea tehnologica si progresul metodelor de exploatare. Exploatările la suprafață sunt mult mai avantajoase decât cele din subteran solicitând resurse mai mici pentru capacități de producție comparabile, acestea producând peste 75% din producția mondiala de substanțe minerale utile.

1 Introducere

La noi in tara multe din exploatările miniere de suprafață si-au început activitatea înainte de 1990, începându-si activitatea in perioada in care Statul Roman era o republica comunista. Suprafețele de teren pe care multe din exploatările miniere le ocupa erau in proprietatea Statului Roman, după 1990 a fost adoptata o noua legislație in domeniul funciar care sa respecte dreptul la proprietate, prin care multe din terenurile preluate de Statul Roman prin legi abuzive (colectivizare si naționalizare) au fost retrocedate vechilor proprietari.

2 Scurta prezentare a legislației privind fondul funciar

In decursul ultimilor 25 de ani au fost emise mai multe legi prin care s-au retrocedat proprietățile deținătorilor (sau urmașilor acestora) de la data in care au fost preluate de Statul Roman, acestea formând un pachet de legislativ care a fost emis succesiv si care au tratat parțial problematica funciara, rezultând in final un sistem stufos si cu multe prevederi contradictorii.

Dintre aceste prevederi legale, enumeram:

a) **Legea fondului funciar nr. 18/1991** privind terenurile de orice fel, indiferent de destinaţie, de titlul pe baza căruia sunt deţinute sau de domeniul public ori privat din care fac parte, constituie fondul funciar al României.

b) **Legea nr. 169/1997** pentru modificarea şi completarea Legii fondului funciar nr. 18/1991

c) **Legea nr. 1/2000** pentru reconstituirea dreptului de proprietate asupra terenurilor agricole şi celor forestiere, solicitate potrivit prevederilor Legii fondului funciar nr. 18/1991 şi ale Legii nr. 169/1997

d) **Legea nr. 247/2005** privind reforma în domeniile proprietăţii şi justiţiei, precum şi unele măsuri adiacente

e) Regulamentul privind procedura de constituire, atribuţiile şi funcţionarea comisiilor pentru stabilirea dreptului de proprietate privată asupra terenurilor, a modelului şi modului de atribuire a titlurilor de proprietate, precum şi punerea în posesie a proprietarilor, aprobat prin H.G. nr. 890/2005

f) Norma metodologică de aplicare a Titlului VII "Regimul stabilirii şi plăţii despăgubirilor aferente imobilelor preluate în mod abuziv" din Legea nr. 247/2005 privind reforma în domeniile proprietăţii şi justiţiei, precum şi unele măsuri adiacente, aprobată prin H.G. nr. 1095/2005

g) **O.U.G nr. 81/2007** pentru accelerarea procedurii de acordare a despăgubirilor aferente imobilelor preluate în mod abuziv

h) **Legea nr. 193/2007** privind modificarea şi completarea Legii nr. 1/2000 pentru reconstituirea dreptului de proprietate asupra terenurilor agricole şi celor forestiere, solicitate potrivit prevederilor Legii fondului funciar nr. 18/1991 şi ale Legii nr. 169/1997

i) **Legea nr. 261/2008** privind modificarea şi completarea art. 29 din Legea nr. 1/2000 pentru reconstituirea dreptului de proprietate asupra terenurilor agricole şi celor forestiere, solicitate potrivit prevederilor Legii fondului funciar nr. 18/1991 şi ale Legii nr. 169/1997

j) **Legea nr. 67/2010** pentru modificarea alin. (3) al art. 18 din Legea fondului funciar nr. 18/1991

k) **O.U.G nr. 62/2010** pentru modificarea şi completarea Legii nr. 221/2009 privind condamnările cu caracter politic şi măsurile administrative asimilate acestora, pronunţate în perioada 6 martie 1945-22 decembrie 1989, şi pentru suspendarea aplicării unor dispoziţii din Titlul VII al Legii nr. 247/2005 privind reforma în domeniile proprietăţii şi justiţiei, precum şi unele măsuri adiacente

l) **Legea nr. 160/2010** privind completarea art. 23 din Legea nr. 1/2000 pentru reconstituirea dreptului de proprietate asupra terenurilor agricole şi celor forestiere, solicitate potrivit prevederilor Legii fondului funciar nr. 18/1991 şi ale Legii nr. 169/1997

m) **Legea nr. 267/2011** privind abrogarea alin. (1) al art. 3 din Legea nr. 1/2000 pentru reconstituirea dreptului de proprietate asupra terenurilor agricole si celor forestiere, solicitate potrivit prevederilor Legii fondului funciar nr. 18/1991 si ale Legii nr. 169/1997

n) **Legea nr. 165/2013** privind măsurile pentru finalizarea procesului de restituire, în natură sau prin echivalent, a imobilelor preluate în mod abuziv în perioada regimului comunist în România.

3 Absenta prevederilor legale privind responsabilitatea proprietarilor fata de comunitate, in situația in care exista rezerve de substanțe minerale utile de interes public in subsolul proprietăților deținute.

Resursele minerale situate pe teritoriul şi în subsolul ţării şi al platoului continental în zona economică a României din Marea Neagră, delimitate conform principiilor dreptului internaţional şi reglementărilor din convenţiile internaţionale la care România este parte, fac obiectul exclusiv al proprietăţii publice şi aparţin statului român. (Conform Legii minelor numărul 85/2003).

Articolul 44 din Constituția României privind dreptul la proprietate privata prevede in mod exclusiv numai drepturile proprietarului fără a se prevede si responsabilități ale proprietarului fata de comunitate, astfel:

(1) Dreptul de proprietate, precum si creanțele asupra statului, sunt garantate. Conținutul si limitele acestor drepturi sunt stabilite de lege.

(2) Proprietatea privată este garantată şi ocrotită în mod egal de lege, indiferent de titular. Cetăţenii străini şi apatrizii pot dobândi dreptul de proprietate privată asupra terenurilor numai în condiţiile rezultate din aderarea României la Uniunea Europeană şi din alte tratate internaţionale la care România este parte, pe bază de reciprocitate, în condiţiile prevăzute prin lege organică, precum şi prin moştenire legală.

(3) Nimeni nu poate fi expropriat decât pentru o cauză de utilitate publică, stabilită potrivit legii, cu dreaptă şi prealabilă despăgubire.

(4) Sunt interzise naţionalizarea sau orice alte măsuri de trecere silită în proprietate publică a unor bunuri pe baza apartenenţei sociale, etnice, religioase, politice sau de altă natură discriminatorie a titularilor.

(5) Pentru lucrări de interes general, autoritatea publică poate folosi subsolul oricărei proprietăţi imobiliare, cu obligaţia de a despăgubi proprietarul pentru daunele aduse solului, plantaţiilor sau construcţiilor, precum şi pentru alte daune imputabile autorităţii.

(6) Despăgubirile prevăzute în alineatele (3) şi (5) se stabilesc de comun acord cu proprietarul sau, în caz de divergenţă, prin justiţie.

(7) Dreptul de proprietate obligă la respectarea sarcinilor privind protecţia mediului şi asigurarea bunei vecinătăţi, precum şi la respectarea celorlalte sarcini care, potrivit legii sau obiceiului, revin proprietarului.

Daca in subsolul terenului proprietate privata a deținătorului persoana fizică sau juridica, se afla resurse minerale, acestea vor putea fi exploatate doar in baza unei licențe de exploatare emisa in condițiile legii de către autoritatea competenta, aceasta fiind Agenția Națională de Resurse Minerale.

4 Formele legale de obținere a accesului la rezervele din subsolul teritoriului național.

Conform articolului 6 din legea 85/2003 dreptul de folosinţă a terenurilor necesare efectuării activităţilor miniere din perimetrul de explorare/exploatare se dobândeşte, în condiţiile legii, prin:

a) vânzarea-cumpărarea terenurilor şi, după caz, a construcţiilor situate pe acestea, la preţul convenit între părţi;

b) schimbul de terenuri, însoţit de strămutarea proprietarului afectat şi de reconstrucţia clădirilor pe terenul nou-acordat, pe cheltuiala titularului care beneficiază de terenul eliberat, conform convenţiei încheiate între părţi;

c) închirierea terenului pe durată determinată, pe bază de contracte încheiate între părţi;

d) exproprierea pentru cauză de utilitate publică, în condiţiile legii;

e) concesionarea terenurilor;

f) asocierea dintre proprietarul terenului şi titularul de licenţă;

g) alte proceduri prevăzute de lege.

5 Aplicabilitatea legislației privind transferul dreptului de proprietate de la proprietar la agentul economic.

Transferul dreptului de proprietate de la un proprietar la altul se poate face direct prin acte juridice intre vii conform legii.

In cazul in care se dovedește utilitatea publică a resursei/rezervei din subsol, atunci se poate trece la exproprierea proprietăților private. Conform articolului 1 din legea 33/1994 exproprierea de imobile, in tot sau in parte, se poate face numai pentru cauza de utilitate publica, după o dreapta si prealabila despăgubire, prin hotărâre judecătoreasca. De asemenea pentru simplificarea demersurilor de expropriere si o reducere a timpului in care statul poate sa intre in posesia unei proprietăți private a fost emisa o noua lege – Legea 255/2010. Aceasta lege are prevederi exprese aferente lucrărilor de exploatare a zăcămintelor de lignit, ce sunt declarate de interes național si care se execută în baza unei licențe de exploatare aprobate. Licențele de exploatare fiind acordate către operatorii economici aflați sub autoritatea Statului Roman unde acesta are capital integral sau majoritar. Acțiunea de expropriere trebuie sa respecte articolul 44 din Constituția României privind despăgubirea proprietarului, care se poate finaliza pe cale amiabila sau in justiție. Etapele succesive prevăzute de normele de aplicare a legilor funciare si de expropriere conduc la derularea acestora pe o perioada îndelungata. Legislația în vigoare solicita documente care nu sunt încă la dispoziția proprietarilor si a autorităților nici după 25 de ani creează un blocaj major urmare a faptului ca in toata aceasta perioada a fost realizata legătura intre proprietar si proprietate in mod unitar si sistematic. Acest lucru a condus la omiterea de proprietari îndreptățiți sa fie puși in posesie si proprietăți sa fie individualizate coerent (fără a fi suprapuneri sau spatii neatribuite).

Emiterea de către autorități de documente întocmite sumar, cu omisiuni sau elemente spațiale necorelate generează imposibilitatea utilizării înainte de a fi îndreptate. Procedura legala de îndreptare a documentelor deja emise este un consumator de timp si resurse materiale fapt ce întârzie declanșarea faptelor juridice de schimbare a proprietarului atât pe calea civila cat si prin expropriere.

In Figura 1 se pot observa observă 3 imobile, proprietăți private care au același proprietar si nu sunt achiziționate de către agentul economic deținător al licenței de exploatare a resurselor minerale de interes național aflate in subsol. Aceste imobile au fost redobândite de către proprietarul actual după ce s-a început activitatea de exploatare miniera. Imobilul 1 se afla in zona deja afectata de lucrări miniere, iar imobilele 2 si 3 se afla in zone neafectate.

Urmare a acestei situații pentru a nu se sista activitatea de exploatare a întregii exploatări, sunt necesare efectuarea de lucrări miniere de ocolire, astfel fel încât proprietățile sa nu fie afectate de lucrările miniere pana la finalizarea negocierilor de transfer a dreptului de proprietate. Reluarea activității de exploatare in aceasta zona se va putea face doar după achiziționarea imobilelor. Pentru continua extracția in perimetrul aprobat, pana la finalizarea negocierilor, este necesar sa se realizeze lucrări tehnologice si netehnologice neprogramate de ocolire a proprietăților si acestea generează costuri suplimentare de exploatare. In situații limita, pot sa se creeze zone imposibil de exploatat din punct de vedere tehnic si economic ce au ca efect abandonarea de rezerve si pierderi economice importante.

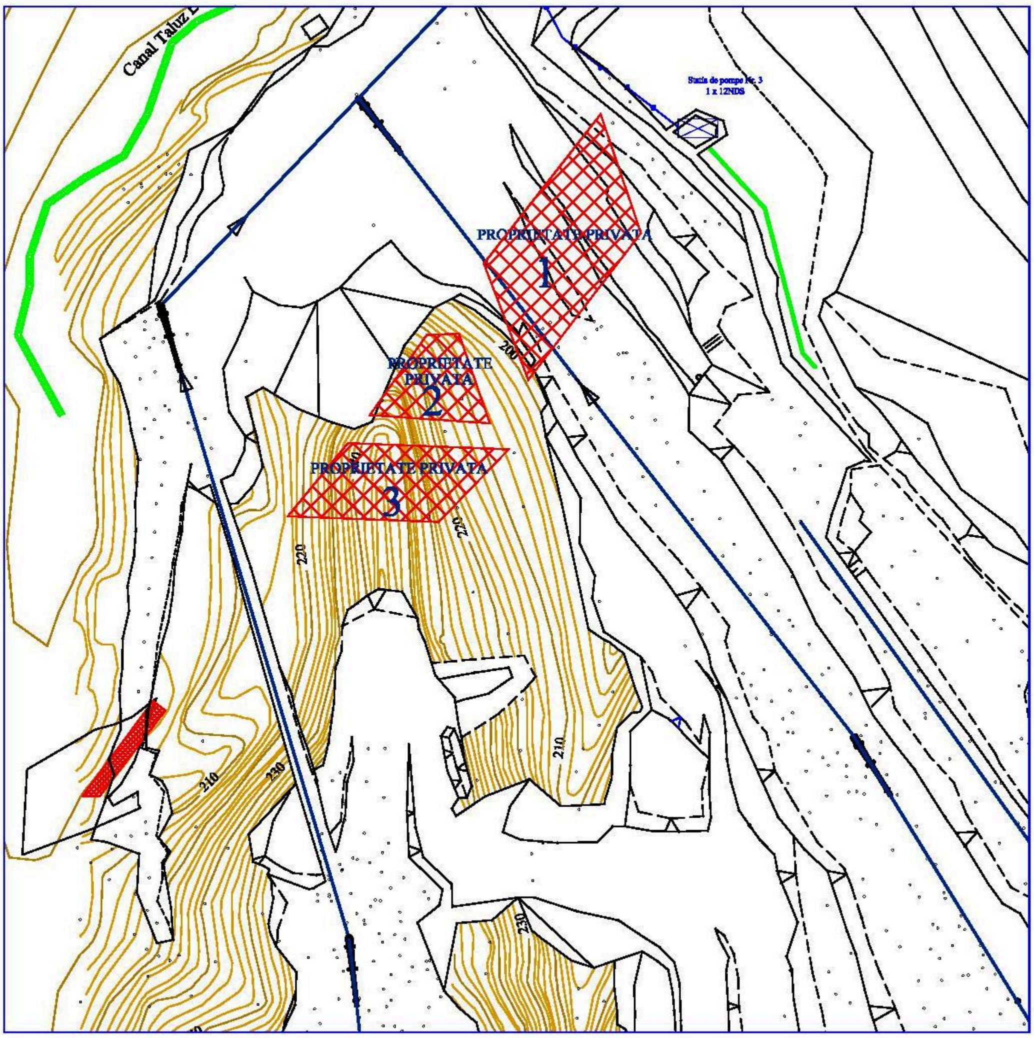

Figura 1.

In figura 2 blocul de culoare albastra poate fi exploatat numai in condițiile ocolirii proprietăților private neachiziționate prin realizarea unui nou acces. Blocurile tehnologice vor putea fi exploatate doar in condițiile modificării fluxului de transport prin procurarea si montarea de noi benzi transportoare suplimentare si scurtări sau prelungiri la cele existente, fapt ce va cauza creșterea costului de exploatare. Sensul de avansare a frontului de excavare trebuie modificat datorita ocolirii proprietăților private neachiziționate, crearea de noi accese pe unde sa poată avansa utilajele si o alta succesiune de atac a blocurilor tehnologice. Prin modificarea planului de exploatare al carierei se modifica parametrii dimensionali ai frontului de excavare, conducând in acest mod la creșterea unghiului general al taluzului in lucru. In aceste condiții pentru a evita eventualele accidente, se sistează excavațiile, generând un blocaj total sau parțial al fronturilor de lucru, moment in care s-au epuizat toate posibilitățile tehnologice de funcționare.

CONCLUZII:

- Creșterea cheltuielilor de exploatare ca urmare a staționarii liniilor tehnologice sau lucrărilor tehnologice de evitare sau ocolire a zonelor neachiziționate.
- Creșterea unghiului general in zona fronturilor de excavare.

- Blocajul total al fronturilor de lucru in momentul in care s-au epuizat toate posibilitățile tehnologice de funcționare.

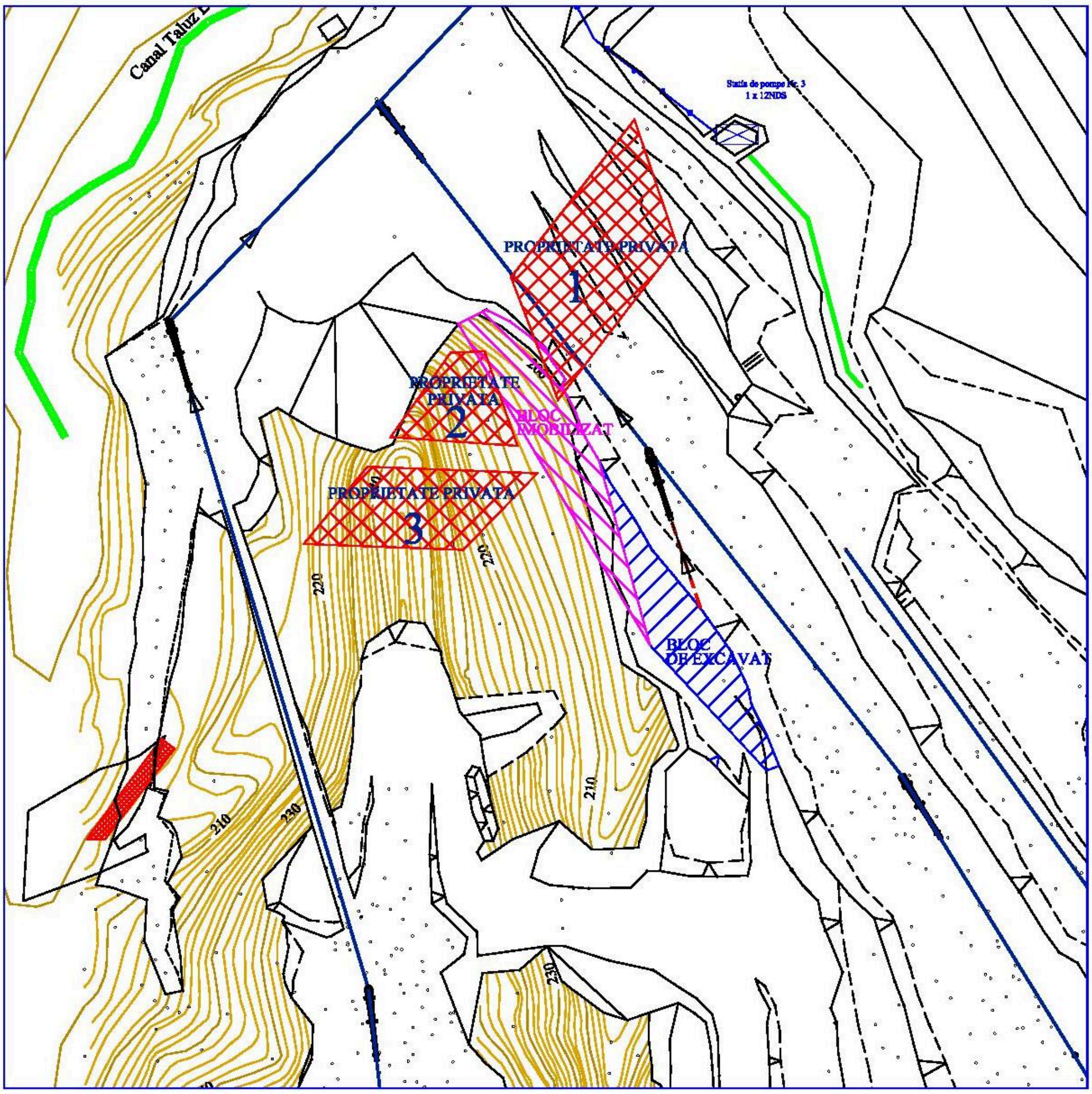

Figura 2

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MUTAŢIILE TEHNOLOGICE ŞI ÎNTREPRINDEREA ÎN SECTORUL DE EXTRACȚIE ȘI VALORIFICARE A RESURSELOR MINERALE ȘI ENERGETICE/

TECHNOLOGICAL CHANGES AND ENTERPRISES ON MINING EXPLOITATION AND RECOVERY SECTOR OF MINERAL AND ENERGY RESOURCES

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ABSTRACT

The paper shows that modern technologies are about to link the sciences. Purely empirical approaches are declining productive. Technological dimension of the crisis (difficulties) going through stages - or generalized - businesses appears study factor and overall performance. Therefore, strong speed of technological change in substance is desired and highly favorable (intrinsic) for a social system, but the realities of economic and productive environment, the productive systems extractive minerals and energy resources, oppose some resistance. The authors found that saturated or nearly saturated technologies in extractive productive systems of mineral resources and energy into the family traditional techniques that have weaker responses to contemporary social and economic demands. For example, the advent of computers and electronic handling of information has contributed decisively to the degradation of the electro-technological system could not maintain supremacy in the group of productive systems. Instead, the nuclear industry, the configuration of computers already dominates decision for safety and security of nuclear plants operation. This paper is a summary of takeover extension study entitled Modern Technologies (Author: Maria Gâf- Deac, Ed. FRM, ISBN 973-582-808-1, Bucharest, 2004) with the application of case law in expansion, on extractive mining and energy sectors, respectively in the nuclear industry.Type your abstract in this field based on the following rules and it must be in English language.

KEYWORDS

technological changes, productive systems extractive minerals and energy resources, nuclear technological sophistication, organization of mining technology / energy.

1. Mutaţii tehnologice în sistemele productive extractive de resurse minerale și energetice

Acceptând ipoteza transformărilor continue a conţinutului şi configuraţiei tehnologiei, în sistemele productive extractive de resurse minerale și energetice, în mod necesar, este acceptabilă constatarea *că mutaţiile tehnologice influenţează întreprinderea în ansamblul său*.

Totodată, în rândul tehnologiilor din sistemele productive extractive de resurse minerale și energetice, se înregistrează o tot mai accentuată şi vizibilă coerenţă.

Tehnologiile sunt pe cale să lege ştiinţele. Demersurile productive pur empirice sunt în scădere. Dimensiunea tehnologică a crizelor (dificultăţilor) prin care trec etapizat – sau generalizat- întreprinderile apare ca factor de studiu şi interpretare globală.

Transformările tehnologice nu mai pot fi considerate o sumă de constrângeri minore, care ar putea fi rezolvate prin simpla achiziţionare a unui sistem fizic de echipamente şi utilaje miniere performante.

Reducerea soluţionării numai la introducerea exclusivă a informatizării în sectorul minier extractiv este inoportună şi frecvent ineficientă când este aplicată „în sine”, unilateral, într-un sistem industrial atât de structurat, cvas-rigid.

Constatăm că se manifestă o cvasi-continuă contradicţie între creşterea puternică a productivităţii (din surse tehnologice avansate) şi regenerarea insuficientă a cererii, care poate conduce în diferite intervale de timp la o subfuncţionare a economiei unei entităţi.

De aceea, viteza puternică a schimbărilor tehnologice, pe fond, este dorită şi extrem de favorabilă (intrinsecă) pentru un sistem social, însă realităţile din mediul economico-productiv în sistemele productive extractive de resurse minerale și energetice, opun unele rezistenţe.

O eventuală încetinire a ritmului dezvoltărilor tehnologice în sistemele productive extractive de resurse minerale și energetice, poate fi explicată adesea prin existenţa unei crize în sistemul productiv de bază (figura. 1).[4]

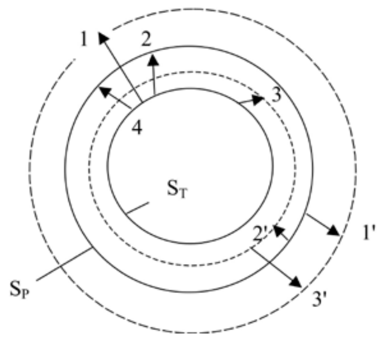

Figura: 1. Influenţe date de criza sistemului productiv asupra dezvoltării tehnologice în sistemele productive extractive de resurse minerale și energetice

SP = sistem productiv; ST = sistemul tehnologiilor; 1 = dezvoltare expansivă a sistemului tehnologic; 2 = dezvoltare echilibrată (echipotenţială) a tehnologiilor împreună cu sistemul productiv; 3 = recesiune tehnologică; 4 = tendinţa de depăşire a crizelor sistemului de producţie minieră cu ajutorul dezvoltării tehnologice; 1′= expansiunea sistemului productiv minier; 2′= recesiunea sistemului productiv minier; 3′= relansarea (revigorarea) sistemului productiv extractiv de resurse minerale și energetice

Pe de altă parte, în diferite entităţi dezvoltate din punct de vedere industrial şi social este menţinută teza potrivit căreia marile descoperiri tehnologice provoacă crize profunde în întreprinderi.

Deoarece acestea aduc creşteri masive ale productivităţii (apariţia şomajului), sunt induse obligaţii pentru schimbări structurale costisitoare ale infrastructurii întreprinderilor, care influenţează creşterea, schimbă raporturile sociale şi conţinutul organizării muncii.

Aspectul are proporții și conținuturi evolutive diferențiate, specifice în sectoare cu înaltă rezoluție științifică, precum în extracția și valorificarea uraniului, în industria nucleară minieră și energetică.

2. Statutul tehnologiilor în întreprinderile miniere și energetice, inclusiv nucleare

Ansamblul productiv poate fi analizat prin metoda separării secvenţelor (sub-structurilor), iar în baza concluziilor obţinute pot fi emise decizii de reglementare sau direcţionare a evoluţiei.

În practică însă, în ultimele decenii s-a produs o mutaţie semnificativă privind conţinutul raportului dintre secvenţele sau substructurile procesului productiv minier, inclusiv a celui tehnologic energetic.

Într-o astfel de situaţie este de subliniat că tehnologiile în sistemele productive extractive de resurse minerale și energetice, sunt deja integrate în gestiunea întreprinderilor.

În acest fel, natura şi statutul tehnologiilor s-au schimbat semnificativ.

Tehnologiile în sistemele productive extractive de resurse minerale și energetice nu mai au caracter evolutiv autarhic. Ele sunt integrate în reţeaua (sau construcţia) întreprinderii. Ele nu sunt numai instrumente, pârghii, proceduri folosite pentru transformarea materiilor în bunuri, ci au devenit elemente de patrimoniu, respectiv componente active care pot influenţa radical bazele companiei.

Ca atare, managementul şi marketingul firmei, organizației, centrează tehnologiile în mulţimea factorilor care pot influenţa decisiv soarta şi bunul mers productiv-economic minier și energetic.

La începutul secolului XX, dimensiunea fizică a unei tehnologii consemna puterea acesteia în sistemul productiv.

În prezent, exemplificativ în domeniul industriei nucleare, tehnologia a devenit un element integrator conceptual al întreprinderii/organizației, deci o variabilă de decizie.

În consecinţă, tehnologiile în sistemele productive extractive de resurse minerale și energetice nu pot fi considerate numai simple ansambluri care oferă soluţii materiale, ci şi factori de influenţă în luarea de decizii.

Tehnologiile au devenit un *loc comun al deciziilor complexe*, datorită faptului că ele oferă variante multiple, ce pot fi încadrate succesiv într-o schemă combinatorie favorabilă generării de noi soluţii.

Datorită pătrunderii în sistemele productive a unei substanţe noi – informaţia –, tehnologiile, mai ales cele nucleare, au început să parcurgă un proces de *dematerializare*.

Nu numai intrarea vertiginoasă a informaţiei în sfera configuraţiilor tehnologice în sistemele productive extractive de resurse minerale și energetice, ci chiar apariţia unor materiale noi sau a unor elemente de biologie avansată arată că dematerializarea industrială a parcurs paşi semnificativi.

Se observă că tehnologiile moderne nu mai sunt legate de ansambluri stabile de echipamente şi maşini sau de soluţii materiale imuabile, perene.

În aceste condiţii, tehnologia în sistemele productive extractive de resurse minerale și energetice, ami ales în sfera cercetării și valorificării potențialului energetic nuclear, este din ce în ce mai mult analizată ca *un ansamblu de funcţiuni*.

Soluţiile tehnologiei nucleare unitare sau modulare, dacă sunt supuse combinării, compunerii şi recompunerii oferă variante inedite de rezolvări şi confirmă faptul că se înregistrează *o creştere a libertăţii conceptuale* într-o întreprindere.

În acelaşi timp, noile tehnologii moderne în sistemele productive extractive de resurse minerale și energetice, *nu au poziţii liniare* în cadrul unei întreprinderi. Dimpotrivă, ele constituie zone de ricoşeuri şi determinări de dezvoltări noi pe orizontală sau verticală ale altor activităţi din alte sectoare productive şi tehnologice specifice substructurilor firmei.

Aspectele de mai sus evidenţiază că o tehnologie internă (în sistemele productive extractive de resurse minerale și energetice) nu este doar o pârghie, ci un loc real de decizie, nu doar un mijloc de realizare productivă, ci o problemă operaţională complexă care ia în considerare: caracteristicile de produs, gradul de automatizare, gradul de integrare ş.a.

Tehnologia unei întreprinderi miniere/energetice este considerată tot mai mult un sistem. Dimensiunea tehnologică este luată în considerare în mod distinct la elaborarea noilor strategii de integrare a companiilor în mediul productiv şi economic global.

Rolul tehnologiei într-o întreprindere în sistemele productive extractive de resurse minerale și energetice,nu mai poate fi delimitat de rolul pe care îl are managementul în asigurarea funcţionării entităţii.

Conducătorii sunt preocupaţi de a crea la nivel de întreprindere condiţiile pentru atingerea de către tehnologii a nivelului de maximă performanţă operaţională (figura. 2). [4]

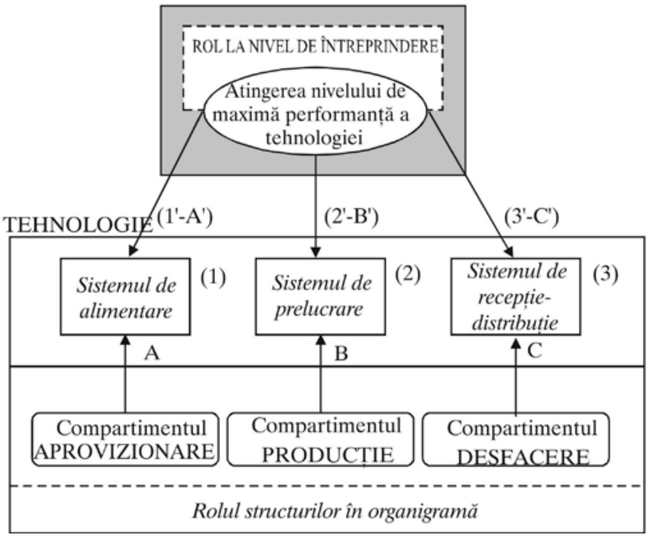

Figura: 2. Exprimarea rolului întreprinderii miniere/energetice faţă de nivelul maxim al performanţei unei tehnologii şi a rolului substructurilor din organigramă faţă de secvenţele tehnologice

Având în vedere că o tehnologie, inclusiv în sistemele productive extractive de resurse minerale și energetice, are în mod implicit cel puţin trei compartimente operaţionale (alimentare, procesare şi evacuare – distribuţie), noua tendinţă managerială este de suprapunere pe aceste module a unor activităţi relaţionale specializate de organizare – conducere şi coordonare a aprovizionării, a producţiei propriu zise şi, respectiv, a desfacerii produselor (bunurilor) obţinute.

Astfel, organigramele sunt formulate cu substructuri organizatorice de tip compartiment, birou, direcţie, divizie ş.a. care răspund relaţional secvenţelor tehnologice de bază instituite.

3. Saturarea tehnologică minieră și energetică

Tehnologiile şi sistemele tehnologice în sistemele productive extractive de resurse minerale și energetice, pot atinge anumite limite ale existenţei lor.

Este dificil de apreciat felul în care se manifestă creşterea în vârstă a tehnologiilor. Există tehnologii a căror rezistenţă şi consistenţă persistă în jur de 100 de ani. Altele ating vârste finale mai reduse (figura. 3). [4]

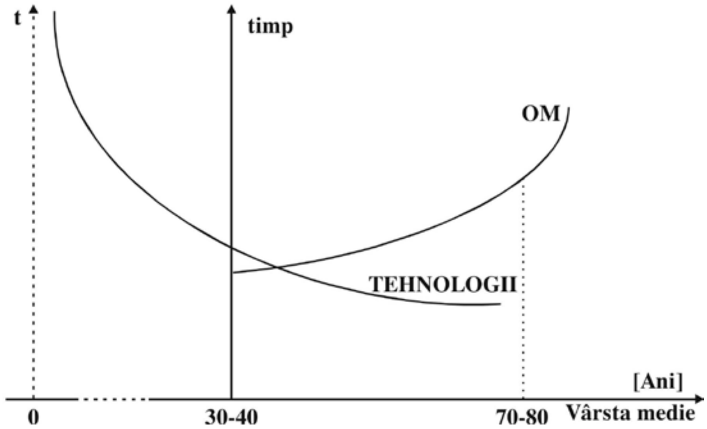

Figura: 3. Tendinţa de scădere a duratei de viaţă a tehnologiilor şi de creştere a duratei de viaţă a omului

La o etapă dată se constată că o anumită tehnologie nu mai este capabilă să determine performanţe acceptabile, dorite mai ales când asupra ei acţionează factori noi de constrângere cum sunt: reorientarea spre reducerea dimensională a întreprinderilor, complexitatea mai ridicată a problemelor productive (ale produsului), poluarea, ş.a.

Aspectele de mai sus îndreptăţesc constatarea că apare o fază de saturaţie pe care tehnologia, inclusiv în sistemele productive extractive de resurse minerale și energetice, o înregistrează previzibil sau imprevizibil. Saturarea rezultă prin degradarea raportului avantaje – dezavantaje.

Acceptabilitatea socială a tehnologiei devine tot mai erodată. Sistemul tehnologic minier /energetic intră în contradicţie mai ales cu cadrul său ecologic (mediul înconjurător în care este plasat fizic ansamblul productiv-economic respectiv).

Sistemul productiv centrat pe o tehnologie devine dezechilibrat deoarece se epuizează oportunităţile îndreptate spre piaţă ca urmare a afectării indicatorilor tehnico-economici luaţi în calcul pentru obţinerea produsului sau serviciului final.

Totodată, se constată că tehnologiile saturate sau aproape saturate în sistemele productive extractive de resurse minerale și energetice, intră în familia tehnicilor tradiţionale care au reacţii mai slabe la exigenţele economice şi sociale contemporane.

De exemplu, apariţia ordinatoarelor şi a prelucrării electronice a informaţiei au contribuit hotărâtor la degradarea sistemului tehnologic electromecanic care nu şi-a mai putut menţine supremaţia în grupul de sisteme productive.

În schimb, în industria nucleară, ordinatoarele deja domină configurația decizională pentru siguranță, securitate a funcționării centralelor nucleare.

În evoluţia procedurilor tehnologice se constată şi manifestarea unor etape de randament scăzut a cercetării, inclusiv o anumită epuizare a capacităţii de inovare.

În figura. 4 [4] este înfăţişat traseul afectărilor factuale de la saturarea, respectiv autosaturarea tehnologiilor până la starea de creştere economică negativă [5], aspect frecvent aplicabil (conceptual) în sectorul de extracție a combustibililor fosili.

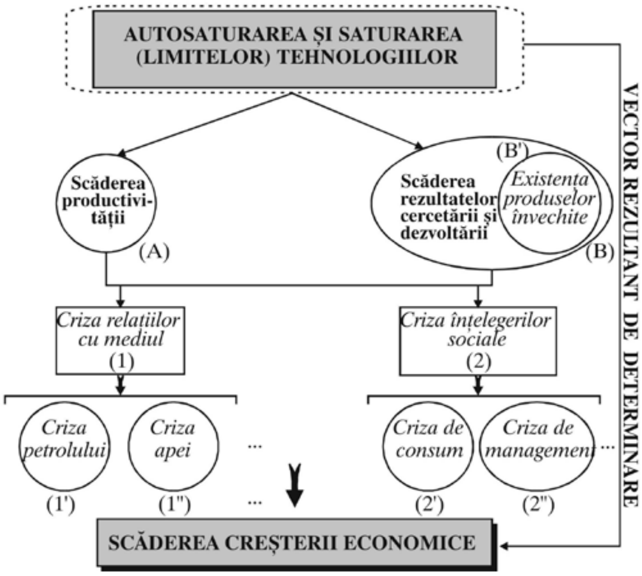

Figura: 4. Modul în care tehnologiile saturate în sistemele productive extractive de resurse minerale și energetice, determină scăderea economică (înregistrarea de creşteri negative)

Se observă că atingerea propriilor limite ale unei tehnologii în sistemele productive extractive de resurse minerale și energetice, induce scăderea productivităţii, concomitent cu reducerea volumului rezultatelor satisfăcătoare din cercetare-dezvoltare. Produsele şi serviciile devin astfel învechite, neatractive şi cu grad sporit de dificultate pentru distribuţie.

Criza relaţiilor cu mediul şi cea a raporturilor sociale în sistemele productive extractive de resurse minerale și energetice, îşi au expresia în crizele secvenţiale (sectoriale) cum sunt cele din domeniul petrolului, apei ş.a., precum şi în starea critică a managementului şi consumului.

Teza necesităţii accelerării progresului tehnic rezultă tocmai dintr-o viziune similară celei prezentate mai sus.

Argumentarea tendinţei necesare de creştere a tehnicităţii este înfăţişată de concluzia că între anii 1967-1971, pe plan mondial, depozitele de brevete de invenţie au cunoscut cea mai agravantă scădere directă (tendinţă de staţionare).

Saturarea tehnologică în sistemele productive extractive de resurse minerale și energetice, reprezintă un proces obiectiv care, nesesizat la momentele limită, afectează (prin degradare) sistemul productiv-economic al unei entităţi, inclusiv starea socială a societăţii.

Contradicţiile între sistemele tehnologice în declin şi cadrul social, organizarea muncii şi modelele de consum constituie indicii (semnalele) că mediul local şi internaţional parcurge transformări ascendente continue în sfera productiv-economică.

4. Concluzii

Sistemul tehnologic minier /energetic intră în contradicţie mai ales cu cadrul său ecologic (mediul înconjurător în care este plasat fizic ansamblul productiv-economic respectiv).

Sistemul productiv centrat pe o tehnologie devine dezechilibrat deoarece se epuizează oportunităţile îndreptate spre piaţă ca urmare a afectării indicatorilor tehnico-economici luaţi în calcul pentru obţinerea produsului sau serviciului final.

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Este menţinută teza potrivit căreia marile descoperiri tehnologice provoacă crize profunde în întreprinderi.

Deoarece acestea aduc creşteri masive ale productivităţii (apariţia şomajului), sunt induse obligaţii pentru schimbări structurale costisitoare ale infrastructurii întreprinderilor, care influenţează creşterea, schimbă raporturile sociale şi conţinutul organizării muncii.

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DIMENSIONAREA TEHNOLOGIILOR DE EXTRACȚIE ȘI VALORIFICARE A RESURSELOR MINERALE ŞI ENERGETICE/

EXTRACTION AND RECOVERY SIZING TECHNOLOGY OF MINERAL AND ENERGY RESOURCES

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ABSTRACT

The authors show that high technology material dimension (machinery, equipment, devices, etc.) in productive systems extractive mineral and energy resources are not expressly subject to (secure) their efficiency. As is demonstrated, for example, that the facilities streamlined with smaller underground and surface quarrying, which can accomplish the same mining products (or other upper) and energy to the configuration of equipment Initially lead to cost reduction, restriction sites affected, reduction of environmental assaults, increased productivity (by reducing the number of servers) etc. This paper is a summary of takeover extension study entitled Modern Technologies (Author: Maria Gâf- Deac, Ed. FRM, ISBN 973-582-808-1, Bucharest, 2004) with the application of case law in expansion, extractive mining and energy sectors, respectively in the nuclear industry. It concludes that all markets technologies and products in one way or another, come at a time of declining. What varies considerably in this process it is localized in time or fixed intervals. The main lines of development of a market are closely related technologies, product placed on the market, and price competition.

KEYWORDS

sizing technology, technological sophistication, organization technology, mining technology development organization model

1. Introducere

Una dintre caracteristicile importante ale comerţului internaţional contemporan cu tehnologii este faptul că scopul urmărit înainte de toate nu este profitul imediat, ci mai degrabă cucerirea de segmente de piaţă şi controlul tehnologiilor fundamentale (de bază).

Este important să se sesizeze creşterea sau declinul unei pieţe, însă la fel de importantă este sesizarea factorilor care o influenţează.

În mediul productiv-economic de ansamblu, există intenţia cvasi-permanentă de a se realiza corelaţii între dimensiunea tehnologiei şi rezultatele practice considerate eficiente pe care aceasta le poate oferi prin aplicare.

De asemenea, o mulţime finită de tehnologii oferă rezultate compuse care formează o mulţime de reacţii caracterizate de un anumit nivel convenţional de eficacitate dorită.

2. Dimensiunea materială a tehnologiilor în sistemele productive extractive de resurse minerale și energetice

O sistematizare a acestor proporţii în sistemele productive extractive de resurse minerale și energetice arată că în timpul (t) faţă de tendinţa de obţinere a unor rezultate convenţional eficiente (R), dimensiunile tehnologiilor (D) sunt în scădere (fig. 1.) [11, [8].

Caracterizarea acestor dependenţe este dată de relaţia:

$$D = R(t) \tag{1}$$

Se observă că viteza de scădere a dimensiunilor D este mai redusă decât creşterea mărimii rezultatelor programate, iar timpul de transformare depăşeşte în valoare absolută ceilalţi parametri din relaţia de dependenţă.

Astfel:

$$|\tau| > |P| > |\Delta| \tag{2}$$

Această legitate demonstrează că transformarea tehnologiilor (respectiv schimbarea lor), urmărind concomitent reducerea lor dimensională şi obţinerea de rezultate superioare întâmpină rezistenţe (constrângeri) în sistemele productive extractive de resurse minerale și energetice, care pot fi învinse în timp relativ îndelungat.

De altfel, perfecţionarea (rafinarea) tehnologiilor (T) în sistemele productive extractive de resurse minerale și energetice se reflectă ca proces condus eficient (E) în măsura în care se obţine minimizarea parametrului timp:

$$T(E) \xrightarrow{(t \to min)} Max \tag{3}$$

Dimensiunea materială ridicată a tehnologiilor (maşini, instalaţii, dispozitive ş.a.) în sistemele productive extractive de resurse minerale și energetice nu constituie expresia obiectivă (sigură) a eficienţei acestora.

În timp se demonstrează, de exemplu, că instalaţiile raţionalizate cu dimensiuni mai reduse în subteran și la suprafață, în cariere, care pot realiza aceleaşi produse miniere (sau chiar altele superioare) și energie faţă de configuraţia instalaţiilor iniţiale conduc la reducerea costurilor, restrângerea amplasamentelor afectate, diminuarea agresiunilor faţă de mediu, creşterea productivităţii (prin scăderea numărului de servanţi) ş.a.

În plus, în cazul tehnologiilor cu dimensiuni fizice mai reduse apare flexibilitatea şi posibilitatea sporită de adaptare.

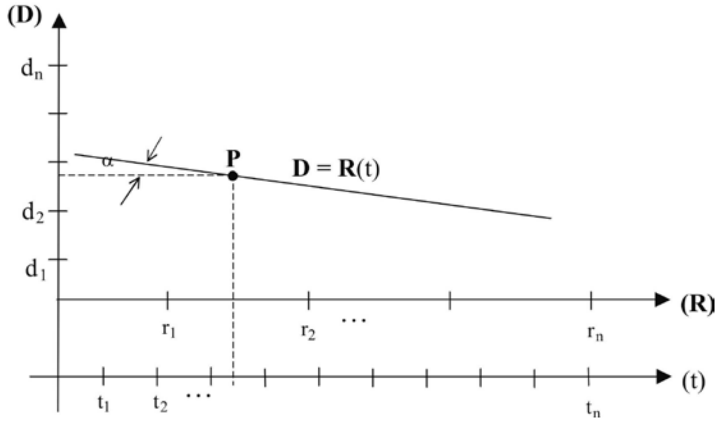

Figura 1: Tendinţa de miniaturizare a tehnologiilor de timp

t = timp; R= rezultate convenţional eficiente; D = dimensiunile tehnologiilor;

P = performanţele tehnologiilor o dată cu creşterea rezultatelor aşteptate;

a = unghi de transformare agregată a dimensiunii tehnologiilor

De exemplu, o anumită concepţie a anilor ’70 a condus la desfăşurarea practică a aglomerărilor industriale masive în sisteme tehnologice de producţie minieră și energetică, și care, în fapt, s-au dovedit ulterior a fi rigide.

În context, a fost demonstrată inconsistenţa dependenţei rezultatelor dorite de dimensiunea fizică a tehnologiilor şi faptul că într-o etapă dată în sistemele productive extractive de resurse minerale și energetice se înregistrează anumite limite de existenţă şi funcţionare tehnologică optimă.

Căutarea optimului în corelaţiile de mai sus se poate opera în sistemele productive extractive de resurse minerale și energetice prin diferenţierea relaţiei [D=R(t)], (1), imprimându-se o pantă (α) care să poziţioneze curba de dependenţă într-o tendinţă convenabilă.

3. Criza sistemului tehnologic electromecanic în sistemele productive extractive de resurse minerale și energetice

3.1 Manifestări indirecte şi directe ale crizei sistemelor tehnologice

La începutul anilor ’70 analiştii politici şi economici au formulat explicaţii concluzive faţă de fenomenul de criză aproape generalizată pe plan mondial.

S-a pornit de la diagnosticarea stării economiei mondiale la momentul respectiv şi s-au putut sistematiza câteva aspecte cum sunt:

– efectele (rezultatele) economice în sistemul productiv general, respectiv în sistemele productive extractive de resurse minerale și energetice, prezentau tendinţa de uşoară scădere sau de staţionare cvasi-constantă;

– soluţiile imaginate pentru creşterea productivităţii muncii şi respectiv reducerea costurilor în sistemele productive extractive de resurse minerale și energetice nu s-au dovedit a fi reprezentative (adică accentuate ca influenţă);

– familia noilor produse miniere și energetice lansate înregistra un ritm de îmbogăţire calitativă şi înfăţişare de noi performanţe considerate prea lente;

– modelele de consum mineral și energetic au rămas într-o cvasi-staţionare, considerându-se că nu se înregistrează o viteză corespunzătoare pentru cereri noi;

– în domeniul cercetării ştiinţifice, rezultatele ca volum şi calitate în sistemele productive extractive de resurse minerale și energetice nu ofereau premise de „rupturi pozitive“ în sistemul productiv-industrial o dată cu aplicarea rezultatelor lor;

– curba consumurilor specifice a înregistrat (sub formulă agregată) pante de descreştere cu unghiuri mici, nesatisfăcătoare;

– tot mai frecvent crizele de organizare s-au identificat drept cauze în declinul companiilor miniere și energetice.

Organizarea muncii pe fluxuri tehnologice intrate în procesul de erodare (învechire) a rămas în sistemele productive extractive de resurse minerale și energetice la stadiul aplicaţiilor deja clasice.

Au fost reţinute semnale care denotau o criză a relaţiilor între sistemele productive şi mediul înconjurător. Ca o înfăşurătoare a conotaţiilor enumerate a fost considerată criza de consens social aferentă etapei respective.

Concluzia semnificativă, cu grad ridicat de reprezentativitate, arată că la acel moment de ultim sfert de veac, de fapt în sistemele productive extractive de resurse minerale și energetice s-a înregistrat o criză a sistemului tehnologic electromecanic şi chimic care a dominat în trecut, mai mult de un veac, domeniul productiv-industrial.

3.2. Saturarea sistemelor tehnologice productive extractive de resurse minerale și energetice

Sistemul tehnologic electromecanic minier şi-a atins limitele sale interne, nemaifiind capabil de performanţe semnificative. Realitatea de mai sus arată starea de saturaţie înregistrată de tehnologii, şi prin extensie de către sistemele tehnologice miniere și energetice [9].

Saturaţia se manifestă prin:

– incapacitatea tehnologiilor miniere și energetice de a răspunde exigenţelor economice şi sociale;

– dispozitivele mai evoluate ale tehnologiilor nu-şi găsesc operaţionalitatea mai accentuată în cadrul fluxurilor productive, înregistrând reduceri ale performanţelor cu toate că ele dispun potenţial şi latent de posibilităţi noi de revigorare a procesului de producţie şi reproducţie minieră;

– capacitatea de inovare în sistemele productive extractive de resurse minerale și energetice rămâne constantă sau în scădere; costurile de cercetare rămân ridicate în raport cu descoperirea ştiinţifică şi efectele economice obţinute prin aplicarea rezultatelor cercetării.

Criza sistemului tehnologic electromecanic şi chimic în sistemele productive extractive de resurse minerale și energetice, o dată sesizată a fost supusă acţiunilor de contracarare.

Civilizaţia tehnică mondială a beneficiat în continuare de o ruptură între etape, respectiv trecerea peste un hotar al dezvoltării prin impunerea unor noi tehnologii generice (electronică, microelectronică, sistemele informaţionale, prelucrarea infor-maţiei ş.a.)

4. Blocajul tehnologic în sistemele productive extractive de resurse minerale și energetice

Fenomenul abaterilor de la normalitate este exprimat elocvent de blocaj. Disfuncţiile, decalajele, disproporţiile, barierele sau diferite obstacole reflectă manifestarea propriu-zisă a blocajului în sistemele productive extractive de resurse minerale și energetice.

Sistemele tehnologice – ca entităţi fizice funcţionale – nu sunt ferite de blocaje.

În principal, blocajul tehnologic în sistemele productive extractive de resurse minerale și energetice constă în:

– rămânerea în urmă, întârzierea, decalajul, criza sau dezechilibrul dintre nivelurile tehnologice ale unei companii miniere, subramuri, ramuri şi al economiei, în general, existente într-o ţară faţă de nivelul mediu mondial sau faţă de cel atins de ţările dezvoltate în sistemele productive extractive de resurse minerale și energetice;

– ritmul lent de asimilare şi distribuţie a noilor tehnici şi tehnologii, precum şi întârzierea modernizării celor existente.

Uzura fizică şi morală a tehnicii din dotare, nivelul scăzut de modernizare, automatizare, robotizare şi cibernetizare a proceselor de producţie în sistemele productive extractive de resurse minerale și energetice împiedică aplicarea metodelor de optimizare.

Decalajele tehnologice – ca expresie firească a diferenţierii – se întâlnesc în economia internă a unei ţări sau în termeni comparativi între ţări.

Nivelul scăzut de dezvoltare economico-socială, ritmul redus de realizare a PIB reflectă dimensiunea şi amploarea decalajelor tehnologice între ţări.

Pe parcursul vieţii tehnologiilor se întâlnesc blocaje în cvasitotalitatea fazelor de la concepţie, proiectare cât şi în exploatare, întreţinere şi reparaţii.

După *G. Zaman* şi *C. Ciutacu* [1; 2], blocajul tehnologic se manifestă prin:

– menţinerea în fabricaţie a unor produse, tehnologii şi echipamente învechite, energofage şi mari consumatoare de materii prime;

– creşterea stocurilor de produse cu vânzare lentă sau greu vandabile;

– productivitatea şi eficienţa redusă a produselor şi serviciilor realizate;

– ponderea scăzută a subramurilor, ramurilor şi produselor cu nivel tehnic ridicat în ansamblul economiei;

– nivel ridicat de afectare ecologică (poluare) a mediului înconjurător.

Atenuarea decalajelor tehnologice în sistemele productive extractive de resurse minerale și energetice se poate realiza cunoscând situaţia lor dimensională cantitativă şi calitativă.

Decalajele tehnologice se referă atât la produse, grupe de produse, cât şi la nivelul tehnologic al companiilor şi al economiei unei ţări în comparaţie cu performanţele atinse în alte ţări.

Totuşi, măsurarea exactă a unui decalaj tehnologic în sistemele productive extractive de resurse minerale și energetice constituie o operaţiune dificilă, însă evidenţierea diferenţelor perceptibile (cuanti-ficate) oferă indiciile suficiente pentru o evaluare folositoare.

Pentru sublinierea amplitudinii şi profunzimii blocajului tehnologic în sistemele productive extractive de resurse minerale și energetice se poate apela la indicatorii de exprimare indirectă a acestei stări (indicatori economici, globali şi parţiali).

Efectele blocajului tehnologic se reflectă în principal prin:

– nivel redus al PIB pe locuitor;

– productivitate socială redusă pe o persoană ocupată;

– consumuri ridicate de energie şi materii prime pe unitatea de produs sau monetară;

– slaba competivitate a produselor;

– volumul redus al exporturilor pe locuitor;

– ponderea scăzută a exportului unei ţări în exportul mondial;

– costuri ridicate de producţie;

– niveluri ridicate ale preţurilor;

– rentabilitate redusă;

– menţinerea unui efort fizic crescut, condiţii grele de muncă, număr ridicat de accidente şi îmbolnăviri profesionale;

– nivel ridicat de poluare.

Între ritmul de creştere economică a unei ţări şi nivelul tehnologic există o strânsă interdependenţă.

Cu cât asimilarea progresului ştiinţific şi tehnic este mai accentuată (rapidă) cu atât este mai intensă dezvoltarea economică.

Invenţiile şi inovaţiile determinând progresul tehnologic pot contribui la relansarea şi dezvoltarea durabilă a economiei unei ţări.

Eliminarea blocajului prin diminuarea decalajului tehnologic în sistemele productive extractive de resurse minerale și energetice se poate realiza şi prin acţiuni de stimulare a dinamicii în unele direcţii cum sunt:

– amplificarea activităţii autohtone de cercetare ştiinţifică şi dezvoltare tehnologică;

– intensificarea transferului de tehnologie, difuzarea eficientă a informaţiilor în domeniu. Transferul de tehnologie, potrivit cercetărilor efectuate de *G. Zaman* şi *C. Ciutacu* [1,2], constituie un subprodus al inovării.

– creşterea capacităţii de asimilare a inovaţiilor. Se apreciază că inovaţia determină întotdeauna perimarea performanţelor prezente.

Blocajul tehnologic în sistemele productive extractive de resurse minerale și energetice este o realitate aferentă sistemelor tehnologice de la naştere până la destrămarea lor.

5. Tehnologiile miniere/energetice şi ciclul de viaþã al acestora

În funcţionarea unei întreprinderi miniere/energetice, pentru ca o tehnologie să înregistreze rezultatele scontate este important să se compare elementele de forţă, dar şi slăbiciunile faţă de piaţa (mediul) în care funcţionează.

Toate pieţele de tehnologii şi de produse, într-un fel sau altul, intră la un moment dat în declin. Ceea ce variază considerabil în acest proces este localizat în timp sau intervale bine determinate.

Este important să se sesizeze creşterea sau declinul unei pieţe, însă la fel de importantă este sesizarea factorilor care o influenţează.

Liniile principale de dezvoltare ale unei pieţe sunt strâns legate de tehnologii, produsul plasat pe piaţă, concurenţă şi preţ (figura. 2) [8].

O analiză corelată pe faze evidenţiază următoarele:

În faza de lansare (L):

– Tehnologiile (t_1) sunt în starea de inovaţie-invenţie;

– Produsul (p_1) este mai puţin sofisticat;

– Piaţa (p'_1) are segmente înguste de operare;

– Concurenţa (c_1) este slabă;

– Preţul produsului (p''_1) este ridicat;

– Marjele de acţiune (M_1) sunt în general ridicate.

În faza de creştere de debut (CD):

– Tehnologiile (t_2) sunt aplicate mai pregnant;

– Produsul (p_2) înregistrează dezvoltări ale rafinamentului său;

– Piaţa (p'_2) înregistrează în continuare segmente înguste de operare;

– Concurenţa (c_2) este slabă;

– Preţurile (p''_2) se menţin relativ ridicate;

– Marjele de acţiune (M_2) sunt largi.

În faza de creştere masivă (CM):

– Tehnologiile (t_3) primesc masă semnificativă de materii prime şi energie care urmează a fi supusă transformărilor, iar aplicaţiile tehnologice industriale sunt mai pregnante;

– Se extinde gama produselor (p_3);

– Piaţa (p'_3) înregistrează o lărgire a segmentelor;

– Concurenţa (c_3) se intensifică şi apare efectul de antrenare;

– Preţurile (p''_3) devin ceva mai reduse;

– Marjele (M_3) de acţiune încep să se limiteze.

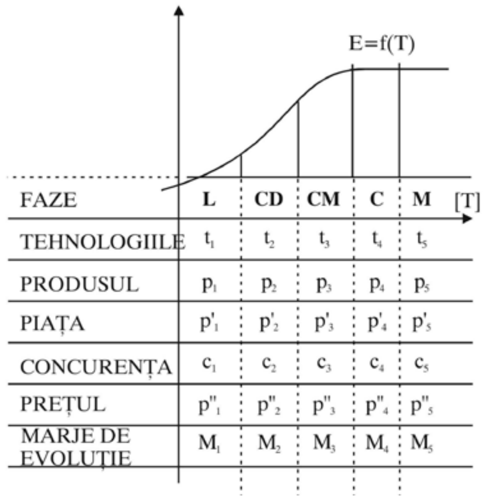

Figura. 2. Evoluţia tehnologiilor şi influenţa lor asupra dezvoltării unei pieţe în corelaţie cu ciclul de viaţă al unui produs

L – lansare; C – consolidare; E – evoluţii; CD – creştere de debut; M – maturizare; T – timp; CM – creştere masivă

În faza de consolidare (C):

– Tehnologiile (t_4) sunt supuse unui efect ce reflectă experienţa tehnologică dobândită, ceea ce determină costuri de aplicare ceva mai reduse;

– Gama produselor (p_4) se extinde;

– Piaţa (p'_4) devine de masă";

– Concurenţa (c_4) determină eliminarea de pe piaţă a produselor cu costuri ridicate;

– Preţurile (p''_4) încep să scadă mai semnificativ;

– Marjele de acţiune (M_4) sunt tot mai reduse.

În faza de maturitate (M):

În faza de maturitate (M):

– Tehnologiile (t_5) chiar dacă sunt funcţionale încep să fie tratate cu rezerve. Se realizează analize ale evoluţiei tehnologiilor respective obţinându-se concluzii suges-tive asupra stării noi înregistrate în evoluţie. Este important de reţinut că în această fază sunt iniţiate acţiuni de dezvoltare a tehnologiilor de înlocuire (substituţie).

– Produsul (p_5) este în proliferare;

– Piaţa (p'_5) înregistrează caracteristică „de masă", însă deja aceasta este segmentată;

– Concurenţa (c_5) este dominantă, ameninţă produsul aflat la maturitate şi promovează cu insistenţă noile produse de substituire (înlocuire);

– Preţurile (p''_5) sunt deja scăzute;

– Marja de acţiune (M_5) are caracteristici dimensionale medii.

Se observă în sistemele productive extractive de resurse minerale și energetice stricta corelaţie a tehnologiilor cu celelalte elemente din sistemul industrial, mai ales cu ciclul de viaţă al produsului.

6. Concurenţa şi sistemele tehnologice miniere / energetice

Integrarea regională, subregională sau zonală crează pieţe unice care induc o serie de efecte asupra structurilor industriale şi, în particular, asupra sistemelor tehnologice productive extractive de resurse minerale și energetice. Dintre acestea se amintesc:

– dispariţia unor întreprinderi miniere purtătoare de tehnologii urmare a intensităţii ridicate a concurenţei;

– dezangajarea unităţilor productive miniere care trebuie să-şi caute noi legături de producţie situate în centre noi cu preţuri de revenire mai scăzute (glisate din centre recunoscute pentru excelenţa factorilor de productivitate);

– achiziţia de tehnologii miniere de la firme situate în interiorul pieţii integrate care se regăsesc în situaţii concurenţiale dezavantajoase şi care nu se află în momente suficient de atractive pentru a putea fi oferite marilor companii transnaţionale;

– achiziţia de întreprinderi şi tehnologii miniere din exteriorul pieţii integrate astfel încât acestea să se regăsească în interiorul ariei integrate;

– achiziţia şi fuzionarea unor companii deţinătoare de tehnologii miniere moderne din motive de integrare pe verticală, astfel încât să poată fi controlate elementele din amonte cât şi cele din aval ale sistemului de valori industriale;

– fuziuni şi realizări de societăţi mixte miniere și energetice (*joint ventures*) pentru refacerea puterii tehnologice şi a poziţiilor întreprinderilor în faţa nevoii de a creşte capacităţile de producţie, a colaborărilor pentru distribuţie şi asigurarea resurselor pentru cercetare şi dezvoltare.

Industria minieră și cea energetică, observate ca depozitare de tehnologii, considerate ca făcând parte dintr-un sistem general de valori, realizează trecerea materiilor prime prin diferite stadii cu scop de obţinere a valorii adăugate, ajungând la consumatorul final. Luând în considerare existenţa fluxului menţionat, este posibilă formularea unui model pentru evaluarea riscurilor schimbărilor pentru o întreprindere minieră/energetică deţinătoare de tehnologii moderne, situată într-o piaţă nouă, integrată.

Este important ca într-un astfel de model să fie evidenţiate probabilităţile de schimbare care afectează furnizorii de tehnologii şi materii prime, clienţii (utilizatorii de tehnologii) şi concurenţa propriu-zisă. Un astfel de model în sistemele productive extractive de resurse minerale și energetice poate indica „punctele de tranzacţie" pentru tehnologii şi produse (figura. 3) [8].

Se observă în sistemele productive extractive de resurse minerale și energetice că există un lanţ al tehnologiilor de-a lungul cărora ele însele au două destinaţii:

– constituie suportul de realizare efectivă a produselor (bunurilor);

– constituie chiar ele un produs (un bun) care poate fi tranzacţionat.

Lanţul produselor aparent distinct este legat de tehnologii.

Ambele lanţuri sunt supuse din exterior unui atac convenţional continuu.

Momentul important căutat în sistemul productiv este cel al compatibilităţii efective (T) între tehnologii şi produsele realizate.

Se deduce că şi în cadrul lanţurilor există condiţionări reciproce între secvenţe.

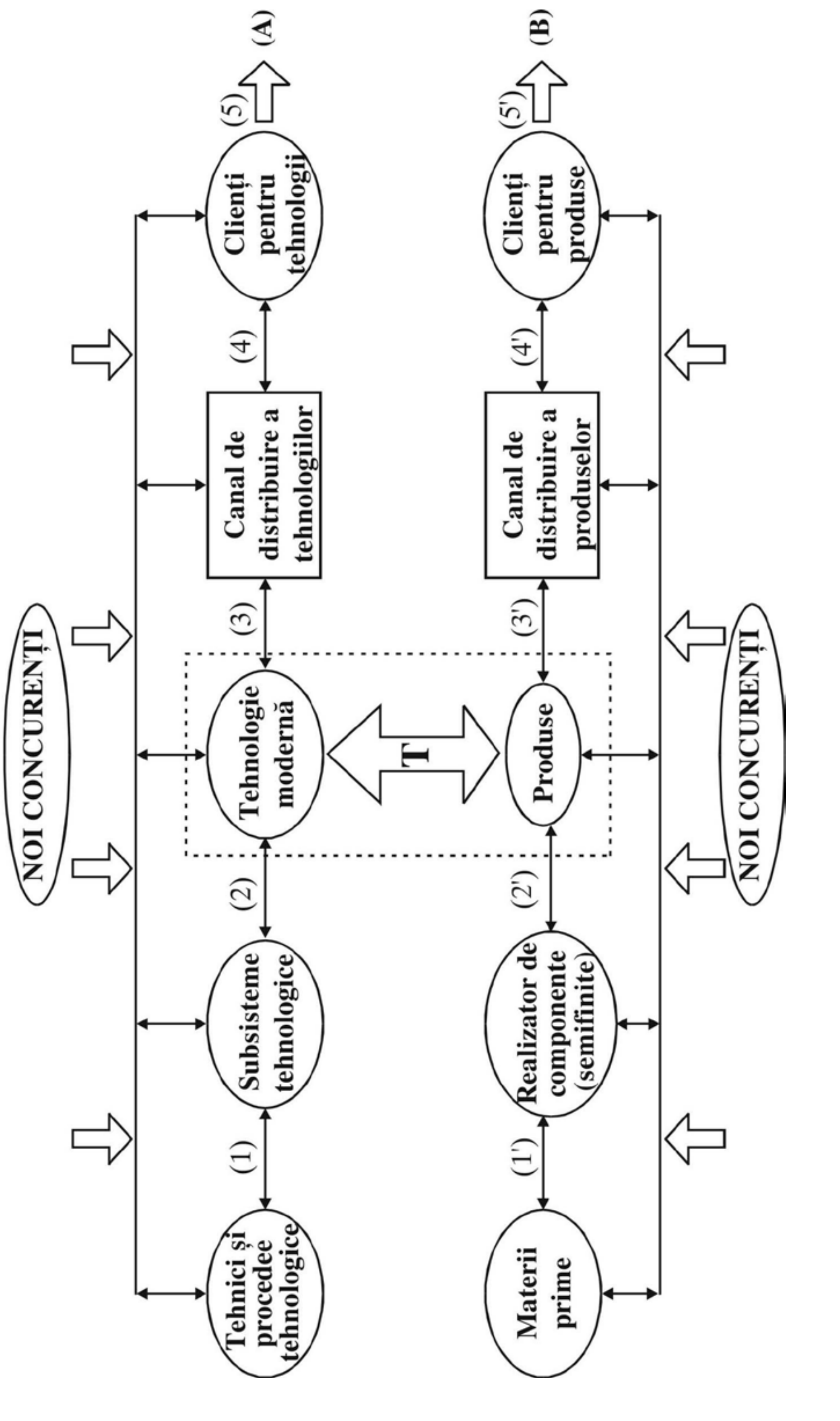

Figura. 3. Model simplificat al sistemului de valori industriale pentru tehnologii şi produse şi interacţiunea principală de tranzacţii (T)

Modelul simplificat prezentat mai sus trebuie optimizat. Fiecare element trebuie supus analizei şi, după caz, adaptării şi reproiectării faţă de situaţiile noi.

Unele secvenţe din cele două înlănţuiri paralele sunt cvasiconstante (aceleaşi pentru un interval dat de timp, de obicei scurt), iar altele (precum concurenţa şi clienţii) sunt permanent variabile.

Modelul are caracter constitutiv obiectiv, însă politicile economice din mediul productiv general conţin măsuri care stimulează chiar variabilitatea.

De exemplu, în sistemele productive extractive de resurse minerale și energetice, pentru tehnologii miniere și energetice se întâlnesc ţări şi regiuni care au reguli semnificative de generare a concurenţei (pentru stimularea introducerii noutăţilor), de lărgire a pieţelor (clienţilor), de căutare şi diversificare a materiilor prime ieftine şi de calitate superioară, de reducere a stadiilor prin care trec materiile prime în situaţii de semifinite ş.a.

Una dintre caracteristicile importante ale comerţului internaţional contemporan cu tehnologii este faptul că scopul urmărit înainte de toate nu este profitul imediat, ci mai degrabă cucerirea de segmente de piaţă şi controlul tehnologiilor fundamentale (de bază).

În mediul internaţional este vehiculată chiar teza existenţei unui război economic continuu. Confruntarea se localizează în două niveluri:

– cel al mărfurilor produse şi vândute către întreprinderi;

– cel al întreprinderilor, care pot fi vândute sau cumpărate şi care formează o piaţă de ordin secundar.

Orice entitate care preferă prezentul viitorului poate sfârşi prin a dispărea.

Patrimoniul tehnologiilor de vârf trebuie salvat, protejat însă şi actualizat.

Referitor la competiţia şi la globalizarea activităţilor industriale se poate sublinia faptul că în anii ’80 ai secolului trecut a apărut un val de internaţionalizare şi sofisticare a pieţelor, urmare a influenţei date de tehnologii. Capacitatea de a crea şi implementa tehnologii a devenit cheia competitivităţii industriale.

Pentru a putea concura în plan global, companiile miniere și energetice au nevoie de o nouă complexitate tehnologică de maximum de flexibilitate, dar şi de produse tradiţionale şi de o vastă reţea de aprovizionare.

Corporaţiile acţionează în prezent la scară globală, cu ajutorul unui amplu sistem de relaţii şi alianţe externe. Întreprinderile depăşesc practicile lor tradiţionale de export şi în prezent oferă facilităţi externe pentru formularea de reţele inter-naţionale complexe, de cercetare tehnologică, de producţie şi informaţii.

Pe de altă parte este de reţinut faptul că nu există politică industrială fără politică tehnologică.

Încredinţarea unui studiu sau a unei dezvoltări tehnologice unei întreprinderi miniere/energetice este un act major de politică industrială.

7. Concluzii

Concluzia semnificativă, cu grad ridicat de reprezentativitate, arată că la acel moment de ultim sfert de veac, de fapt în sistemele productive extractive de resurse minerale și energetice s-a înregistrat o criză a sistemului tehnologic electromecanic şi chimic care a dominat în trecut, mai mult de un veac, domeniul productiv-industrial.

Între ritmul de creştere economică a unei ţări şi nivelul tehnologic există o strânsă interdependenţă.

Cu cât asimilarea progresului ştiinţific şi tehnic este mai accentuată (rapidă) cu atât este mai intensă dezvoltarea economică.

Invenţiile şi inovaţiile determinând progresul tehnologic pot contribui la relansarea şi dezvoltarea durabilă a economiei unei ţări.

Pentru a putea concura în plan global, companiile miniere și energetice au nevoie de o nouă complexitate tehnologică de maximum de flexibilitate, dar şi de produse tradiţionale şi de o vastă reţea de aprovizionare.

Toate pieţele de tehnologii şi de produse, într-un fel sau altul, intră la un moment dat în declin. Ceea ce variază considerabil în acest proces este localizat în timp sau intervale bine determinate.

Este important să se sesizeze creşterea sau declinul unei pieţe, însă la fel de importantă este sesizarea factorilor care o influenţează.

Liniile principale de dezvoltare ale unei pieţe sunt strâns legate de tehnologii, produsul plasat pe piaţă, concurenţă şi preţ.

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DECIZII COMPLEXE PRIVIND FOLOSIREA UTILAJELOR TEHNOLOGICE ÎN DOMENIUL EXPLOATĂRII șI VALORIFICĂRII URANIULUI/

COMPLEX DECISIONS FOR USING TECHNOLOGICAL EQUIPMENT IN THE URANIUM EXPLORATION AND EXPLOITATION

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ABSTRACT

The paper shows that the optimal balance necessary for satisfying that productive uranium can be determined accurately enough light more strongly two general factors: equipment and usability. It concludes that in every industrial firm mining / nuclear power there is a level of technological equipment. These facilities must determine the degree of use, taking account of certain elements for the immediate and medium term perspective stage of introduction of machinery into production uranium. Defining a dimension of its endowment involves formulating quantitative, qualitative and (new nuclear machinery with new performances). In choosing the best (effective) offers used nuclear will consider their adaptability to specific operating conditions, without exaggeration retention suggestions bidders on modifying technologies work on the equipment that generates, by introduction, technological costs November whether the bidder is in the country or abroad. This paper is a summary of takeover extension study entitled Modern Technologies (Author: Maria Gâf-Deac, Ed. FRM, ISBN 973-582-808-1, Bucharest, 2004) with the application of case law in expansion, extractive mining and energy sectors, respectively in the nuclear industry.

KEYWORDS

management technologies, technological complexity, use of technology, exploitation of uranium, uranium recovery, nuclear industry.

1. Introducere

În industria minieră și energetic ă uraniferă echilibrul necesar pentru satisfacerea cerinţelor productive uranifere, se poate determina suficient de exact ţinând seama mai pregnant de doi factori generali: dotarea şi gradul de folosire.

Se ajunge la concluzia că că în orice firmă industrială minieră/ de energetică nucleară există un nivel de dotare tehnologică.

Acestei dotări trebuie să i se determine un grad de folosire, ţinând seama de elementele certe pentru etapa imediată şi perspectiva medie de introducere a utilajelor în circuitul productiv uranifer.

Definirea unei dimensiuni a dotării presupune formularea cantitativă a acesteia, dar şi cea calitativă (utilaje nucleare noi cu performanţe noi).

În alegerea celor mai bune (eficiente) oferte de utilaje nucleare se va avea în vedere adaptabilitatea acestora la condiţiile de exploatare specifice, fără a exagera reţinerea de sugestii ale ofertanţilor privind modificarea tehnologiilor de lucru în funcţie de echipamentele ce generează, prin introducere, costuri tehnologice noi indiferent dacă ofertantul este din ţară sau din străinătate.

2. Alternativele folosirii complexe a utilajelor într-o tehnologie nucleară

Experimentarea variantelor pentru folosirea utilajelor în sectorul industrial nuclear este mai costisitoare decât experimentarea utilajelor.

În primul caz, sunt impli-ate într-o serie S un număr mai mare de utilaje de acelaşi tip S_1 sau tipuri diferite S_2 [18].

Ca atare, o variantă tehnologică nucleară impusă experimentării conţine:

$$S = S_1 + S_2 \qquad (1)$$

echipamente tehnologice distincte.

Utilajele de acelaşi tip S_1 pot fi noi S_1n sau S_1^r, refolosite (în domeniul minier, al extracției zăcămintelor de uraniu) şi în acelaşi fel utilajele de tipuri constructive diferite pot fi exprimate prin:

$$\sum_i S_2^{ni} \text{ (noi)} \qquad \text{şi} \qquad \sum_i S_2^{ri} \text{ (refolosite)} \qquad (2)$$

În context se înregistrează însumarea de mai jos:

$$S = \left(S_1^n + S_1^r\right) + \left(\sum_i S_2^{ni} + \sum_i S_2^{ri}\right) \quad (i = 1,2,\ldots K) \qquad (3)$$

Comportamentul totalităţii utilajelor nucleare S, care se include într-o tehnologie complexă, imprimă accente experimentale puternice, mai ales prin termenii S_1^n şi $\sum S_2^{ni}$, deoarece parametrii funcţionali ai acestor echipamente sunt iniţial cunoscuţi şi comparaţi mai mult teoretic.

În interiorul variantei pot fi interpolate tendinţele şi concluziile privind folosirea unor echipamente nucleare componente ale seriei, obţinute din funcţionări anterioare ale acestora, în faza de prototip şi în condiţii de exploatare minieră / energetică diferite.

Totodată, este posibil ca un element nuclear (utilaj) din serie, chiar dacă are reacţie (răspuns) nedorită ca rezultate în tehnologia complexă, acesta trebuie să nu compromită experimentul propriu-zis.

Prin feed-back-uri se identifică disfuncţia respectivă şi se acţionează implicit pentru reglare.

Aspectele menţionate se supun atenţiei ca metodologie de abordare a definirii conţinutului noilor alternative de retehnologizare şi dotare, în special minieră, pentru perspectiva dezvoltării întreprinderilor uranifere șia acentarlelor nuclear-electrice.

3. Despre folosirea extensivă a utilajelor într-o tehnologie nucleară

Se acceptă realitatea că în firmele miniere şi în structurile industriale energetice nucleare dintr-o entitate există un nivel de dotare.

Notând cu Q volumul total al utilajelor nucleare pentru prezent, dar mai ales pentru perspectiva imediată şi medie, ca extensie spre viitor, se impune delimitarea din această cantitate a numărului q_1, de echipamente cu grad de folosire certă (figura.1).

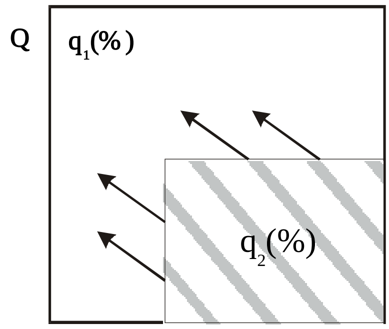

Figura: 1. Delimitarea cantitativă a volumului de utilaje tehnologice nuclearec şi tendinţa necesară pentru creşterea gradului de utilizare

Această fracţiune, prin evaluare reală de patrimoniu, devine operaţională astfel:

$$q' \sqsupseteq q * q_1^r \quad (4)$$

în care:

q_1 este volumul operaţional de utilaje din întreprinderea minieră şi în structurile industriale energetice nucleare;

q_1^r este volumul rezidual de utilaje (nefolosibile din cauze conjuncturale sau obiective, dar care au disponibilitate şi vor avea cerere certă de folosire).

Practic, în unităţile industriale miniere şi în structurile industriale energetice nucleare se manifestă raportul următor:

$$q_1 < q_2 \quad (5)$$

În fapt, este necesar să apară tendinţa:

$$[q_1 \geq q_2] \rightarrow \sim Q \quad (6)$$

în condiţiile în care: $Q_{real} = (q_1 \cup q_2) * (q_1^r \cup q_2^r)$ (7)

unde q_2^r are aceeaşi semnificaţie reziduală, însă pentru volumul de utilaje nefolosite sau cu certitudine redusă de utilizare.

Folosirea cantitativă a utilajelor şi echipamentelor nucleare sub contextul relaţional de mai sus conduce la fructificarea potenţialului dotării existente.

4. Definirea unei dimensiuni a dotării cu utilaje într-o tehnologie nucleară

La un anumit moment se consideră că: există o cantitate totală Q a utilajelor nucleare din dotare. Această dimensiune este discutabilă din mai multe puncte de vedere pentru diverşi agenţi nucleari/ economici (minieri și energetici) şi anume:

a) Q este prea redus (deficienţe cantitative de dotare);

b) Q este suficient ca mărime;

c) Q este mult peste necesarul activităţii productive nucleare curente şi de perspectivă imediată.

Toate cele trei aspecte se pot manifesta separat. Faţă de ultima apreciere apare necesitatea reevaluării dotării cu utilaje într-o tehnologie nucleară.

Notând cu Q_m cantitatea reevaluată în minus, rezultă:

$$Q_m < Q \quad (8)$$

Aşadar, noua cantitate de utilaje rămasă în dotare este:

$$Q1=\Delta Q=Q-Q_m \quad (9)$$

Cantitatea Q_m se poate redistribui, conserva, vinde, licita sau se casează atunci când utilajele întrunesc condiţiile respective.

Ca urmare, gradul de folosire G, aferent cantităţii Q de utilaje nucleare din dotare devine G_1 şi se transferă la Q_1.

Deci: $$G\ (Q) \rightarrow G_1\ (Q_1), \quad (10)$$

Apare necesitatea ca: $$G \approx G_1 \quad (11)$$

Nu este însă suficient să se îndeplinească numai condiţia de mai sus. Degrevarea cantităţii totale de utilaje, de acele echipamente ce nu sunt necesare în etapa dată, optimizează dimensiunea dotării în raport cu folosirea.

Într-o astfel de situaţie scopul final este: $$G_1 > G \quad (12)$$

Se pot aplica şi variante triplu modificate, în care apare un al treilea grup de utilaje, respectiv opţiunea faţă de utilajele nou achiziţionate, intervenind astfel corecturi privind mărimea gradului de folosire.

În figura 2 este redată variaţia: $$f(Q) = G \quad (13)$$

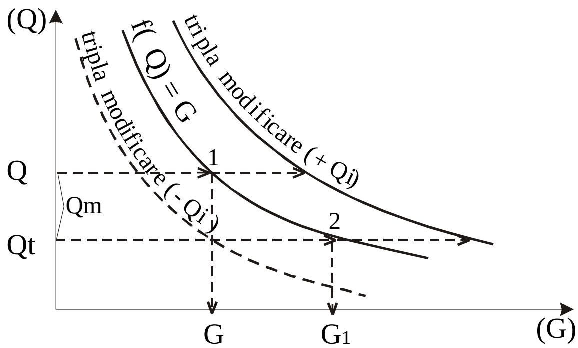

Figura: 2. Creşterea relativă a gradului de utilizare autilajelor nucleare în raport cu reducerea dotării

din care rezultă o creştere relativă a gradului de folosire, o dată cu scăderea numărului de utilaje din dotare, precum şi alternativa influenţelor date de modificări de tipul (±Q1), reprezentând utilaje noi.

În figura.3, relaţia evidenţiază variaţia cantitativă a utilajelor (Q_1) în raport cu un grad de folosire cerut, ţinând seama şi de posibilităţile diferite ($\pm G_1$) ce rezultă ca influenţe din introducerea utilajelor noi în dotare.

$$f\ (G) = Q$$

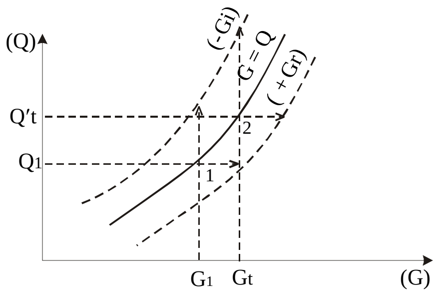

Figura: 3. Variaţia dotării cu utilaje nucleare în raport cu un grad de folosire cerut de condiţiile de exploatare

Este important de reţinut că optimul, respectiv echilibrul necesar pentru satisfacerea cerinţelor productive, se poate determina suficient de exact pe această cale, ţinând seama mai pregnant de aceşti doi factori generali (dotarea şi gradul de folosire). Dar, aceste relaţii este imperios necesar să fie plasate într-o scară dinamică a evoluţiei cererii procesului de producţie proiectat.

5. Concluzii

În principal se desprind următoarele:

1. *Formularea deciziilor* de folosire a utilajelor în sectorul industrial nuclear fundamentează „prognozarea”, mai exact pornirea procesului de retehnologizare.

2. *Experimentarea variantelor* este în mod cert mai costisitoare decât experimentarea utilajelor nucleare.

Totuşi, retehnologizarea presupune schimbarea variantelor, alternalivelor, respective, îmbunătăţirea sau perfecţionarea lor. Nu se poate trece însă peste necesitatea potrivirii caracteristicilor utilajului nuclear individual cu condiţiile productive specifice.

Această concluzie susţine latura de natură financiară a retehnologizării, pe baze cât mai obiective.

3. Se acceptă realitatea că în orice firmă industrială minieră/ de energetică nucleară există un nivel de dotare tehnologică. Acestei dotări trebuie să i se determine *un grad de folosire*, ţinând seama de elementele certe pentru etapa imediată şi perspectiva medie de introducere a utilajelor în circuitul productiv uranifer.

4. *Definirea unei dimensiuni a dotării* presupune formularea cantitativă a acesteia, dar şi cea calitativă (utilajenucleare noi cu performanţe noi).

5. În alegerea celor mai bune (eficiente) oferte de utilaje nucleare se va avea în vedere *adaptabilitatea acestora la condiţiile de exploatare specifice*, fără a exagera reţinerea de sugestii ale ofertanţilor privind modificarea tehnologiilor de lucru în funcţie de echipamentele ce generează, prin introducere, costuri tehnologice noi indiferent dacă ofertantul este din ţară sau din străinătate.

6. Pentru o mai bună corelare a utilajelor în retehnologizare trebuie avute în vedere aspectul căutării *soluţiilor optime de exploatare nucleară*, eliminarea sau refacerea infrastructurii ce se dovedeşte nepotrivită cu perspectiva propriu-zisă a lucrărilor de exploatare.

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RETEHNOLOGIZAREA ŞI PROGNOZA TEHNOLOGICĂ ÎN INDUSTRIA DE EXPLOATARE A METALELOR RARE ŞI URANIULUI

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ABSTRACT

The article states that the review of nuclear technology looks can be achieved through a new technology management; recomposition, resetting and alignment of sequences technical performance of technology; introduce new technologies, more efficient compared to existing ones; intervention on existing technologies in increasing the performance of essential parameters positively influencing the flow changes, disposal of non-performing technologies that induce inefficiency direct and indirect frequently productive throughout the work, setting a deadline of life of existing technologies that have entered the stage of disintegration coupled with forecasts for the technology replacement (with performance superior to that required to be deleted). This paper is a summary of takeover extension study entitled Modern Technologies (Author: Maria Gâf-Deac, Ed. FRM, ISBN 973-582-808-1, Bucharest, 2004) with the application of case law in expansion, extractive mining and energy sectors, respectively in the nuclear industry.

KEYWORDS

energy crisis, the status of technology, life technologies, technological bottleneck, technological restructuring, investment flow technology used for extensive, intensive use, technological forecasting.

1. Introducere

În activitatea productivă nucleară sunt situaţii în care apar semnele unui proces de depreciere tehnologică.

Deteriorarea continuă a nivelului tehnologiilor şi echipamentelor se realizează de regulă lent.

La sfârşitul secolului XX se constată că termenul de „lent" este menţinut în uz pentru aprecieri de genul celor de mai sus, atât timp cât nu i se opune noţiunea de „instantaneu".

O tehnologie – după naşterea sa nu poate înregistra deterioare instantanee, deoarece ea dacă nu ajunge la maturitate, respectiv consolidare, nu se înscrie în familia celor validate şi implementate în sistemele productive. În acest caz, ea poate fi denumită cel mult „inovativă", de ruptură sau de tranziţie.

Lipsa de informatizare actualizată a întreprinderilor şi tehnologiilor, menţinerea unui grad redus de prelucrare, scăderea competitivităţii produselor şi eficienţa generală redusă a activităţilor economice constituie, de asemenea, elemente de erodare a tehnologiilor.

În mediul economico-productiv – într-o companie minieră/ energetică nucleară – se pot lua decizii care vizează aducerea în prim plan a unor intervenţii tehnologice care dinamizează schimbarea.

Se constată că nevoia de tehnologii este permanentă. În mulţimea tehnologiilor deja existente (implementările) se identifică tehnologiile cu accente neperformante. Acestea sunt supuse procesului decizional pentru a se hotărî soarta lor.

Decidenţii constată că pot opta pentru introducerea de tehnologii noi sau pot menţine încă în funcţiune tehnologiile validate (moderne) maturizate.

În schimb, în numărul de situaţii tehnologice concrete se identifică şi existenţa tehnologiilor deja „clasice", în destrămare şi a unora care trebuie scoase din uz, ca fiind neperformante. Ultimele două categorii de tehnologii nu sunt dorite şi ele se află la limita finală a intervalului de deteriorare lentă.

2. Revizuirea stărilor tehnologice

Tehnologiile stabile, inclusiv cele din domeniul uraniului, sunt supuse „îmbătrânirii" iar semnul vizibil al acestui proces este deteriorarea performanţelor.

Această schimbare de situaţii se manifestă prin uzura fizică şi mai ales morală a echipamentelor, chiar scăderea performanţelor iniţiale (considerate „standard") cu consecinţe imediate în creşterea consumurilor specifice, a costurilor şi reducerea productivităţii şi a profiturilor.

Gama de performanțe pozitive poate fi soluţionată respectiv adjudecată prin retehnologizare.

Revizuirea stărilor tehnologice nucleare se poate realiza prin:

- un nou management tehnologic;
- noi recompuneri, reaşezări şi ralieri performante ale secvenţelor tehnice dintr-o tehnologie;
- introducerea de tehnologii noi, mai performante comparativ cu cele existente;
- intervenţia asupra tehnologiilor existente în direcţia creşterii performanţelor unor parametrii care influenţează esenţial în sens pozitiv fluxul transformărilor.
- scoaterea din uz a tehnologiilor neperformante, care induc ineficienţa direct şi frecvent indirect în ansamblul productiv în care mai funcţionează.

- stabilirea unui termen limită de viaţă al tehnologiilor existente care au intrat în faza de destrămare, corelat cu previziunea asupra tehnologiei înlocuitoare (cu performanţe obligatoriu superioare faţă de cea care urmează a fi eliminată).

Retehnologizarea continuă ca politică generală acceptată în strategia economi-

co-productivă a unei ţări presupune alocări semnificative de resurse din produsul intern brut (PIB).

La semnalele incipiente de depreciere a tehnologiilor, ţările dezvoltate reacţionează operativ, deoarece drumul spre profit este întreţinut cvasipermanent prin faza de cercetare-dezvoltare, ca rezervor de inovare tehnologică.

În aceleaşi circumstanţe, transferul rapid de tehnologie suplineşte variaţiile progresului înregistrat prin resurse proprii.

Demersurile de mai sus necesită capitaluri de modernizare pentru dezvoltarea ştiinţei şi tehnologiei şi investiţii alocate pentru schimbări structurale.

În plan sectorial, retehnologizarea evidenţiază necesitatea îmbunătăţirii structurii tehnologice a investiţiilor totale, în direcţia creşterii ponderii echipamentelor şi utilajelor, a părţilor active ale investiţiei.

Abordarea macroeconomică a retehnologizării în mediul economiei de piaţă este dificilă, deoarece infuzia masiv centralizată de tehnologii nu este posibilă din partea unui buget public naţional.

Modernizarea tehnologică a capacităţilor de producţie viabile, punerea în valoare a unor avantaje tehnologice, competitive a oportunităţilor tehnice şi creşterea capacităţii de difuzare tehnologică (*spill-overs*), constituie elemente de contribuţie practică în procesul retehnologizării.

Abordarea retehnologizării la nivel microeconomic, în manieră iterativă este calea cea mai utilă de soluţionare a stării performanţelor, mai ales, în cazul în care instituţiile statale sunt permisive în privinţa introducerii noilor tehnologii (suportă în mod stimulativ) din punct de vedere legislativ şi ca orientare strategică.

În orice sistem – implicit cel tehnologic şi productiv – din perspectiva intenţiei de a obţine date de desfacere a tehnologiilor viabile se deduce că intervin factori generatori de discontinuitate sau de transformări calitative (structurale). Dintre aceştia, cea mai semnificativi sunt *invenţiile* şi *inovaţiile tehnologice*.

Raţionalizarea tehnologiilor este o acţiune obiectivă independentă de evoluţia de ansamblu a sistemelor tehnologice. Procesul are loc în două sfere:

- în *sfera internă* – proprie configuraţiei tehnologiei (se desfăşoară acţiuni asupra arhitecturii şi fracţiunilor de bază ale tehnologiei pentru eficientizare);
- în *sfera exterioară* – când inventarul tehnologiilor este strict necesar (se realizează clasificări, ierarhizări, comasări, eliminări ş.a.).

În primul caz, complexitatea internă a sistemului tehnologic (a tehnologiei) induce influenţe asupra performanţelor sistemului managerial aferent aplicării tehno-logiei respective, situaţie în care organizarea şi conducerea trebuie aşezate pe baze noi.

Noutăţile cu grad ridicat de probabilitate de aplicare pot produce unele rupturi de tendinţe, cu consecinţe practice distincte.

3. Tehnologiile nucleare moderne şi viitorul

3.1. Cercetarea ştiinţifică şi dezvoltarea tehnologică nucleară

Se consideră că, în prezent, ştiinţa este mai importantă pentru bunăstarea unei naţiuni decât capitalul sau forţa de muncă. Ştiinţa a devenit deja principala resursă a dezvoltării.

O sistematizare a unor direcţii de acţiune în sfera dezvoltării cercetării ştiinţifice se rezumă în principal la următoarele:

1. – formularea practică a unor indicatori ştiinţifici cantitativi şi raportarea lor la evoluţia dezvoltărilor în ştiinţă şi tehnologie;

2. – formularea sistemelor de informare (informatic şi informaţional) în ştiinţă şi tehnologie;

3. – cuantificarea rezultatelor interconexiunii elementelor de ştiinţă cu cele de tehnologie;

4. – identificarea proceselor optime (eficiente) de cunoaştere (descoperire) în contextul socio-organizatoric dat de mediul în care urmează a se dezvolta ştiinţă şi tehnologia;

Se constată că ştiinţa contribuie fundamental la dezvoltarea tehnologiei. Această implicare este mai accentuată ca oricând în istoria dezvoltării tehnologice. Rezultatele (beneficiile) obţinute de societatea umană din tehnologiile ce ating un nivel convenţional acceptat al performanţelor tind să se regionalizeze, respectiv să dobândească răspândire mondială.

Tehnologiile neconvenţionale se află în avangarda (în primul front) al acestor implicaţii şi transformări.

Deja în mediul internaţional se identifică grupări de specialişti abilitaţi direct cu elaborarea procedeelor şi stabilirea modelelor de aplicare mai rapidă a tehnologiilor, cu deosebire a celor avansate.

Raportul între cercetarea fundamentală şi cea aplicativă induce creşterea proporţiei în favoarea celei dintâi, care la rândul ei are totuşi în componenţă un domeniu suficient dimensionat de cercetare empirică.

Încă din anul 1959 s-a pus în discuţie (analiză) „impactul unei ştiinţe naţionale asupra tehnologiei naţionale”. Astăzi au loc interferări între „tehnologiile europene” şi alte configuraţii tehnologice regionale sau chiar mondiale.

Este cert însă că economiile naţionale sunt beneficiarele primare ale cercetărilor fundamentale. În practică se întâlnesc legături vizibile între ştiinţele fundamentale şi cele aplicative.

Cercetarea ştiinţifică oferă exemplele numeroase ale transpunerii practice a conceptului de „inovaţie liniară”. Acesta presupune luarea în considerare a cel puţin trei etape de formare, după cum urmează:

E_1 – **Etapa tehnologiei teoretice-fundamentale**. Cercetarea ştiinţifică fundamentală are în vedere existenţa „savantului cercetător” (acumulator larg de cunoştinţe ştiinţifice), care prin autoselectare şi autoreglare a procesului de căutare identifică o aşa numită „descoperire” ce dobândeşte calificativ (cu caracterizări specifice) de „inven-ţie”. Invenţia înglobează o cantitate selectată de cunoştinţe ştiinţifice.

E_2 – **Etapa tehnologiei cvasiaplicative.** Invenţia este preluată de elementul „un nou savant cercetător” care cristalizează noutatea în primele scheme logice de flux tehnologic. Este apoi sarcina „inginerului” spre a consolida tehnologia înglobându-i arhitectură concretă şi alocându-i funcţiuni care să o facă operabilă în câmpul productiv economic. „Inginerul” va reţine – sintetizat – un volum mai redus de cunoştinţe ştiinţifice, care sunt condensate (deja înglobate) în invenţie (inovaţie) în comparaţie cu predecesorul său „cercetătorul”.

E_3 – **Etapa tehnologiei aplicative-practice** include valorificarea, prin lansarea şi exploatarea propriuzisă a tehnologiei. În această etapă - în mod sugestiv – cunoştinţele ştiinţifice înglobate în tehnologie devin deja „istorice”. Este momentul în care un nou ciclu de cercetare provoacă prin noutate stabilitatea tehnologiei puse în operă. Cu alte cuvinte, o tehnologie „descoperită”, pusă în practică devine instantaneu veche, adică generatoare de dimensiuni care solicită noutăţi cu performanţe superioare.

Se observă că în acest ciclu intervin următorii „actori”: savant cercetător, nou savant cercetător şi inginer, care prin atribuţiile şi răspunderile lor provoacă disocierea ideii de ştiinţă şi tehnologie naţională şi internaţională. În inventarul ştiinţific al tehnologiilor rămâne marcată sursa, respectiv localizarea descoperirii ca expresie a potenţialului de inteligenţă a unei naţiuni sau a unei entităţi sociale.

Ştiinţa fundamentală a devenit tot mai scumpă şi depăşeşte în multe cazuri posibilităţile individuale ale unei ţări.

Sfera ştiinţei s-a lărgit şi domeniile de cuprindere a tehnicii şi tehnologiei s-au extins. Deja sunt operaţionale tehnologiile economice, sociale, culturale, ecologice ş.a.

Mulţimea instituţiilor producătoare sau consumatoare de ştiinţă şi tehnologie este de asemenea în creştere.

În întâmpinarea dezvoltării mondiale, în general, pot fi avansate cel puţin două oferte:

– un cadru de garantare a dezvoltării (care ar putea stabili limitele de variaţie a preţurilor ştiinţelor şi tehnologiilor);

– măsuri de îmbunătăţire a accesului la tehnologiile cele mai importante, la managementul lor şi la schimbul de informaţii ştiinţifice şi tehnologice.

În practică se constată că evaluarea opţiunilor tehnice de fapt desemnează procesul de înfăptuire a unui echilibru între ştiinţă şi tehnică.

3.2. Conducerea tehnologiilor nucleare

Structura organizatorică (a firmei) pune în valoare tehnologiile din dotare cu scopul transformării materiilor prime, materialelor, energiei şi informaţiilor în produse, bunuri şi servicii [6].

Structurile productive cu dimensiuni mari parcurg delimitări mai pregnante care vizează:

a) *conturarea tehnologiilor* cu elemente de dezvoltare;

b) *conturarea activităţilor manageriale* pentru asigurarea operaţionalităţii optime a tehnologiilor.

Un model de conducere a tehnologiilor reflectă punerea în funcţiune a structurii acestora şi aplicarea de reguli de evoluţie şi comportament tehnic. Se identifică cel puţin 6 structuri de management tehnologic (figura. 1). [6]

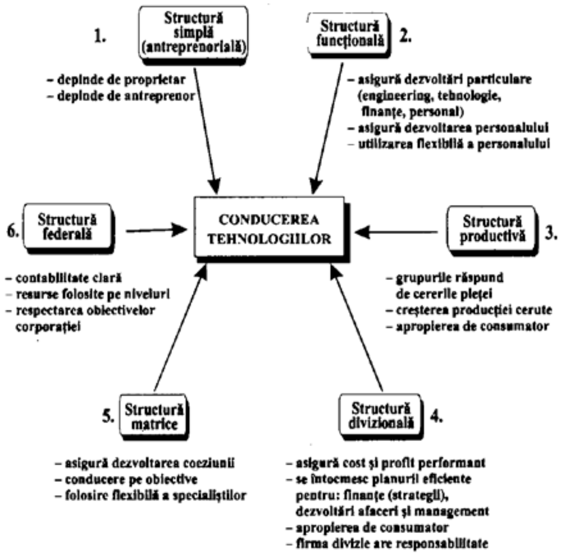

Figura: 1. Elemente structurale de influenţă a conducerii tehnologiilor 1. structura simplă sau antreprenorială; 2. structura funcţională; 3. structura productivă; 4. structura divizională (diviziune a scopurilor); 5. structura de tip matrice; 6. structura reunită de tip federal.

Statistic, se constată că numeroase companii de dimensiuni mai mari aplică frecvent conducerea tehnologiilor prin structuri de tip divizional *(4)* sau matrice *(5)* însă, practic, se întâlnesc transpuse toate formulele enumerate.

Principalele alternative ce stau în faţa firmelor atunci când abordează alegerea unei maniere de conducere a tehnologiilor se referă la:

– centralizarea faţă de descentralizare;

– profesionism faţă de management;

– controlul faţă de acţiunea liberă, neîngrădită;

– schimbarea faţă de stabilitate.

Conducerea tehnologiilor se realizează în baza principiilor ce desemnează funcţionalitatea unui sistem de producţie.

Funcţiile managementului şi procedeele de conducere pot fi aplicate fără rezerva în conducerea tehnologiilor.

În schimb, în condiţiile creşterii complexităţii tehnologice, a manierei noi de localizare a companiilor în mediul economic transnaţional, conducerea tehnologică este situată între resurse şi obiective (figura.2). [6]

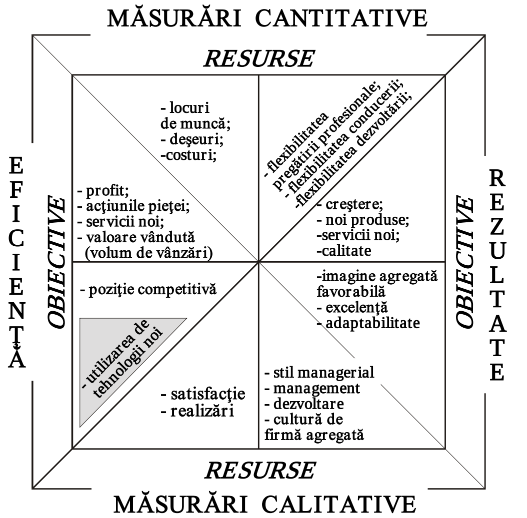

Figura:2. Amplasamentul managementului tehnologiilor noi în sistemul resurse-obiective

La rândul lor, resursele sunt situate între măsurările *cantitative* şi cele *calitative*.

Tehnologiile conduse convenţional favorabil definesc la nivel de firmă resursele în viziune cantitativă care în principal pot fi: locuri de muncă, deseuri şi reglementarea eliminării (depozitării) lor, costuri, flexibilitate în privinţa instruirii profesionale, flexibilitatea conducerii şi a dezvoltării ş.a.

Aspectele calitative ale resurselor în procesul conducerii tehnologiilor se regăsesc în stilul de management aplicat, în managementul propriu-zis şi dezvoltarea efectivă, formula agregat de cultură de firmă, nivelul satisfacţiei şi volumul realizărilor.

Obiectivele firmei se situează între nevoia (tendinţa) de a obţine rezultate şi eficienţă.

Conducerea favorabilă a tehnologiilor vizează obţinerea de rezultate care să reflecte creşterea, lansarea de noi produse şi servicii însoţite de un nivel de calitate.

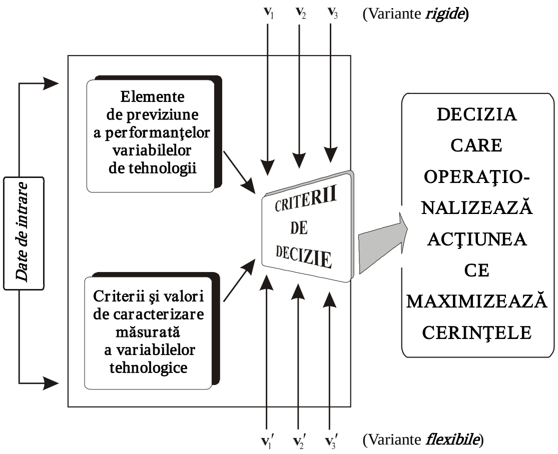

Figura: 3. Schema simplificată a structurii luării deciziilor în conducerea tehnologiilor

Eficienţa este reflectată prin nivelul atins de profit, modul de racordare la acţiunile pieţei, volumul livrărilor (vânzărilor), poziţia ocupată în competiţie (competitivitate) şi în mod esenţial felul în care sunt utilizate tehnologiile noi, utilajele şi echipamentele aferente. (figura.3) [6]

Viziunea expusă este mult diferită în conţinut şi mod de abordare a laturilor conducerii tehnologiilor faţă de modelul clasic în care organizarea, atribuţia de funcţiuni şi controlul pe liniile tehnologice productive sunt primordiale.

Incidenţele din figura.3 subliniază necesitatea luării în considerare în mod conjugat (şi compus) a mai multor factori în sistemul resurse-obiective, ce în ultimă instanţă se referă la acelaşi model cibernetic al producţiei, care – simplificat – cuprinde intrările (resurse) – procesarea (conducerea propriu-zisă a tehnologiilor) – ieşirile (obiective).

Decizia raţională tehnologică este reprezentată de acţiunile care realizează valoarea ponderată maximă.

Schema simplificată a structurii luării deciziilor în conducerea tehnologiilor este redată în figura.3.

Gradul de libertate în elaborarea procesului de luare a deciziilor în domeniul tehnologiilor este dependent de nivelul de cunoaştere a conţinutului tehnologic şi de complexitatea decizională abordată.

Criteriile şi valorile de conducere a tehnologiilor trebuie să fie clare şi simple, iar riscurile elocvent conturate.

3.3. Organizarea tehnologiilor nucleare

Organizarea dezvoltării este o expresie generică privind intervenţia strategică în progresul unei companii. Scopul unei intervenţii este triplu:

– dezvoltarea situaţiilor individuale (punctuale, de natură tehnologică şi umană);

– dezvoltarea situaţiilor de grup (de natură tehnologică şi umană);

– dezvoltarea întreprinderii ca sistem.

Top managementul firmei de regulă sprijină şi este implicat în rezolvarea problemelor pe termen lung şi soluţionarea proceselor de reînnoire. Aceste implicaţii se îndeplinesc prin elaborarea efectivă a *diagnozelor colaborative şi a culturii manageriale a firmei*.

Cu ajutorul unor grupuri formale de lucru, echipe temporare şi intergrupuri – şi cu asistenţa unui consultant facilitator – se apelează la teoria comportamentului şi la analiza de tehnologii prin acţiunea de cercetare complexă.

Într-un astfel de context tehnologiile sunt organizate, ele însele, în propria configuraţie şi în raport cu întreprinderea ca sistem.

Organizarea tehnologiilor are drept scop identificarea „zonelor de gol” care pot fi completate cu secvenţe practice operaţionale vizând tehnologiile moderne. În fond, un astfel de demers înseamnă în esenţă asigurarea dezvoltării firmei respective.

Într-o întreprindere este formulat întotdeauna practic un model operaţional tehnologic.

Periodic (etapizat) acesta este revizuit şi adaptat, imprimându-i-se tendinţa spre „ideal” respectiv „strategic”. La rândul său, modelul tehnologic formulat (organizat) se regăseşte într-un circuit care se centrează pe organizarea dezvoltării tehnologice de ansamblu (figura.4). [6]

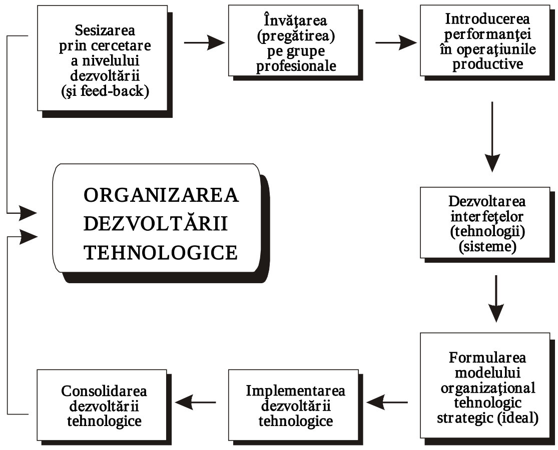

Figura: 4. Organizarea tehnologiilor şi modelul organizării dezvoltării tehnologice

În ordine operaţională circuitul cuprinde:

– sesizarea (prin cercetare) a nivelului de dezvoltare tehnologică în contextul organizatoric dat al întreprinderii şi luarea în considerare a feed-back-urilor aferente;

– pregătirea pe grupe profesionale (procesul de învăţământ) referitoare la schimbarea tehnologică;

– introducerea performanţei în operaţiunile productive, aferente tehnologiilor aflate în exploatare;

– dezvoltarea interfeţelor (identificarea graniţelor şi a barierelor) între tehnologii şi alte sisteme sau subsisteme interne şi exterioare;

– formularea modelului organizaţional tehnologic strategic (ideal). Această etapă constituie în practică aplicarea principiilor organizării în liniile tehnologice şi asupra tehnologiei în ansamblu;

– implementarea dezvoltării tehnologiei propuse, urmare a noii configuraţii organizatorice în liniile de producţie;

– consolidarea dezvoltării tehnologice prin măsuri de menţinere a tendinţelor imprimate.

În circuitul enunţat şi în ipostaza dublă de element central „organizarea dezvoltării tehnologice” devine temă strategică în existenţa şi funcţionarea oricărei companii.

4. Concluzii

Organizarea tehnologiilor este mai mult tehnică decât umană. Utilajele, echipamentele, dispozitivele au parametrii constructiv-funcţionali bine definiţi. Astfel, în sistemul productiv se procedează mai degrabă la o relaţionare structurală cvasi-înoită a modulelor tehnologice.

Climatul organizaţional, de exemplu, are importanţă mai redusă în organizarea tehnologiilor. În schimb, modificările structurale (organizatorice) tehnologice pot influenţa vizibil climatul particular sau de ansamblu al firmei.

Angajamentul de muncă poate fi raţionalizat în cazul unei organizări noi, mai convenabile a tehnologiilor.

Managementul dezvoltării este o expresie (printre altele) şi a organizării tehnologice.

Conflictele organizaţionale sunt distincte şi de regulă nelegate de organizarea tehnologiilor.

Organizarea tehnologiilor este afectată de mărimea forţelor schimbării.

Schimbarea tehnologică poate fi însoţită de următoarele:

– modificări tehnice, tehnologice, de procedee şi proceduri;

– extinderea cunoştinţelor;

– rapida schimbare ciclică a produselor tehnologice;

– schimbarea naturii forţei de muncă;

– schimbarea mediului de muncă.

Rezistenţa la schimbare poate fi:

1) la nivel individual;

2) la nivel organizaţional.

Rezistenţele individuale faţă de schimbările ce pot produce organizarea nouă a tehnologiilor sunt:

– percepţia selectivă;

– obişnuinţa;

– inconvenienţa pierderii unui grad de libertate clasic;

– implicaţii economice;

– securitatea locului de muncă;

– slabe cunoştinţe despre schimbare-organizare (neştiinţa).

Rezistenţele de schimbare tehnologică la nivelul întreprinderilor au în vedere:

– menţinerea stabilităţii;

– investiţia în resurse;

– obişnuinţa cu legăturile şi acordurile mai vechi;

– tratamentul ce vizează puterea de influenţă.

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COMPLEXITATEA TEHNOLOGICĂ ÎN DOMENIUL EXPLOATĂRII ŞI VALORIFICĂRII RESURSELOR MINERALE ŞI ENERGETICE/

TECHNOLOGICAL COMPLEXITY IN THE EXPLORATION AND RECOVERY OF MINERAL AND ENERGY RESOURCES

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ABSTRACT

The paper shows that between complex and complicated differences manifest themselves recognized. Complexity science and technology is defined as the ability of a system to record a large number of different states in a defined time interval. Status of complexity depends on the capacity (ability) technological system to evolve over time, the type of behavior by multiplying its elements and the evolution and variability circuits between items. Status of sophistication of technological systems assemblies depends on the type, number and differences between elements, and the number and difference of relations between elements.

This paper is a summary of takeover extension study entitled Modern Technologies (Author: Maria Gâf- Deac, Ed. FRM, ISBN 973-582-808-1, Bucharest, 2004) with the application of case law in expansion, extractive mining and energy sectors, respectively in the nuclear industry.

KEYWORDS

technological sophistication, technology status, life technologies, size of technology, utilizing extensive use intensive technological forecasting

1. Introducere

În situaţiile curente sociale şi productive între **complex** şi **complicat se manifestă diferenţe recunoscute.** Complexitatea în sfera ştiinţei şi tehnologiei se defineşte ca fiind **aptitudinea unui sistem de a înregistra un mare număr de stări diferite într-un interval determinat de timp [24].**

De asemenea, nu trebuie confundată **complexitatea** cu **dinamica** sa. Anumite sisteme, de exemplu, în domeniul exploatării și valorificării resurselor minerale și energetice, nu înregistrează decât o gamă restrânsă de stări posibile.

Ele sunt mai puţin dinamice, iar această restricţie **se opune** complexităţii. În acest caz sistemele sunt considerate ca fiind simple.

Un exemplu de sistem simplu trivial îl reprezintă **maşina** care într-o manieră precisă, invariantă are o intrare determinată, apoi pe baza unei funcţii de aplicaţie realizează transformarea substanţei intrate pentru a obţine un rezultat prevăzut, sigur.

Fiecărei intrări în domeniul exploatării și valorificării resurselor minerale și energetice îi corespunde întotdeauna aceeaşi ieşire. Acest tip de comportament este caracteristic maşinilor.

Entităţile complexe, nontriviale se comportă însă într-o manieră mai aleatoare. Aceeaşi intrare poate să ajungă în ieşiri configurate divers în conţinut, calitate, formă ş.a.

Traseul „intrări precise – ieşiri diverse" are loc fără ca sistemul tehnologic să sufere disfuncţii în domeniul exploatării și valorificării resurselor minerale și energetice.

Studiul transformărilor imprevizibile arată că sistemului tehnologic i se aplică o funcţie nontrivială care se modifică ea însăşi în timp. Funcţia respectivă are efecte de „dinamică proprie".

Astfel, acelaşi *input* realizat în două momente diferite va putea înregistra două maniere diferite ale stării sale la etapa *output.*

Se poate aprecia că în domeniul exploatării și valorificării resurselor minerale și energetice ieşirea depinde de intrare, însă concomitent starea finală depinde de situaţia în care se află sistemul tehnologic la aplicarea intrării respective.

2. Starea de complexitate și complicare tehnologică în domeniul exploatării și valorificării resurselor minerale și energetice

Viaţa proprie a sistemului tehnologic în domeniul exploatării și valorificării resurselor minerale și energetice depinde deci de capacitatea de interacţiune şi modificare între componentele sale.

O relaţie tehnologică oarecare – indiferent în ce etapă de transformare este considerată - poate deci cunoaşte un curs diferit. Prin urmare, aplicarea funcţiei nontriviale de transformare şi relaţiile interne ale sistemului tehnologic pot determina aşa numita „globalitate", şi din punct de vedere dinamic rezultă o largă varietate de componente posibile.

De altfel, sistemele tehnologice în domeniul exploatării și valorificării resurselor minerale și energetice – pentru a fi acceptate – profită de complexitatea lor ridicată.

Deja, în contemporaneitate, într-un sistem tehnologic modern managerii nu mai rămân prizonierii reflexiei „cauză-efect". Ei caută şi comandă „măsurile salvatoare" care declanşează schimbări adecvate prin care se obţin rezultatele aşteptate.

Cu toate acestea, complexitatea face dificilă inserarea în sistemele tehnologice în domeniul exploatării și valorificării resurselor minerale și energetice a unei maniere simple de mişcare a substanţei în transformare. Într-o primă evaluare se constată că tendinţa generală este de simplificare a complexităţii obiective a sistemelor tehnologice superioare (glisarea de la nontrivial la trivial).

Asimilarea ansamblului cu un sistem trivial în domeniul exploatării și valorificării resurselor minerale și energetice pare justificată. Iniţial se construieşte un model simplu, stăpânit, care apoi treptat este lărgit, astfel încât realitatea complexă să se comporte în final ca şi modelul de bază. Acest demers este chiar el **complicat**.

În practică, sistemele tehnologice simple în domeniul exploatării și valorificării resurselor minerale și energetice urmează un drum (C) al complexităţii (relativ complex, complex, extrem de complex) şi de readucere la starea de simplitate (S) pentru a facilita controlul şi conducerea lor (sistem extrem de complex, complicat, relativ complicat, simplu) (figura. 1). [5]

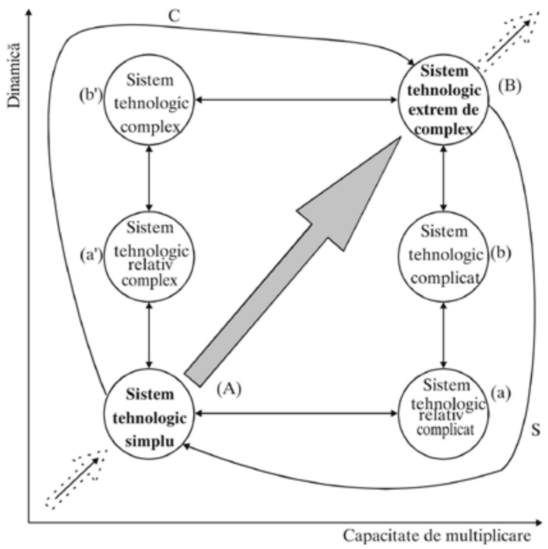

Figura: 1. Tendinţa de înregistrare a unei noi complexităţi a sistemelor tehnologice în domeniul exploatării și valorificării resurselor minerale și energetice şi încercarea de reducere la modelele nontriviale, necomplicate de conducere a acestora

Starea de complexitate depinde de capacitatea (aptitudinea) sistemului tehnologic în domeniul exploatării și valorificării resurselor minerale și energetice de a evolua în timp, prin multiplicarea tipului de comportament a elementelor sale precum şi de evoluţia şi variabilitatea circuitelor între elemente.

Starea de complicare a sistemelor tehnologice în domeniul exploatării și valorificării resurselor minerale și energetice depinde de tipul asamblărilor, numărul şi diferenţele între elemente, precum şi de numărul şi diferenţa dintre relaţiile stabilite între elemente.

Este important de remarcat că în domeniul tehnic sistemele tehnologice nu se construiesc şi nu pot fi definite ca entităţi compuse din funcţii invariante. O maşină, un utilaj, un echipament, odată realizate şi omologate, nu sunt destinate funcţionării hazardate.

Piesele şi subansamblele ş.a. sunt programate pentru scopuri precise. Ansamblul tehnologic în domeniul exploatării și valorificării resurselor minerale și energetice este „regizat” prin reguli fixe, prestabilite de constructor.

Cibernetica maşinilor permite actualmente elaborarea unei game largi a repertoarului de comportamente. Cu toate acestea, **frontierele** de manevre rămân încă **limitate.**

De exemplu, roboţii se autodirijează însă numai în interiorul unui câmp de acţiune bine definit. Într-un anumit sens acest tip de maşini rămân „triviale”, iar acţiunile lor de transformare justifică aspiraţia managerială de simplificare.

Dimpotrivă, produselor tehnicii li se pot aloca (ataşa) alte sisteme decât cele care le-au realizat. De exemplu, ecosistemele sau sistemele sociale au ‚părţi vii”, complexe.

Sistemele ecologic şi social sunt necesarmente complexe. Ele nu au caracteristici finale triviale. Complexitatea lor poate fi variabilă şi acceptată convenţional – ca înţelegere – de către managerii din sistemele tehnologice.

În interiorul sistemului social, întreprinderea din domeniul exploatării și valorificării resurselor minerale și energetice este un instrument al managerilor pentru a naviga într-o complexitate superioară, iar sistemele tehnologice se regăsesc în structurile companiilor.

A surmonta complexitatea sistemelor în domeniul exploatării și valorificării resurselor minerale și energetice nu înseamnă a proceda la reducerea acesteia.

De exemplu, la exploatarea subterană a substanţelor minerale utile și energetice, inclusiv radioactive, este posibilă protejarea presiunii miniere (construind şi folosind utilaje, echipamente deci folosind tehnologii adecvate care să lucreze într-un regim dat) faţă de combaterea nivelului presiunii respective [5].

Aşadar:

– complexitatea în domeniul exploatării și valorificării resurselor minerale și energetice este aptitudinea unui sistem de a trece la un număr mare de stări distincte într-un interval scurt de timp;

– maşinile sunt **sisteme noncomplexe**, deci triviale deoarece au un comportament predefinit, previzibil;

– sistemele ecologice şi sociale sunt **complexe**, deci nontriviale, deoarece comportamentul lor concret la un moment dat nu este previzibil.

În schimb, diversificarea surselor de schimbări tehnologice în domeniul exploatării și valorificării resurselor minerale și energetice conduce la o complexitate specifică în sistemele productiv-industriale.

Tipul de surse, gama nevoilor, experienţa tehnică a întreprinderilor în domeniul exploatării și valorificării resurselor minerale și energetice determină noi metode de acţiune, prin „noutăţi”.

Complexitatea tehnologică în domeniul exploatării și valorificării resurselor minerale și energetice poate fi gestionată deoarece programarea acţiunii maşinilor din fluxurile de transformare denotă tendinţa de obţinere cât mai precisă a rezultatelor dorite.

Un management neperformant, lipsa de reguli sau neaplicarea acestora (ori aplicarea limitată) determină complexitatea tehnologică aparentă.

Complexitatea proceselor productiv-industriale în domeniul exploatării și valorificării resurselor minerale și energetice este în creştere deoarece în mediul economic general sunt vehiculate informaţii şi reacţii asupra cărora planează o permanentă incertitudine în privinţa validităţii lor.

Întreprinderile din domeniul exploatării și valorificării resurselor minerale și energetice acceptă constatarea că fluxurile productive devin mai complexe şi că neralierea la această complexitate riscă să afecteze competitivitatea lor.

Dacă în mod curent procedurile de dotare tehnologică complexă, competitivă erau rezervate unor domenii cu sprijin statal strict, direcţionat sau cu interes privat accentuat (aeronautică, armament, microelectronică ş.a.), în prezent se constată că şi industriile „ordinare” se angrenează într-o astfel de tendinţă.

2. Tehnologiile dominante în sectorul exploatării și valorificării resurselor minerale și energetice

Noile tehnologii, în general, înfăţişează următoarele consecinţe principale o dată cu apariţia şi aplicarea lor:

– introducerea în procesele productiv-industriale a unor procedee şi metode tehnice noi, cu parametrii diferiţi, superiori, faţă de cei actuali;

– apariţia de noi obiecte: produse şi servicii cu grad mărit de noutate;

– apariţia unor noi lanţuri de transformare a materiilor şi materialelor ce intră în procesul tehnologic în domeniul exploatării și valorificării resurselor minerale și energetice.

Noile tehnologii în domeniul exploatării și valorificării resurselor minerale și energetice formează o familie cu elemente care, individual - într-un anumit interval de timp – domină prin competitivitate procesele productiv-industriale.

Concomitent, de la o etapă la alta, are loc diversificarea materialelor. Rupturile între familiile de tehnologii sunt date de gradul de dominanţă.

Diversificarea oferă o nouă libertate a creaţiei tehnologice şi o nouă evoluţie a domeniului productiv-industrial.

Familia tehnologiilor noi (F_N) în domeniul exploatării și valorificării resurselor minerale și energetice, situată pe un palier superior (P_S) are tendinţa de dominaţie asupra familiilor tehnologiilor actuale (F_A), situate pe palierul actual, contemporan (P_A), determinând scoaterea din starea de operaţionalitate a tehnologiilor epuizate (F_E), şi plasarea lor pe un palier istoric, inferior (P_E). (figura. 2) [5].

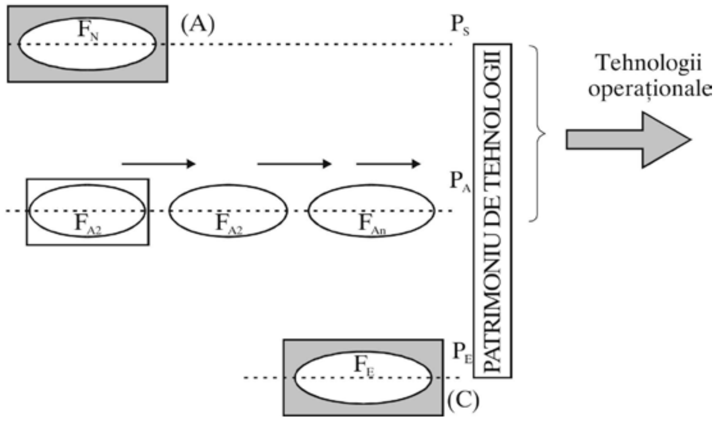

Figura: 2. Amplasarea tehnologiilor dominante (F_N) în domeniul exploatării și valorificării resurselor minerale și energetice

Pe măsura avansării în timp a întregului ansamblu de tehnologii (F_N; F_A; F_E) se constată că tehnologiile noi în domeniul exploatării și valorificării resurselor minerale și energetice contribuie la imprimarea următoarelor tendinţe:

– se ameliorează (se îmbunătăţeşte) precizia în execuţii;

– creşte viteza de lucru;

– scade intervenţia omului în procesul de obţinere a produsului minier/energetic.

Patrimoniul tehnologic - îmbogăţit –, în domeniul exploatării și valorificării resurselor minerale și energetice, constituie un *avantaj rezidual* semnificativ ca urmare a transformărilor cvasipermanente suferite de tehnologii. Ierarhizarea, respectiv clasificarea dominaţiei este dificilă, aceste operaţii fiind valabile – asemenea sondajelor – pentru intervale de timp bine definite.

Totuşi, se poate aprecia că în familia tehnologiilor dominante aparţinând prezentului, cu potențila de transfer specific în domeniul exploatării și valorificării resurselor minerale și energetice, se înscriu cele din sfera informaticii (informaţionale), microelectronica, prelucrarea electronică a datelor şi informaţiilor, tehnologiile militare, spaţiale şi parţial un număr de tehnologii neconvenţionale intrate în atenţie pentru aplicare într-un interval de timp mai apropiat.

3. Cererile în domeniul tehnologiilor din domeniul exploatării și valorificării resurselor minerale și energetice

Scopul teoriei cererii este să determine diferiţi factori care afectează cererea.

Raţiunea de a fi a teoriei cererii este stabilită de „legea cererii” (care printre altele arată că cererea pieţei este potrivnică în general preţului) însă este la fel de adevărată constatarea că preţurile concentrează determinările de cerere de pe piaţă. (figura.3) [5]

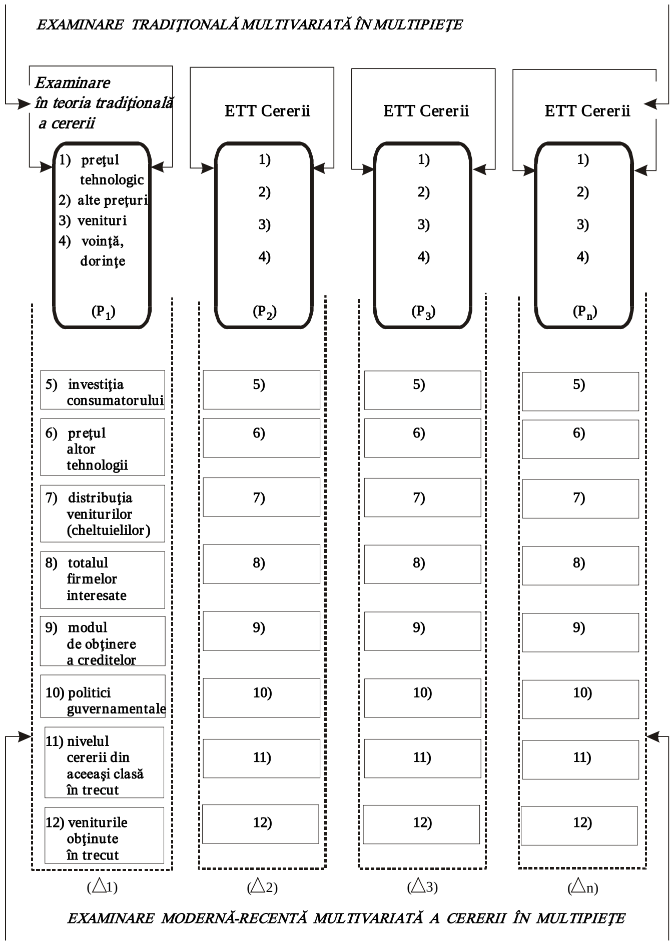

Figura: 3. Evoluţia complexităţii examinării cererii de tehnologii pe piaţă în domeniul exploatării și valorificării resurselor minerale și energetice

Cererea este o relaţie multivariabilă deoarece ea este susţinută de numeroşi factori cu acţiune simultană.

Unul dintre cei mai importanţi determinanţi ai cererii de piaţă pentru un produs distinct – aşa cum este o tehnologie în domeniul exploatării și valorificării resurselor minerale și energetice – este propriul preţ alături de investiţia consumatorului (achizitorului) şi preţurile altor bunuri, dorinţele achizitorului de tehnologie, distribuţia venitului (a cheltuielilor), totalul firmelor (populaţie) interesate (absorbante), fiabilitatea, fezabilitatea şi ecologia tehnologiei, modul de obţinere a creditelor, politici guvernamentale, nivelul cererii de tehnologii din aceeaşi clasă în trecut şi volumul veniturilor obţinute în trecut utilizând tehnologii similare.

Teoria tradiţională a cererii în domeniul exploatării și valorificării resurselor minerale și energetice este concentrată de regulă pe patru dintre determinanţii de mai sus şi anume: *1)* preţul bunului (tehnologiei), *2)* alte preţuri, *3)* volumul veniturilor şi *4)* voinţa, respectiv dorinţele achizitorului (utilizatorului de tehnologie).

Ceilalţi factori au fost introduşi în teoria cererii, relativ recent.

Se precizează că teoria tradiţională a cererii examinează numai cererea finală a consumatorilor în domeniul exploatării și valorificării resurselor minerale și energetice, care poate fi caracterizată durabilă sau non-durabilă.

Acest tip de demers arată că se manifestă o anumită parţialitate a examinării cererii, care se referă la stadiul într-o singură piaţă considerată izolată faţă de cererile ce se manifestă în alte pieţe.

O simplificare asumată în teoria cererii este aceea că firmele îşi vând produsele lor (tehnologiile) direct consumatorului (utilizatorului) final în domeniul exploatării și valorificării resurselor minerale și energetice.

Nu este însă cazul general în sfera afacerilor moderne pe plan mondial, când traseul vânzării este mult mai complicat, ceea ce are implicaţii serioase în determinarea preţurilor.

O altă viziune dificilă generată de teoria tradiţională a cererii se referă la faptul că ia mai restrâns în considerare vânzările de bunuri de investiţii (aşa cum sunt şi tehnologiile în domeniul exploatării și valorificării resurselor minerale și energetice), prin neurmărirea accentuată a cererilor distincte ce le suferă produsele intermediare (secvenţele din lanţul tehnologic).

În analize sunt incluse cererea totală şi *cererea finală*, în timp ce *cererile intermediare* în domeniul exploatării și valorificării resurselor minerale și energetice sunt cuprinse între total şi final [5].

Cererea finală este divizată între cererile parţiale ale consumatorilor (utilizatorilor) şi *cererile de bunuri de investiţii.*

Teoria tradiţională a cererii operează numai cu cererea consumatorilor, care este considerată pentru fiecare o fracţie din total cerere din întreaga economie,

Cererile consumatorilor individuali în domeniul exploatării și valorificării resurselor minerale și energetice în economiile dezvoltate se ridică la 30-40% din total cerere.

În context, în continuare se vor examina conţinuturile diferitelor formule sub care operează cererea (atât maniera tradiţională cât şi cea modernă) în domeniul exploatării și valorificării resurselor minerale și energetice.

1. *Teoria comportării consumatorului de tehnologii (utilizator)*

Teoria tradiţională a cererii porneşte de la examinarea comportării consumatorului în condiţiile în care cererea pieţii poate fi considerată o sumă a cererilor individuale ale acestora. În primul rând se examinează derivarea cererii pentru un consumator individual în domeniul exploatării și valorificării resurselor minerale și energetice.

Consumatorul este presupus a fi raţional în actul său de consum. Cheltuielile sale şi preţurile de pe piaţă ale diferitelor bunuri îl determină să-şi planifice efortul pentru a obţine cea mai mare satisfacţie sau utilitate. Aceasta este axioma utilităţii *maxime*.

Totodată, în teoria tradiţională a cererii se consideră că un consumator este în posesia cunoştinţelor complete care caracterizează produsul şi are informaţiile relevante pentru decizia sa.

Pentru a atinge obiectivele sale utilizatorul (consumatorul în domeniul exploatării și valorificării resurselor minerale și energetice) trebuie să fie capabil să compare utilitatea (de exemplu a unei tehnologii) faţă de o mulţime de alte bunuri pe care le poate achiziţiona prin cheltuiala sa.

Apar astfel două posibilităţi de abordare a problemei comparaţiei utilităţilor respective *a)* abordarea *cardinalistă* şi *b)* abordarea *ordinalistă*.

Şcoala cardinalistă postulează că utilitatea *poate fi măsurată*. În timp au fost avansate diferite sugestii pentru măsurarea utilităţii.

Sub o certitudine (de exemplu posesia de cunoştinţe complete asupra condiţiilor pieţii şi a nivelului cheltuielilor pentru o perioadă planificată) unii analişti din domeniu au sugerat că utilitatea poate fi măsurată în unităţi monetare, în raport cu decizia consumatorului pentru o altă unitate de produs (bun, tehnologie).

Şcoala ordinalistă postulează că utilitatea nu poate fi măsurată, însă aceasta poate fi considerată o *magnitudine ordinală* (o amplitudine).

Astfel, consumatorul în domeniul exploatării și valorificării resurselor minerale și energetice nu ar avea nevoie să ştie utilitatea în unităţi specifice pentru a alege un bun (o tehnologie) dintr-o mulţime de alte bunuri (tehnologii). Pentru el este suficientă cunoaşterea *clasei de produse* (tehnologii) din mulţimea respectivă, în concordanţă cu voinţa sau dorinţa (necesitatea) sa de achiziţionare.

Într-o astfel de situaţie el trebuie să fie capabil să determine în *ordinea preferinţelor* o tehnologie, pe baza diferenţelor ce le sesizează între tehnologiile din mulţimea supusă atenţiei.

Teoria ordinalistă se bazează pe *clasa curbelor de indiferenţă* şi pe *ipotezele relevante ale preferinţei.*

În continuare se referă la unele elemente de bază ce vizează conţinutul teoriei utilităţii cardinale, respectiv aspectele care au în vedere posibilităţile de măsurare, deci cuantificare a indicatorului în raport cu cererea pieţei.

Conceptul de utilitate măsurabilă este atribuită lui *Grossen* (1854), *Jevons* (1871) şi *Walras* (1874). O anumită contribuţie provine de la *Marshall* (1890) care a introdus noţiunea de *utilitate independentă aditivă.*

Considerentele principale luate în considerare sunt următoarele:

a) *Raţionalitatea (Rationality.)* Consumatorul (sau utilizatorul de tehnologii în domeniul exploatării și valorificării resurselor minerale și energetice) este raţional. Scopul său principal este maximizarea utilităţii în comparaţie cu cheltuielile pe care le efectuează;

b) *Utilitatea cardinală.* Conceptul arată că în domeniul exploatării și valorificării resurselor minerale și energetice utilitatea fiecărui bun este măsurabilă. Utilitatea este un concept cardinal, respectiv cartezian.

Cea mai convenabilă măsurare este cu ajutorul banilor; utilitatea este măsurată cu ajutorul unităţilor monetare, în condiţiile în care consumatorul este pregătit să plătească dacă este mai avantajos pentru o altă unitate de bun.

c) *Utilitatea marginală constantă a banilor (Constant marginal utility of money).* Acest considerent apare ca necesar din cauză că pentru măsurarea utilităţii sunt utilizaţi banii.

Aspectul esenţial pentru un standard unitar al măsurării este ca acesta să fie constant.

Dacă utilitatea marginală a banilor se schimbă ca venituri-cheltuieli în creştere sau descreştere, măsurarea utilităţii trebuie să fie stăpânită de o regulă elastică, ceea ce nu este pozitiv pentru măsurarea propriu-zisă;

d) *Reducerea (diminuarea) utilităţii marginale (Diminishing marginal utility).* Utilitatea este câştigată (obţinută din evaluare) prin evidenţierea unităţilor succesive a bunurilor diminuate (prin reducţie). Cu alte cuvinte, utilitatea marginală a bunurilor diminuate este legată de cerinţa în cantităţi tot mai largi a acestor bunuri din partea consumatorilor. *Aceasta este axioma utilităţii marginale diminuate (minime).*

De exemplu, totalul utilităţii „unei mulţimi de tehnologii" depinde de cantitatea individuală de tehnologii cerute şi introduse în folosinţă (consum) în domeniul exploatării și valorificării resurselor minerale și energetice.

Dacă există un număr de tehnologii în cantităţile (sortimentele constructiv-funcţionale) x_1, $x_2,\ldots,x_n$ atunci utilitatea totală U este [5]:

$$U = f\,(x_1,\ x_2,\ldots,x_n) \qquad (1)$$

În versiunea extrem de apropiată a teoriei comportamentului consumatorului, se poate demonstra că utilitatea totală este aditivă:

$$U = U_1\,(x_1) + U_2\,(x_2) + ,\ldots, + U_n\,(x_n) \qquad (2)$$

Pentru a înfăţişa echilibrul consumatorului (utilizatorului de tehnologii în domeniul exploatării și valorificării resurselor minerale și energetice) se porneşte de la un model simplu, luând în considerare tehnologia X.

Consumatorul poate cumpăra tehnologia X sau poate reţine cheltuiala sa (să nu cheltuie) în volum Y.

În aceste condiţii, consumatorul este în echilibru (pot să cumpăr – pot să păstrez banii să nu cumpăr) atunci când utilitatea marginală (UM) a tehnologiei X este egală cu preţul său de piaţă (P_x), adică:

$$UM_x = P_x \qquad (3)$$

Dacă utilitatea marginală a tehnologiei X este mai mare decât preţul, consumatorul poate creşte capacitatea (posibilitatea) sa de a achiziţiona mai ieftin sau de a achiziţiona mai multe unităţi de tehnologie.

În mod similar, dacă utilitatea marginală a tehnologiei x este mai redusă decât preţul, consumatorul poate să-şi îndeplinească voinţa (dorinţa) de achiziţionare diminuând cantitatea (volumul de lanţuri procesuale) de tehnologie care să-i intre în posesie.

În acest caz, el se aşteaptă să maximizeze utilitatea prin:

$$UMx = P^1_x \qquad (4)$$

în care P^1_x este preţul asiguratoriu pentru o anumită cantitate (dimensiune sau volum) de bun sau produs.

Dacă există un număr mai mare de tehnologii în domeniul exploatării și valorificării resurselor minerale și energetice considerate ca bunuri supuse comercializării, condiţia înregistrării unui echilibru din partea consumatorului este existenţa egalităţii între raţiile utilităţilor marginale individuale faţă de preţurile tehnologiilor respective.

3. Concluzii

Noile tehnologii, în general, înfăţişează următoarele consecinţe principale o dată cu apariţia şi aplicarea lor:

– introducerea în procesele productiv-industriale a unor procedee şi metode tehnice noi, cu parametrii diferiţi, superiori, faţă de cei actuali;

– apariţia de noi obiecte: produse şi servicii cu grad mărit de noutate;

– apariţia unor noi lanţuri de transformare a materiilor şi materialelor ce intră în procesul tehnologic în domeniul exploatării și valorificării resurselor minerale și energetice.

Noile tehnologii în domeniul exploatării și valorificării resurselor minerale și energetice formează o familie cu elemente care, individual - într-un anumit interval de timp – domină prin competitivitate procesele productiv-industriale.

Concomitent, de la o etapă la alta, are loc diversificarea materialelor. Rupturile între familiile de tehnologii sunt date de gradul de dominanţă.

Diversificarea oferă o nouă libertate a creaţiei tehnologice şi o nouă evoluţie a domeniului productiv-industrial.

Teoria tradiţională a cererii în domeniul exploatării și valorificării resurselor minerale și energetice este concentrată de regulă pe patru dintre determinanţii de mai sus şi anume: *1)* preţul bunului (tehnologiei), *2)* alte preţuri, *3)* volumul veniturilor şi *4)* voinţa, respectiv dorinţele achizitorului (utilizatorului de tehnologie).

În analize trebuie incluse cererea totală şi *cererea finală*, în timp ce *cererile intermediare* în domeniul exploatării și valorificării resurselor minerale și energetice sunt cuprinse între total şi final.

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DIAGNOSTICAREA STRATEGICĂ A ENTITĂȚILOR MODERNE DIN DOMENIUL EXPLOATĂRII ȘI VALORIFICĂRII RESURSELOR NATURALE /

STRATEGIC DIAGNOSTICS FOR MODERN ENTITIES ON EXPLOITATION AND CAPITALIZATION OF NATURAL RESOURCES

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ABSTRACT

The article shows that essentially diagnostic analysis is a measurement of self-reported performance company in the exploration and exploitation of natural resources, embodied in all indicators that highlight the rhythms of change from previous periods of various phenomena and economic processes of economic and financial results obtained. In a practical context, the business strategy of the company in the exploration and exploitation of natural resources can be developed based on a model portfolio of activities. It notes that in modern facilities increase the role of strategic options for diversification and renewal of production of its permanent adaptation to new requirements of the competition. However, there is a significant increase in financial resources needs of companies engaged in various businesses. Increasingly, every enterprise in the exploration and exploitation of natural resources requires a thorough analysis and multi-criteria competitiveness level.

KEYWORDS

diligence, the business strategy of the company, the exploration and exploitation of natural resources.

1. Introducere. Despre analiza diagnostic a entităților moderne din domeniul exploatării și valorificării resurselor naturale

Analiza diagnostic vizează evaluarea potenţialului întreprinderii studiate din domeniul exploatării și valorificării resurselor naturale şi a mediului în care este integrată.

Are ca scop identificarea forţelor şi slăbiciunilor care se manifestă în posibilităţile sale interne, privite din diferite puncte de vedere, a ocaziilor şi ameninţărilor mediului ambiant al întreprinderii extractive/ de preparare.

Analiza-diagnostic are caracter istoric şi se referă la situaţia întreprinderii din domeniul exploatării și valorificării resurselor naturale în perioadele trecute, considerate de referinţă pentru evaluarea performanţelor realizate.

Se identifică posibilităţile interne ale întreprinderii, punctele forte şi slabe existente la nivelul diferitelor laturi ale activităţii acesteia.

Analiza-diagnostic priveşte întreprinderea din domeniul exploatării și valorificării resurselor naturale ca o entitate separată, ale cărei forţe şi slăbiciuni sunt determinate in exclusivitate de posibilităţile sale interne urmărite prin prisma evoluţiei lor în timp.

În esenţă, analiza diagnostic este o măsurare autorelativă a performanţelor întreprinderii din domeniul exploatării și valorificării resurselor naturale, concretizată în ansamblul indicatorilor care evidenţiază ritmurile de modificare faţă de perioadele anterioare a diverselor fenomene şi procese economice, a rezultatelor economico-financiare obţinute.

2. Diagnosticarea strategică a întreprinderii din domeniul exploatării și valorificării resurselor naturale

Diagnosticarea strategică are ca obiect identificarea posibilităţilor de dezvoltare a activităţii întreprinderii din domeniul exploatării și valorificării resurselor naturale pe baza perspectivelor de evoluţie a acesteia.

Aceasta va asigura investigarea posibilităţilor interne ale întreprinderii din domeniul exploatării și valorificării resurselor naturale în corelaţie cu situaţia altor competitori din sectorul extractiv și de valorificare a resurselor natural în care îşi desfăşoară activitatea.

Punctele forte şi punctele slabe identificate au un caracter relativ, manifestându-se într-un context concurenţial ca avantaje şi dezavantaje competitive.

Ele apar ca rezultate ale măsurării corelative a performanţelor întreprinderii şi se exprimă prin intermediul indicatorilor de competitivitate financiari şi de piaţă.

Procesul de diagnosticare strategică se bazează pe utilizarea unor metode şi tehnici de investigare a fenomenelor şi proceselor diferite de cele ale diagnosticării manageriale a activităţii întreprinderii din domeniul exploatării și valorificării resurselor naturale.

3. Diagnosticarea strategică a activităţii întreprinderii din domeniul exploatării și valorificării resurselor naturale prin grila şcolii Harvard

Se consideră că strategia unei întreprinderi din domeniul exploatării și valorificării resurselor naturale este determinată în mod hotărâtor de trei factori:

- potenţialul întreprinderii;

- mediul în care este integrată întreprinderea din domeniul exploatării și valorificării resurselor naturale;

- persoanele care decid strategia întreprinderii.

Analiza potenţialului întreprinderii din domeniul exploatării și valorificării resurselor naturale se referă în principal la trei domenii de bază.

1. Poziţia întreprinderii pe pieţele sale,

2. Poziţionarea întreprinderii în raport cu factorii săi de producţie,

3. Poziţionarea întreprinderii în raport cu factorii de competitivitate.

Logica de abordare propusă prin acest model poate fi aplicată în diferite domenii de activitate şi în orice context al diagnosticării strategice.

Pe această bază poate fi explicată larga sa difuzare ca model de referinţă în toate demersurile strategice.

3.1.4. Diagnosticarea strategică SWOT a activităţii întreprinderii din domeniul exploatării și valorificării resurselor naturale

Modelul SWOT se bazează pe principiile generale ale grilei de diagnostic a Şcolii Harvard.

Semnificaţia denumirii SWOT provine din: S de la *„strength"* = forţă, tărie, punct forte (tare); W de la *„weakness"* = slăbiciune, punct slab; O de la *„opportunity"* = oportunitate, ocazie; T de la *„threat"* = ameninţare.

Metoda SWOT cuprinde două etape:

a) evaluarea potenţialului întreprinderii;

b) analiza mediului ambiant.

Evaluarea (analiza) potenţialului întreprinderii din domeniul exploatării și valorificării resurselor naturale urmăreşte identificarea punctelor forte şi a punctelor slabe ale activităţii în comparaţie cu situaţia celorlalţi competitori din sectorul în care este integrată şi se referă la:

1. Capacitatea comercială a întreprinderii;

2. Capacitatea financiară a întreprinderii;

3. Opacitatea productivă a întreprinderii;

4. Capacitatea managerială a întreprinderii.

Fiecare dintre factorii supuşi analizei va fi încadrat într-una din următoarele cinci categorii: *1)* forţă majoră, *2)* forţă minoră, *3)* slăbiciune majoră, *4)* slăbiciune minoră şi *5)* factor neutru.

Procesul de diagnosticare se va orienta în principal spre forţele şi slăbiciunile majore, care exercită o influenţă semnificativă asupra evoluţiei activităţii întreprinderii şi a performanţelor sale economice.

În literatura de specialitate se recomandă folosirea *„matricei de evaluare a factorilor interni*" (MEFI).

Fiecare factor de analiză este evaluat prin intermediul unui coeficient subunitar de importanţă (K_i) şi a unei note (N_i) de la -1 la 4. Nota acordată fiecărui factor evidenţiază natura acestuia pentru domeniul de analiză abordat.

Factorii notaţi cu 1 şi 2 reprezintă slăbiciuni majore şi, respectiv, minore pentru domeniul care face obiectul analizei. Factorii evaluaţi prin note de 3 şi 4 sunt consideraţi forte minore şi, respectiv, majore pentru domeniul abordat.

Pe baza factorilor cărora li s-au ataşat cele două elemente de evaluare, se stabileşte *„puterea globală internă a firmei"* (PGIF), pe domenii de analiză strategică precum: capacitatea comercială, capacitatea financiară, capacitatea productivă, capacitatea managerială - sau pe funcţiuni ale întreprinderii din domeniul exploatării și valorificării resurselor naturale precum cercetare-dezvoltare, producţie, comercială, de resurse umane, financiar-contabilă şi pe ansamblul acestora. Calculul acestui indicator se face cu relaţia:

$$PGIF = \sum_{i=1}^{n} K_i N_i \quad (1)$$

cu condiţia ca $\sum_{i=1}^{n} K_i = 1$

În funcţie de nivelul „puterii globale interne a firmei" se evaluează potenţialul acesteia, sub raportul fiecărui domeniu de analiză strategică şi al fiecărei funcţiuni, precum şi pe ansamblul sistemului.

Analiza mediului ambiant are ca obiect investigarea factorilor din afara întreprinderii din domeniul exploatării și valorificării resurselor naturale, care acţionează direct sau indirect asupra activităţii ei.

Se recomandă folosirea "*matricei ocaziilor (oportunităţilor) mediului*" pentru gruparea acestora în funcţie de cele două criterii de evaluare într-o abordare bidimensională: *a)* ridicat(ă) sau *b)* scăzut(ă).

În cadrul matricei se individualizează patru cadrane de grupare a ocaziilor mediului concurenţial.

Cadranul 1 cuprinde ocaziile (oportunităţile) majore, caracterizate printr-un grad de atractivitate şi o probabilitate de succes ridicate.

Cadranele 3 şi 4 cuprind ocaziile definite printr-o atractivitate ridicată şi o probabilitate de succes scăzută sau invers, printr-o probabilitate de succes ridicată şi o atractivitate scăzută.

Cadranul 4 include ocaziile (oportunităţile) minore, caracterizate printr-o probabilitate de succes şi o atractivitate scăzute.

În acelaşi context se elaborează "*matricea ameninţărilor mediului*".

În *cadranul 1* sunt comasate ameninţările majore, caracterizate printr-o probabilitate de apariţie şi o seriozitate ridicate.

În *cadranele 2 şi 3* se găsesc acele ameninţări care se caracterizează printr-o seriozitate ridicată şi o probabilitate de apariţie scăzută şi, invers, printr-o probabilitate de apariţie ridicată dar un grad de seriozitate scăzut.

Cadranul 4 grupează ameninţările minore, caracterizate printr-o seriozitate şi o probabilitate de apariţie scăzute.

Fiecărui factor de caracterizare a mediului i se ataşează un coeficient de importanţă (Ki) şi o notă de evaluare (Ni) de la 1 la 4.

În următoarea etapă se stabileşte "puterea globală externă a firmei" (PGEF), atât pentru ocazii şi ameninţări, cât şi pe ansamblul acestora, folosindu-se o relaţie similară cu cea a "puterii globale interne a firmei" din domeniul exploatării și valorificării resurselor naturale.

Totodată, în diagnosticarea strategică se poate folosi "*matricea ocaziilor şi ameninţărilor mediului*".

Pentru formularea strategiei economice se propune folosirea unei matrice prin care se combină concluziile evaluării potenţialului firmei din domeniul exploatării și valorificării resurselor naturale cu cele ale analizei mediului, cunoscută în lucrările de specialitate sub denumirea "*matricea puncte forte – puncte slabe – ocazii - ameninţări*" (SWOT).

În interiorul matricei se individualizează patru cadrane de combinare a concluziilor aferente celor două etape ale diagnosticării strategice.

Într-un context mai practic, strategia economică a întreprinderii din domeniul exploatării și valorificării resurselor naturale poate fi elaborată în baza unui model al portofoliului de activităţi.

Se constată că în întreprinderea modernă creşte rolul opţiunilor strategice de diversificare şi înnoire a producţiei, de adaptare permanentă a acesteia la noile exigenţe ale mediului concurenţial.

Totodată, se înregistrează o mărire semnificativă a necesităţilor de resurse financiare ale firmelor angajate în diverse afaceri.

Tot mai mult, fiecare întreprindere din domeniul exploatării și valorificării resurselor naturale are nevoie de o analiză amănunţită şi multicriterială a gradului de competitivitate.

Modelele bazate pe portofoliu de activităţi au cerinţa de integrare a strategiilor secvenţiale într-o strategie concurenţială globală, adaptată la posibilităţile firmei şi la exigenţele mediului de competiţie.

Aplicarea modelelor bazate pe portofoliu de activităţi presupune efectuarea în prealabil a unui proces de segmentare strategică a ansamblului activităţilor firmei.

Segmentarea strategică este procesul prin care se defineşte fiecare activitate din portofoliul unei firme din domeniul exploatării și valorificării resurselor naturale, în raport cu natura celorlalte activităţi.

În concepţie internă, segmentarea strategică constă în delimitarea şi definirea diferitelor subdiviziuni autonome de fundamentare, elaborare şi aplicare a strategiilor la nivelul activităţilor firmei din domeniul exploatării și valorificării resurselor naturale.

4. Concluzii

Analiza-diagnostic priveşte întreprinderea din domeniul exploatării și valorificării resurselor naturale ca o entitate separată, ale cărei forţe şi slăbiciuni sunt determinate in exclusivitate de posibilităţile sale interne urmărite prin prisma evoluţiei lor în timp

Analiza diagnostic vizează evaluarea potenţialului întreprinderii studiate din domeniul exploatării și valorificării resurselor naturale şi a mediului în care este integrată.

Are ca scop identificarea forţelor şi slăbiciunilor care se manifestă în posibilităţile sale interne, privite din diferite puncte de vedere, a ocaziilor şi ameninţărilor mediului ambiant al întreprinderii extractive/ de preparare.

Analiza-diagnostic are caracter istoric şi se referă la situaţia întreprinderii din domeniul exploatării și valorificării resurselor naturale în perioadele trecute, considerate de referinţă pentru evaluarea performanţelor realizate.

Se identifică posibilităţile interne ale întreprinderii, punctele forte şi slabe existente la nivelul diferitelor laturi ale activităţii acesteia.

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PERFORMANŢELE ŞI COMPETITIVITATEA ÎNTREPRINDERII EXTRACTIVE A RESURSELOR MINERALE

/ PERFORMANCE AND COMPETITIVENESS OF MINERAL EXTRACTION ENTREPRISE

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ABSTRACT

The article presents aspect expressing that economic and financial performance of trading size characterization returning from mineral extraction. In this way, it takes place close results and measuring performance using indicators such as turnover, production and added value year. The evaluation starts by investigating complex these indicators compared with the objects in dynamic and determined, overall and by various specific structures. Diagnostic analysis of global production volume activity aimed at examining the mineral extraction enterprises qualifying, completing the product has a relatively long duration and therefore holds a significant share work in progress. The structure of global production (production year) returns in profit or loss.

KEYWORDS

mineral extraction company, performance, competitiveness.

3. Performanţele întreprinderii extractive a resurselor minerale. Volumul activităţii şi calitatea bunurilor/ serviciilorIntroducere

Performanţele economico-financiare revin din caracterizarea dimensiunii activităţii întreprinderii extractive a resurselor minerale.

În acest fel, are loc apropierea rezultatelor şi măsurarea performanţelor cu ajutorul unor indicatori precum: cifra de afaceri, producţia exerciţiului şi valoarea adăugată.

Evaluarea începe prin investigarea complexă a acestor indicatori, în dinamică şi comparativ cu obiectele stabilite, pe total şi pe diverse structuri specifice.

Analiza diagnostic a producţiei globale vizează examinarea volumului activităţii întreprinderilor extractive a resurselor minerale cu ciclu lung, în care finalizarea produselor are o durată relativ mare şi în consecinţă, producţia neterminată deţine o pondere semnificativă.

Structura producţiei globale (producţia exerciţiului) revine din contul de profit şi pierderi.

Producţia globală (producţia exerciţiului) este formată din *producţia vândută* (sau cifră de afaceri în preţuri de vânzare exclusiv TVA), *producţia stocată* şi *producţia imobilizată* (ultimele două exprimate în costuri de producţie). *(Figura.1)*

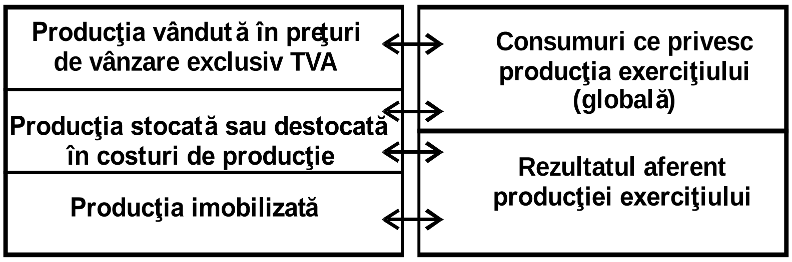

Figura. 1. Interacţiuni între elementele producţiei globale

Un neajuns al indicatorului îl reprezintă faptul că în timp ce producţia vândută este exprimată în preţuri de vânzare (exclusiv TVA), celelalte două componente sunt evaluate în costuri de producţie, ceea ce afectează comparabilitatea.

Înlăturarea inconvenientului se face prin folosirea costurilor (standard sau prestabilite) pentru toate elementele.

Orice schimbare a elementelor componente poate să însemne modificarea structurală şi o anume dinamică a ei.

Cauzele modificării producţiei vândute (cifrei de afaceri), producţiei stocate şi a celei imobilizate sunt şi cauze ale modificării producţiei globale.

Cifra de afaceri este un indicator de bază pentru măsurarea volumului activităţii oricărei forme de funcţionare a întreprinderii extractive a resurselor minerale.

Managerii întreprinderilor extractive a resurselor minerale urmăresc maximizarea cifrei de afaceri, în limite în care să fie realizat un profit rezonabil.

Se constată că prioritatea cifrei de afaceri nu elimină profitul fără de care perenitatea întreprinderii extractive a resurselor minerale nu este asigurată.

Cifra de afaceri este considerată indicatorul fundamental al volumului activităţii întreprinderii extractive a resurselor minerale.

Un nivel al cifrei de afaceri corespunde unei anumite structuri a activităţii miniere.

Cifra de afaceri se calculează prin însumarea veniturilor rezultate din livrări de bunuri (produse minerale miniere), executarea de lucrări şi prestări de servicii şi alte venituri din exploatare, mai puţin rabaturile, remizele şi alte reduceri acordate clienţilor.

Procedee de analiză a structurii cifrei de afaceri a întreprinderii extractive a resurselor minerale vizează:

a_1) Coeficientul de concentrare (C_c)

Este cunoscut sub denumirea *Gini-Struck* şi ia în considerare ponderea produsului sau grupei de produse minerale miniere *i* notată (Pi) în cifra de afaceri, într-o serie cu *n* termeni.

$$C_c = \sqrt{\frac{n \cdot \sum P_i^2 - 1}{n-1}} \qquad (1)$$

Se constată că în practică $C_c \in [0,1]$.

Apropierea de zero (0) semnifică o distribuţie relativ uniformă a vânzărilor pe structurile implicate în calcul.

a_2) Măsurarea gradului de diversificare a activităţii pe diverse structuri ale întreprinderii. Este cunoscută sub denumirea de coeficientul Herfindhal (C_H).

$$C_H = \sum_{i=1}^{n} P_i^2 \qquad (2)$$

Valoarea coeficientului este nulă dacă întreprinderea extractivă a resurselor minerale vinde un singur produs mineral şi este egală cu l/n dacă producţia sau vânzările sunt reprezentate în proporţii egale în cadrul nomenclatorului acesteia.

a_3) Analiza structurii vânzărilor pe produse (Metoda ABC)

Se elaborează o curbă teoretică de analiză, identificându-se în total produse minerale miniere comercializate o subgrupă de produse şi mărfuri reduse ca număr, dar care realizează o mare parte a cifrei de afaceri. La aceasta se adaugă alte două subgrupe care oferă mai puţin de jumătate din cifra de afaceri, dar care controlează majoritatea produselor realizate şi, respectiv comercializate.

Metoda este utilizată în teoria economică pentru investigarea structurii cifrei de afaceri pe categorii de consumatori de resurse minerale miniere.

Coordonatele statistice ale curbei teoretice sunt următoarele:

Zona I arară că 10 - 15% din numărul de produse sau mărfuri reprezintă 60 - 70% din cifra de afaceri.

Această zonă cuprinde produse cu o rotaţie mai rapidă, cu o marjă a costurilor variabile şi respectiv comercială mai redusă.

Repartiţia optimală arată că 10% din clienţi reprezintă 60% din vânzări.

Zona I contribuie semnificativ la realizarea cifrei de afaceri, din punct de vedere al securităţii firmei este cea mai riscantă.

Cu cât numărul de clienţi este mai mic, cu atât riscul întreprinderii extractive a resurselor minerale este mai mare.

Când numărul de clienţi este foarte redus, întreprinderea extractivă a resurselor minerale este obligată să consimtă la acordarea unor avantaje financiare, ceea ce-i poate afecta rentabilitatea.

Zona II arată că 25-30% din numărul de produse sau mărfuri vândute prezintă echivalentul a 25-30% din cifra de afaceri.

Cuprinde produse/mărfuri a căror rotaţie şi marje sunt apropiate de media întreprinderii extractive a resurselor minerale şi 40% din clienţi reprezintă 30% din vânzări.

Această zonă asigură cel mai mare grad de stabilitate, ca cifră de afaceri şi rentabilitate.

Zona III arată că 65-70% din numărul de produse sau mărfuri concură cu 10-15% în cifra de afaceri.

Este formată din produse sau mărfuri cu rotaţie scăzută dar cu o marjă mai mare. Această zonă ridică probleme legate de lansarea comenzilor, de aprovizionare şi stocare.

Costul de aprovizionare şi stocare este mai ridicat comparativ cu zonele I şi II.

În *zona III* 50% din clienţi reprezintă 10% din vânzări.

Zona III cantonează numărul de clienţi foarte mare; se caracterizează prin cheltuieli de exploatare ridicate (livrare, facturare) atunci când comenzile au o valoare scăzută.

Corelând ponderea zonei în realizarea cifrei de afaceri cu tendinţa cheltuielilor de exploatare, că zona dezavantajează întreprinderea extractivă a resurselor minerale atât în ceea ce priveşte volumul activităţii cât şi rentabilitatea.

b) Ritmicitatea şi sezonalitatea reflectate în producţie şi în cifra de afaceri

Ritmicitatea producţiei şi similar vânzărilor (distribuţiei) se poate aprecia pe baza următoarelor elemente procedurale:

- pe baza ponderii producţiei fizice sau valorice pe diviziuni de timp în cadrul perioadei de analiză;
- pe baza indicilor realizării obiectivului pe diviziuni de timp în cadrul perioadei analizate;
- pe baza coeficienţilor ritmicităţii.

Ritmicitatea nu se confundă cu uniformitatea. Ritmicitatea trebuie înţeleasă ca realizare a obiectivelor în concordanţă cu distribuţia pe diviziuni de timp, programată sau în funcţie de cerere şi capacitate de ofertă.

În examinarea sezonalităţii, pe lângă coeficientul clasic al acesteia se pot utiliza şi coeficienţii de concentrare sezonieră *Gini-Struck* sau *Herfindhal*.

Totodată, este utilă analiza diagnostic de tip factorial a cifrei de afaceri şi a reflectării ei în indicatorii de bază ai performanţei economico-financiare a întreprinderii extractive a resurselor minerale.

Cifra de afaceri ca *valoare* se reflectă în indicatori ai performanţei economico-financiare a întreprinderii extractive a resurselor minerale, precum:

a) suma profitului aferent cifrei de afaceri;

b) valoarea adăugată la 1 leu cifră de afaceri;

c) eficienţa activelor de exploatare;

d) eficienţa mijloacelor fixe (cifra de afaceri la 1000 lei mijloace fixe);

e) eficienţa activelor circulante de exploatare (cifră de afaceri la 1000 lei active circulante de exploatare);

f) eficienţa stocurilor (ca element de bază al activelor circulante de exploatare; cifră de afaceri la 1000 lei stocuri);

g) eficienţa capitalurilor;

h) indicatorii de eficienţă stabiliţi pe baza profitului ca efect;

i) capacitatea de finanţare şi pe această bază alte echilibre financiare;

j) capacitatea de remunerare a capitalului (prin profit ca premisă a măririi dividendelor şi dobânda pentru împrumut).

Ca structură valorică (luarea în considerare a influenţei preţurilor) cifra de afaceri are incidenţă asupra:

a) sumei profitului aferent cifrei de afaceri (prin intermediul profitului mediu la 1 leu cifră de afaceri);

b) valoarea adăugată (prin valoarea adăugată la 1 leu cifră de afaceri);

c) eficienţa activelor de exploatare (pe baza profitului aferent cifrei de afaceri);

d) eficienţa mijloacelor fixe (pe baza profitului şi valorii adăugate la 1000 lei mijloace fixe;

e) eficienţa activelor circulante (în principal a stocurilor);

f) eficienţa muncii pe baza profitului aferent cifrei de afaceri pe un salariat;

g) eficienţa capitalurilor (pe baza profitului aferent cifrei de afaceri);

h) capacitatea de autofinanţare şi de remunerare a capitalurilor prin prisma ei – profitul.

4. Evidenţierea valorii adăugate prin analiza diagnostic

Valoarea adăugată dimensionează aportul întreprinderii extractive a resurselor minerale în procesul de producţie şi distribuţie a bunurilor, iar prin însumare contribuie la formarea P.I.B. cu unele ajustări la nivelul economiei naţionale.

Analiza diagnostic a valorii adăugate prezintă în primul rând importanţă ca indicator de performanţă economico-financiară a întreprinderii extractive a resurselor minerale, şi în al doilea rând în sistemul fiscalităţii.

Analiza structurală şi dinamică a valorii adăugate arată că:

- în dinamica valorii adăugate se reflectă structura producţiei vândute la care, sub impulsul cererii, pot avea loc deplasări în favoarea unor produse sau servicii cu rate ale valorii adăugate faţă de cifra de afaceri (după nivelul de comparaţie) mai mari decât cea medie a acestuia;

- în analiza structurală a valorii adăugate esenţială este cota parte şi dinamica profitului, ca indicator de bază al performanţei economico-financiare a întreprinderii extractive a resurselor minerale (el preia şi reducerea cheltuielilor materiale).

Analiza valorii adăugate pe baza ratei faţă de producţia exerciţiului şi cifra de afaceri evidenţiază că:

- prin rata menţionată se dimensionează cota parte a valorii create în activitatea întreprinderii extractive a resurselor minerale de către muncă şi capital, respectiv

- capitalul tehnic în cadrul cifrei de afaceri şi reflectă gradul de integrare a întreprinderii extractive a resurselor minerale;

- aprofundarea diagnosticării la nivelul de produs înseamnă examinarea consumurilor materiale (valorice şi fizice) şi preţurile produselor sub incidenţa inflaţiei ş.a. (condiţiilor formării lor pe piaţa pe care activează întreprinderea extractivă a resurselor minerale).

Analiza diagnostic de tip factorial a valorii adăugate subliniază că în cazul valorii adăugate aferente cifrei de afaceri, modelele sunt similare, doar că în loc de producţia exerciţiului se foloseşte cifra de afaceri.

De regulă, în practică o strategie a valorii adăugate cu cuantificări relativ precise nu este posibilă datorită oscilaţilor efectelor valorice ale factorilor.

Oscilaţiile sunt determinate de mediul economico-financiar al tranziţiei sau de mecanismele clasice ale economiei de piaţă.

2. Asigurarea condiţiilor de competitivitate pentru producţia întreprinderii extractive a resurselor minerale

Întreprinderea extractivă a resurselor minerale de *înaltă performanţă* se caracterizează prin capacitatea de a se lansa şi menţine în afaceri viabile, care-i asigură posibilitatea sporirii profiturilor realizate şi dezvoltării pe această bază a activităţii sale.

Modelul *A.D. Little* pentru întreprinderea de înaltă performanţă se referă la următoarele tipuri de factori:

- latura organizatorică a întreprinderii, definită prin cultura şi structura ei;

- resursele de producţie ale întreprinderii, privite prin prisma cerinţelor de asigurare şi gestionare eficientă în condiţii de concurenţă accentuată;

- procesele întreprinderii, abordate sub aspectul preocupărilor de inovare a acestora şi produselor rezultate;

- beneficiarii afacerii întreprinderii, cunoscuţi sub numele de „*stakeholders*" care trebuie să fie motivaţi prin satisfacerea eficientă a aşteptărilor particularizate.

Forma de evaluare se bazează pe *măsurarea autorelativă* a performanţelor economice ale întreprinderii.

Prin intermediul acestei forme, realizările întreprinderii extractive a resurselor minerale dintr-o anumită etapă sunt comparate cu cele obţinute de ea într-o perioadă anterioară, considerată ca bază de referinţă.

Se identifică şi o altă formă de evaluare, care are ca fundament măsurarea corelativă a performanţelor economice ale întreprinderii extractive a resurselor minerale.

Aceasta presupune compararea realizărilor întreprinderii extractive a resurselor minerale evaluate cu cele ale unei întreprinderi similare, cu care concurează într-un anumit sector de activitate.

Pe baza principiilor ce caracterizează modalitatea de *măsurare corelativă* a performanţelor economice ale întreprinderii extractive a resurselor minerale s-a elaborat metoda de evaluare *„benchmarking"* („cotare de nivel").

Competitivitatea întreprinderii extractive a resurselor minerale constă în capacitatea ei de a participa cu succes la competiţia economică şi de a aspira la ocuparea unor poziţii avantajoase în cadrul acesteia.

Competitivitatea sistemului de producţie al întreprinderii extractive a resurselor minerale se reflectă în capacitatea acestuia de a realiza o productivitate înaltă pe baza utilizării inovative a resurselor de care dispune şi de a crea o „valoare" sporită.

Nivelul de competitivitate a producţiei întreprinderii extractive a resurselor minerale este influenţat hotărâtor de doi factori principali ai mediului concurenţial: clienţii şi competitorii.

Avantajul (atuul) concurenţial (competitiv) se concretizează în realizarea de către întreprinderea extractivă a resurselor minerale a unor produse superioare, dintr-un punct de vedere semnificativ pentru clienţii săi, care le influenţează în mare măsură decizia de cumpărare, comparativ cu ofertele de produse similare ale concurenţilor importanţi dintr-un anumit sector de activitate.

Avantajul competitiv de cost poate prin producerea şi distribuirea produselor cu cele mai mici costuri. El este deţinut de cel mai ieftin producător dintr-un anumit sector de activitate.

Avantajul competitiv de diferenţiere poate fi asigurat prin producerea şi comercializarea unor produse care sunt net diferite de cele oferite de concurenţii întreprinderii dintr-un anumit sector de activitate.

Avantajul competitiv de flexibilitate exprimă capacitatea sistemului de producţie de a se adapta operativ la nevoile concrete, cerinţele şi dorinţele în continuă diversificare şi particularizare ale clienţilor, prin schimbarea a ceea ce face.

Avantajul competitiv al calităţii permite întreprinderii extractive a resurselor minerale să ofere produse mai bune, executate pe baza respectării stricte a specificaţiilor tehnologice şi de proiectare constructivă.

Avantajul competitiv al tehnologiei defineşte posibilitatea întreprinderii extractive a resurselor minerale deţinătoare de a executa şi oferi pe piaţă produse cu caracteristici tehnologice deosebite

Avantajul competitiv de promptitudine reflectă capacitatea sistemului de producţie de a onora comenzile primite repede şi la timp.

Avantajul competitiv al serviciilor post-vânzare se bazează pe diversificarea serviciilor oferite de întreprinderea extractivă a resurselor minerale după vânzarea produselor.

Avantajul competitiv de soliditate combină avantajul calităţii cu cel al tehnologiei. El exprimă capacitatea sistemului de producţie de a furniza permanent produse „solide", care se caracterizează prin parametrii tehnologici şi de calitate superiori.

Avantajul competitiv de sensibilitate rezultă din combinarea avantajelor de flexibilitate şi de promptitudine.

4.Concluzii

Întreprinderea extractivă a resurselor minerale de înaltă performanţă se caracterizează prin capacitatea de a se lansa şi menţine în afaceri viabile, care-i asigură posibilitatea sporirii profiturilor realizate şi dezvoltării pe această bază a activităţii sale.

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RISCURILE ECONOMICE ÎN ÎNTREPRINDEREA COMPLEXĂ DE PRODUCȚIE A ENERGIEI NUCLEARE/

ECONOMIC RISK OF NUCLEAR ENERGY PRODUCTION IN COMPLEX ENTERPRISE

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ABSTRACT

Economic analysis of risks in complex enterprise production of nuclear energy allows formalizing factors with positive or negative influence on economy and production, to determine the compatibility between outputs and inputs, measuring profitability Energo-Nuclear plant, while highlighting the evolution of economic indicators etc. Studies of economic analysis of risks in undertaking complex production of nuclear energy requires a body of knowledge in the fields of economy, statistics, computer science, mathematics, ecology, etc. psiho-sociology Therefore, they have inter and multidisciplinary. The article presents the findings economic analyzes risk enterprises of production of nuclear energy which is based on value judgments, in which examination of quantitative (methods and specific procedures used), serves as a tool helps qualitative analysis being determinative. Items undertaking economic analysis in complex risks of nuclear energy production serve to a better understanding of reality and nuclear production and enable better decision substantiation document management and developing alternative weather or followed by economic interest theory and practice and energy production.

KEYWORDS

enterprises of producing nuclear energy, risk, operational, electronuclear power plant.

1. Riscul economic operaţional sau de exploatare în întreprinderea complexă de producție a energiei nucleare

Analiza riscului de exploatare în întreprinderea complexă de producție a energiei nucleare se bazează pe structurarea cheltuielilor de exploatare în cheltuieli variabile şi cheltuieli fixe:

$$Ce = Cv + Cf \qquad (1)$$

În întreprindere e complexă de producție a energiei nucleare există riscul nerecuperării în totalitate a cheltuielilor efectuate, urmare a neadaptării acesteia, pe baza cerințelor de recuperare a unor mari investiții, la exigenţele economice concurenţiale.

Riscul de exploatare reprezintă variaţia aleatoare a cifrei de afaceri CA (fără TVA) care afectează previziunile ce se referă la diferite criterii de gestiune: a) rezultatul exploatării; b) rentabilitatea economică; c) rentabilitatea financiară.

Ca atare, indicarea nivelului probabil al cheltuielilor la 1000 lei cifra de afaceri este o exigenţă a managementului prin costuri vizând prevenirea riscului de exploatare sau a riscului operaţional.

Pentru evitarea manifestării riscului de exploatare, este necesar ca volumul efectiv de activitate (producere de energie nucleară) să fie mai mare decât volumul de activitate corespunzător punctului critic sau pragului de rentabilitate.

Etapele determinării gradului minim de utilizare a capacităţii de producere de energie nucleară sunt:

a) Se inițializează ecuaţia care arată că volumul de activitate (producere de energie nucleară) reprezentat prin cifra de afaceri, să acopere integral cheltuielile de exploatare a centralei electronucleare:

$$CA = Ce \qquad (2)$$

b) Cheltuielile totale de exploatare a centralei electronucleare rezultă prin însumarea cheltuielilor variabile cu cheltuielile fixe:

$$Ce = Cv + Cf \qquad (3)$$

c) Se recurge la egalaizarea celor două relații ecuaționale:

$$CA = Cv + Cf \qquad (4)$$

d) în continuare, se redă gradul de utilizare a capacităţii funcționale, dar critice, de producţie de energie nucleară după formula:

$$K = \frac{CA_{cr}}{Q_{max}} * 100 \qquad (5)$$

K - gradul de utilizare a capacităţii de producţie de energie nucleară;

Q_{max} - capacitatea de producţie de energie nucleară în expresie valorică.

$$K = \frac{Cf}{Q_{max}(1 - \overline{R_v})} * 100 \qquad (6)$$

A şti, a cunoaşte "riscul" în economia unei centrale electronucleare semnifică a cuprinde şi înţelege raţiunea operaţională a obiectului şi subiectului capacităţii funcţionale a entităţii complexe supuse organizării şi conducerii.

În managementul riscurilor în economia unei centrale electronucleare, cunoştinţele clasice şi neoclasice de organizare şi conducere se folosesc pentru operaţionalizarea eficientă a instrumentelor neconforme ale activităţii productiv-economice (producere de energie nucleară).

Managementul riscurilor în economia unei centrale electronucleare cuprinde esenţialul concepţiei şi obiectului supus organizării şi conducerii.

Investitorii în infrastructura unei centrale electronucleare consideră că este important să cunoască şi să înţeleagă, pentru început, *riscul de ţară*.

În România cât şi în plan internaţional, din observaţii sistematizate,se deduce că pentru evaluarea riscului în economia unei centrale electronucleare, *sunt necesari operatori metrici*, *de măsurare* pentru eliminarea nedeterminărilor faţă de fezabilitatea sistemelui de producţie de energie nucleară şi contracararea riscurilor.

Operatorii metrici, potrivit [10] pot fi: 1) – riscul de ţară, cuantificat determinativ şi iterativ prin riscul politic (se poate apela la instrumentul deja formalizat metodologic prin documentul internaţional cunoscut sub numele *„The International Country Risk Guide's Political Risk"; 2) - riscul financiar;* 3) - riscul economic; *4)-* indicele de *risc compus (Composite Risk Indices)* şi *5)- rating* (folosind aşa numitul instrument metodologic "*Institutional Investor's Country Credit Ratings").*

Riscul de ţară poate fi *auto-evaluat* (pentru propria ţară) sau *evaluat* (pentru alte ţări). România, prin economia sa a intrat şi intră permanent sub analize de risc.

2. Evaluarea riscurilor şi a incertitudinilor operaţionale sau de exploatare în întreprinderea complexă de producție a energiei nucleare

Probabilitatea evenimentelor economice operaţionale sau de exploatare în întreprinderea complexă de producție a energiei nucleare poate fi modificată de evoluții externe sau interne ale mediului.

Se asumă incertitudinea referitoare la nivelul beneficiilor sau costurilor care apar în viitor, însă este urmărită și apariţia evenimentelor care pot avea eventuale efecte dăunătoare asupra investiţiilor nucleare şi care ar putea conduce la pierderi financiare sau la eşecul proiectelor energonucleare.

De aceea, se conturează alternativele productive nucleare şi de eficienţă dintr-o anumită perspectivă, în viitor.

Analiza de risc tehnic nuclear înseamnă identificarea şi evaluarea factorilor care pot afecta reuşita investiţiilor în producţia de energie nucleară, în ceea ce priveşte atingerea scopurilor centralei energonucleare.

O astfel de analiză de risc se foloseşte pentru a evalua alternativele de investiţii nucleare şi pentru a defini măsurile preventive de reducere a probabilităţii ca factorii negativi să apară în producţia de energie nucleară. [10]

Etapele analizei de risc în întreprinderea complexă de producție a energiei nucleare se referă la:

1. Identificarea în analiza de risc a probabilităţilor de apariţie a riscurilor în întreprinderea complexă de producție a energiei nucleare

Calcularea probabilităţilor constă în analiza incidenţei evenimentelor economice negative în raport cu evoluţia procesului investiţional în întreprinderea complexă de producție a energiei nucleare.

2. Măsurarea consecinţelor unui risc în întreprinderea complexă de producție a energiei nucleare

Se constată că acelaşi factor de risc poate avea în întreprinderea complexă de producție a energiei nucleare impacturi diferite, sau opuse în legătură cu rezultatele activităţii sau investiţiei în producția energiei nucleare.

3. Evaluarea riscurilor în întreprinderea complexă de producție a energiei nucleare

În context, se iau în considerare evenimente/ incidente de natură nucleară, care presupun gestionarea riscurilor (în mod deosebit, situații de riscuri de funcţionare sau de mediu). De aceea, are loc identificarea *zonelor de risc* pentru evaluarea riscurilor economice propriu-zise în întreprinderea complexă de producție a energiei nucleare.

Prima zonă este zona sigură, în care nu se preconizează nici o pierdere economică. Aceasta este o situaţie aproape imposibilă în viaţa reală, respectiv în economia reală, deoarece nu se pot planifica activităţile economice în întreprinderea complexă de producție a energiei nucleare ca fiind 100% sigure. [10].

Cea de-a doua zonă este *zona de risc acceptabil*, în care alternativa de a fi evaluat este utilă, întrucât beneficiile calculate depăşesc pierderile.

Tehnologiile nucleare ale căror riscuri se încadrează sub nivelul de risc acceptabil pot fi folosite în producțiea energiei nucleare, fără ca beneficiarul să aibă preocupări faţă de riscurile pe care le prezintă pentru ceilalţi.

Următoarea zonă, deja periculoasă, este *zona cu risc critic*, în care pot apărea pierderi care să depăşească beneficiile preconizate. Nu este rentabil să se deruleze activităţi în întreprinderea complexă de producție a energiei nucleare într-o astfel de situaţie. În ceea ce priveşte investiţiile, un astfel de caz, trebuie studiat luându-se în considerare o eventuală creştere a beneficiilor pe termen lung.

În *zona cu risc catastrofal* în întreprinderea complexă de producție a energiei nucleare pierderile economice depăşesc nivelul critic şi la o valoare maximă a acestora pot depăşi chiar şi valoarea bunurilor tangibile.

4. Gestionarea neutralizării riscurilor în întreprinderea complexă de producție a energiei nucleare

Pierderile cauzate de diverse riscuri în întreprinderea complexă de producție a energiei nucleare sunt diferite; pe această bază derivată din realitate, beneficiarii iau decizii de *gestionare a neutralizării riscurilor.*

Mecanismele de neutralizare a riscurilor în întreprinderea complexă de producție a energiei nucleare sunt create în raport de situaţia de risc.

În general, măsurile pentru combaterea posibilelor consecinţe ale unui risc potenţial în întreprinderea complexă de producție a energiei nucleare sunt:

– *Măsuri preventive.* (reprezintă sarcinile de precauţie luate din timp pentru a preveni posibilele pierderi în infrastructurile din întreprinderea complexă de producție a energiei nucleare îndeosebi, în cadul operaţional și se referă la decizii administrative sau coercitive).

– *Măsuri de compensare*. (reprezintă sarcinile luate pentru a compensa efectele adverse în cazul afectărilor negative ale personalului şi infrastructurii din întreprinderea complexă de producție a energiei nucleare. Pe acest aliniament sunt instituite acorduri de grupare a riscurilor, se dau asigurări şi se recurge la constituirea unor planuri și fonduri de rezervă, care se află sub incidenţa decizională a managerilor).

3. Reconsiderarea metodelor şi tehnicilor de management în câmpul evenimentelor nepredictibile în întreprinderea complexă de producție a energiei nucleare

În contemporaneitatea economică marcată de complexitate modelele de management a riscului în întreprinderea complexă de producție a energiei nucleare este posibil să sufere „stornarea" către riscul generat de *managementul evenimentelor nepredictibile*.

Semnalele de tip rezultat, tot mai frecvent încep să nu se regăsească distribuite *gaussian*.

În cadrul enunțat poate avea loc un proces de străpungere a cunoaşterii cu ajutorul unor *noi tipuri de statistici,* avansând de la periferie spre un centru complet nepredictibil, dar care prin nepredictibilitatea sa dovedită, reduce acţionalitatea la certitudini finite în întreprinderea complexă de producție a energiei nucleare.

Acceptarea distorsiunilor enunţate mai sus consfinţeşte imersiunea managerială *într-un nou tip de behaviorism,* respectiv într-o nouă structură comportamentală în privinţa organizării şi conducerii în întreprinderea complexă de producție a energiei nucleare.

Evaluarea riscului în întreprinderea complexă de producție a energiei nucleare presupune analize de identificare parametrică/factorială a abaterilor cu posibilitate efectivă de manifestare ce pot fi înregistrate în viitorul evolutiv.

Fiecare risc în întreprinderea complexă de producție a energiei nucleare este clasificat în funcţie de nivelul său: *scăzut*, *mediu* sau *înalt.*

În general, în întreprinderea complexă de producție a energiei nucleare se acordă atenţie riscurilor individuale, însă nu întotdeauna este strict necesar să fie procesate toate riscurile.

Are loc o concentrare pe riscurile majore şi pe factorii de ameliorare sau eliminare a acestora.

4. Concluzii

Prin analiza riscurilor pot determina cauzele lor, fiind manifestat prilejul pentru luarea unor decizii potrivite în raport cu reducerile sau creşterile de venituri. Analizând preţul de cost, pentru cheltuielile de desfacere neafectate de riscuri se pot adopta tacticile corespunzătoare de acceptare.

Scopul analizei economice a riscurilor este de a descoperi caracteristicile esenţiale ale părţilor componente ale întregului cercetat, interacţiunile dintre ele, şi de a obține concluziile necesare sintezei la nivelul fenomenului sau procesului productiv studiat. [10]

După momentul în care se efectuează, faţă de fenomenele şi procesele cercetate, în întreprinderea complexă de producție a energiei nucleare analiza economică a riscurilor este :

- *retrospectivă (post-factum)* - pentru faptele petrecute într-o perioadă anterioară;
- *curentă (operativă)* - pentru actele şi faptele economice examinate în timpul producerii lor;
- *prospectivă (previzională)* - pentru viitoarele tendinţe care se prefigurează în activitatea economică.

In raport de evoluţia în timp a fenomenelor şi proceselor economice, analiza economică a riscurilor în întreprinderea complexă de producție a energiei nucleare este:

- *statică* - în sensul că se cercetează activitatea economică la un moment dat;
- *dinamică* - în sensul că studiază actele şi faptele economice în mişcarea lor.

În funcţie de laturile realităţii studiate, analiza economică a riscurilor în întreprinderea complexă de producție a energiei nucleare este:

- *cantitativă* - pentru actele şi faptele economice care pot fi cuantificate, exprimate statistic;
- *calitativă* pentru interpretarea fenomenelor şi proceselor economice şi productive.

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EVALUAREA PERFORMANŢELOR ÎNTREPRINDERII DE PRODUCERE A ENERGIEI REGENERABILE PRIN ANALIZA ECONOMICO-FINANCIARĂ/

EVALUATION OF FINANCIAL PERFORMANCE OF RENEWABLE ENERGY PRODUCTION COMPANY

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ABSTRACT

The article shows that balance sheet bonds reflects the interdependence quantitative elements of renewable energy production process analysis. They underlying the development programs for current activity and future production of renewable energy undertaking. Economic analysis in absolute phenomenon in an enterprise production of renewable energy, this change is reflected in the records is determined as the difference between its actual value and the reference value. Essentially, profitability is one of the most synthetic forms of expression efficiency of the entire economic and financial activities of the enterprise for the production of renewable energy. Economic efficiency of the production of renewable energy is essentially an economic category comprehensive than profitability. Return is a production capacity of renewable energy to profit by using inputs and capital, irrespective of their origin.

KEYWORDS

renewable energy production process, profitability, economic and financial analysis.

1. Aspecte de bază

În analiza economico-financiară se întrevăd performanţele întreprinderii de producție a energiei regenerabile.

Se au în vedere metode cantitative ale analizei în strânsă legătură cu examinarea activităţii de producţie şi comercializare a energiei regenerabile.

Totodată, se identifică elementele de caracterizare a rentabilităţii.

Principalele metode cantitative se referă la:

- *2.1. Metoda input-output (balanţieră)*

Se urmăreşte asigurarea unor proporţii, a unui echilibru între resurse şi necesităţi în diferite domenii de activitate (balanţa consumurilor de materiale, balanţa veniturilor şi a cheltuielilor).

În relaţia:

$$F = a+b-c \tag{1}$$

notaţiile sunt: F = fenomenul analizat; a, b, c = elementele care influenţează procesul de producție a energiei regenerabile.

Metoda se foloseşte în situaţii în care între elementele procesului de producție a energiei regenerabile analizat există relaţii de sumă şi/sau diferenţă.

Legăturile balanţiere reflectă cantitativ interdependenţa elementelor procesului de producție a energiei regenerabile analizat. Ele stau la baza elaborării programelor pentru activitatea curentă şi de perspectivă a întreprinderii de producție a energiei regenerabile.

Analiza fenomenului economic în mărime absolută în cadrul unei întreprinderi de producție a energiei regenerabile, se concretizează în evidenţa modificării acestuia care se stabileşte ca diferenţă între valoarea efectivă a acestuia şi valoarea de referinţa.

$$\Delta F = F_1 - F_0 \quad (2)$$

în care:

F_1 = valoarea efectivă a procesului de producție a energiei regenerabile;

F_0 = valoarea iniţială a procesului de producție a energiei regenerabile.

În mărime relativă, fenomenul este analizat cu ajutorul indicelui acestuia (I_F) care se determină ca raport între valoarea efectivă şi valoarea de referinţă a acestuia.

$$I_F = \frac{F_1}{F_0} * 100 \quad (3)$$

- *2.2. Metoda iterării (substituirilor în lanţ)*

Se aplică în cazul relaţiilor de tip determinist care îmbracă forma matematică a produsului sau raportului (proporţionalitate directă sau inversă).

Metoda substituirilor în lanţ implică respectarea următoarelor principii:

- aşezarea factorilor se face în ordinea condiţionării lor economice, ceea ce înseamnă că se substituie întâi factorul cantitativ şi apoi cel calitativ;

- substituirile se fac succesiv (a, b, c, … = factori);

- un factor substitutive se menţine ca stare în operaţiile ulterioare.

2. Analiza rentabilităţii întreprinderi de producție a energiei regenerabile

Rentabilitatea procesului de producție a energiei regenerabile este strâns legată de eficienţa economică.

În esenţă, rentabilitatea este una din formele cele mai sintetice de exprimare a eficienţei întregii activităţi economico-financiare a întreprinderii de producție a energiei regenerabile. Eficienţa economic a procesului de producție a energiei regenerabile, în esenţă, este o categorie economică mai cuprinzătoare decât rentabilitatea.

Rentabilitatea este capacitatea unei întreprinderi de producție a energiei regenerabile de a obţine profit prin utilizarea factorilor de producţie şi a capitalurilor, indiferent de provenienţa acestora.

Legătura între rentabilitate şi eficienţă economică rezultă din conţinutul definiţiilor fiecărui concept.

Potrivit lui *Mărgulescu, D.,* (1994), "eficienţa economică reprezintă cea mai generală categorie care caracterizează rezultatele ce decurg din diferite variante preconizate pentru utilizarea (consum productiv, consum individual, vânzare) sau economisirea unor resurse (umane, materiale sau financiare) intrate sau neintrate în circuitul economic".

Exprimarea rentabilităţii procesului de producție a energiei regenerabile revine din două categorii de indicatori: *a)* profitul şi *b)* ratele de rentabilitate.

Rentabilitatea, în mărime absolută este reflectată în profit.

Prin *analiza structurală a profitului* procesului de producție a energiei regenerabile se urmăreşte stabilirea contribuţiei diferitelor tipuri de rezultate la modificarea totală, precum şi punerea în evidenţă a schimbărilor intervenite pe elemente componente. (Figura.1)

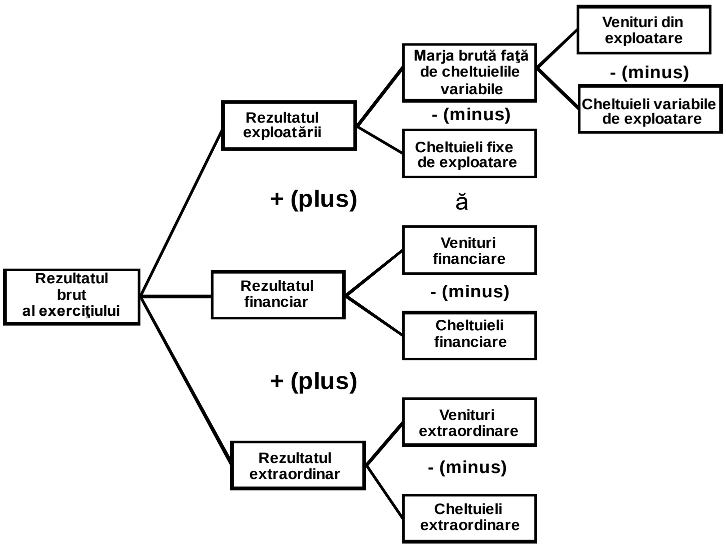

Figura.1 Elemente de analiză structurală a rezultatului brut al întreprinderii [14]

Pragul de rentabilitate poate fi determinat prin reprezentare grafică (Figura.1).

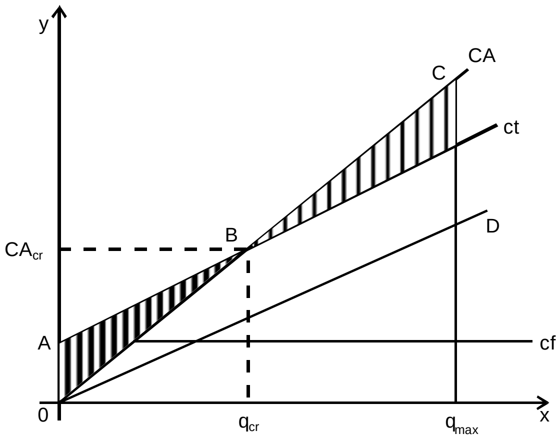

Figura.1 Reprezentarea grafică a pragului de rentabilitate pe produs [14]

Notaţiile au semnificaţiile:

Ox - reprezintă volumul fizic al producţiei procesului de energie regenerabilă; Oy - indicatorii valorici (cifra de afaceri, cheltuieli, etc); ct - cheltuieli totale pe produs; cv - cheltuieli variabile pe produs; cf- suma cheltuielilor fixe pe produs; ΔOAB - zona pierderilor; ΔBCD - zona profitului.

Profitul maxim ($P_{r\ max}$) ce poate fi obţinut, în condiţiile date este respectat de latura CD din triunghiul BCD, şi se poate determina prin relaţia:

$$P_{r\ max} = q_{max}\ (p - cv) - cf = q_{max}\ mbv - cf \qquad (4)$$

Pragul de rentabilitate marchează acea dimensiune a producţiei de energie regenerabilă în care costul unitar este egal cu preţul de vânzare, profitul fiind zero.

3. Exprimarea rentabilităţii procesului de producție a energiei regenerabile

Indicatorii de reflectare în mărime absolută a rentabilităţii procesului de producție a energiei regenerabile sunt:

- Rezultatul exploatării = venituri de exploatare - cheltuieli de exploatare;
- Rezultatul financiar = venituri financiare - cheltuieli financiare;
- Rezultatul curent = rezultatul exploatării + rezultatul financiar;
- Rezultatul extraordinar = venituri extraordinare - cheltuieli extraordinare;
- Rezultatul brut = rezultatul curent + rezultatul extraordinar;
- Rezultatul impozabil = rezultatul brut + elemente nedeductibile fiscal - elemente deductibile fiscal;
- Rezultatul net = rezultatul brut - impozit pe profit.

Analiza profitului procesului de producție a energiei regenerabile se înfăptuieşte prin:

a) Analiza structurală a profitului (ASP)

Se poate efectua pe baza grupării veniturilor şi cheltuielilor după natura lor sau a grupării cheltuielilor după destinaţia lor în cadrul întreprinderii de producție a energiei regenerabile.

b) Analiza soldurilor intermediare de gestiune (SIG)

Prin solduri interne de gestiune se înţeleg principalii indicatori economico-financiari stabiliţi pe baza datelor din contul de profit şi pierdere, cu ajutorul acestora se caracterizează modul de folosire a resurselor materiale, financiare şi umane ale întreprinderii de producție a energiei regenerabile.

4. Concluzii

Exprimarea rentabilităţii procesului de producție a energiei regenerabile revine din două categorii de indicatori: *a)* profitul şi *b)* ratele de rentabilitate.

Rentabilitatea, în mărime absolută este reflectată în profit.

Analiza fenomenului economic în mărime absolută în cadrul unei întreprinderi de producție a energiei regenerabile, se concretizează în evidenţa modificării acestuia care se stabileşte ca diferenţă între valoarea efectivă a acestuia şi valoarea de referinţa. În esenţă, rentabilitatea este una din formele cele mai sintetice de exprimare a eficienţei întregii activităţi economico-financiare a întreprinderii de producție a energiei regenerabile.

Eficienţa economic a procesului de producție a energiei regenerabile, în esenţă, este o categorie economică mai cuprinzătoare decât rentabilitatea.

Prin *analiza structurală a profitului* procesului de producție a energiei regenerabile se urmăreşte stabilirea contribuţiei diferitelor tipuri de rezultate la modificarea totală, precum şi punerea în evidenţă a schimbărilor intervenite pe elemente componente.

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ANALIZA CHELTUIELILOR ÎNTREPRINDERII MINIERE/

MINING ENTERPRISE EXPENDITURE REVIEW

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ABSTRACT

The main objective of the mining company is to reduce production costs. It is therefore necessary to analyze in detail the key expense categories that contribute to the cost. For financing the mining production and mining investment, mining companies can turn to bank loans, which bear interest costs are included or not, and usually affects the net profit of the company.

KEYWORDS

mining production, mining investment expenses, reduce production costs

1. Metode şi tehnici de analiză a cheltuielilor întreprinderii miniere

Analiza cheltuielilor întreprinderii miniere permite înţelegerea mecanismului de formare a rezultatelor întreprinderii miniere în funcţie de volum, structură şi tendinţele diferitelor categorii de consumuri.

Obiectivul prioritar al întreprinderii miniere îl reprezintă reducerea costurilor de producţie.

De aceea, este necesară analiza detaliată a principalelor categorii de cheltuieli care contribuie la formarea costului.

Tipurile de analiză se referă la:

• *Analiza nivelului cheltuielilor la 1000 lei venituri totale*

Cheltuielile şi veniturile întreprinderii miniere se grupează după cum urmează:

a) Cheltuieli de exploatare, reprezentând consumurile efectuate în scopul realizării obiectului de activitate:

- ✓ materii prime, materiale consumabile, obiecte de inventar;
- ✓ lucrări şi servicii executate de terţi (întreţinere, chirii, reparaţii, ş.a.);
- ✓ impozite, taxe şi vărsăminte asimilate;
- ✓ salarii şi cheltuieli asimilate acestora;
- ✓ amortizări şi provizioane.

b) Cheltuieli financiare, care cuprind:

- ✓ dobânzile curente aferente împrumuturilor primite;
- ✓ pierderile din vânzarea valorilor mobiliare de plasament;

- ✓ diferenţele nefavorabile de curs valutar din operaţiunile curente;
- ✓ disponibilităţile în devize;
- ✓ sconturile acordate clienţilor, ş.a.

c) Cheltuieli excepţionale, care sunt formate din alte cheltuieli care nu sunt legate de activitatea curentă a întreprinderii miniere.

Ele cuprind:

- ✓ operaţiuni legate de capital (valoarea contabilă a imobilizărilor cedate şi alte cheltuieli excepţionale);
- ✓ operaţiuni de gestiune (amenzi, penalităţi, lipsuri de inventar, donaţii, subvenţii acordate, pierderi din debitori insolvabili).

Veniturile totale ale întreprinderii miniere se grupează în:

1)Venituri din exploatare, care cuprind:

- veniturile din vânzarea produselor, lucrărilor executate, serviciilor prestate şi mărfurilor;
- veniturile din producţia stocată;
- veniturile din producţia de imobilizări (active fixe);
- alte venituri din exploatare.

2) Venituri financiare, care cuprind:

- dobânzi încasate;
- venituri din titluri de plasament;
- diferenţe favorabile de curs valutar;
- venituri din participaţii;
- venituri din sconturi obţinute;
- venituri din alte imobilizări financiare, ş.a.

3) Venituri excepţionale, reprezintă acele venituri care nu sunt legate de activităţile curente ale întreprinderii miniere.

Aceste se referă la:

- operaţiuni de capital (venituri din cedarea activelor);
- operaţiuni de gestiune (despăgubiri şi penalităţi încasate, donaţii primite, ş.a.).

Pentru urmărirea evoluţiei cheltuielilor aferente veniturilor se utilizează indicatorul *“rata de eficienţă a cheltuielilor totale (cheltuieli la 1000 lei venituri)”.*

În procesul de analiză este necesară precizarea unor aspecte legate de acţiunea cheltuielilor la 1000 lei venituri pe categorii ale acestora, şi anume:

- ✓ cheltuielile la 1000 lei venituri din exploatare;
- ✓ cheltuielile la 1000 lei venituri financiare;
- ✓ cheltuielile la 1000 lei venituri excepţionale.

• *Analiza nivelului cheltuielilor de exploatare la 1000 lei venituri din exploatare*

Acest indicator are în vedere cheltuielile aferente activităţii de exploatare totale a exerciţiului financiar inclusiv costul mărfurilor.

Pentru dimensionarea şi urmărirea evoluţiei cheltuielilor de exploatare se foloseşte indicatorul “*rata de eficienţă a cheltuielilor de exploatare (cheltuieli la 1000 lei venituri din exploatare)”.*

• *Analiza diagnostic a cheltuielilor la 1000 lei cifră de afaceri*

Cheltuielile la 1000 lei cifră de afaceri implică diagnosticul următoarelor aspecte:

- ✓ analiza dinamicii şi structurii cheltuielilor la 1000 lei cifră de afaceri;
- ✓ analiza diagnostică de tip factorial a cheltuielilor la 1000 lei cifră de afaceri;

- ✓ reflectarea cheltuielilor la 1000 lei cifră de afaceri în principalii indicatori ai performanţei economico-financiare a întreprinderii;
- ✓ estimarea probabilă a cheltuielilor la 1000 lei cifră de afaceri şi elemente de bază ale strategiei reducerii lor;
- ✓ analiza dinamicii şi structurii cheltuielilor la 1000 lei cifră de afaceri;

• *Analiza diagnostic a cheltuielilor variabile (după caz, directe) la 1000 lei venituri din exploatare sau cifră de afaceri*

Se au în vedere următoarele aspecte:

- analiza dinamicii şi structurii costurilor variabile pe baza nivelului la 1000 lei venituri din exploatare şi respectiv cifra de afaceri;

- analiza diagnostic de tip factorial a nivelului cheltuielilor variabile la 1000 lei venituri din exploatare şi respectiv cifră de afaceri;

- analiza reflectării nivelului cheltuielilor variabile în principalii indicatori ai performanţei economico-financiare a întreprinderii;

- estimarea probabilă a nivelului cheltuielilor variabile pe termen scurt şi mediu;

• *Analiza eficienţei cheltuielilor fixe*

Se au în vedere:

- analiza dinamică şi structurală a nivelului cheltuielilor fixe la 1000 lei venituri din exploatare sau/şi cifră de afaceri;

- analiza diagnostic de tip factorial a cheltuielilor fixe;

- reflectarea cheltuielilor fixe în principalii indicatori ai performanţei economico-financiare a întreprinderii;

• *Analiza eficienţei cheltuielilor cu personalul*

Se au în vedere următoarele:

- analiza eficienţei cheltuielilor salariale;

- analiza corelaţiei dintre dinamica productivităţii muncii şi dinamica salariului mediu.

- corelaţia dintre dinamica productivităţii muncii şi dinamica salariului mediu se reflectă în indicatori ai performantei economico-financiare a întreprinderii miniere precum:

a) nivelul cheltuielilor salariale la 1000 lei venituri din exploatare, cifră de afaceri, valoare adăugată (funcţie de calculul productivităţii muncii miniere)

b) profitul din exploatare, profitul aferent cifrei de afaceri, profitul aferent valorii adăugate;

c) eficienţa activelor de exploatare stabilită pe baza profitului din exploatare, sau celui aferent cifrei de afaceri şi valorii adăugate ca efect:

d) eficienţa mijloacelor fixe;

e) eficienţa activelor circulante de exploatare.

• *Analiza cheltuielilor materiale*

Din punct de vedere structural, cheltuielile materiale pot fi analizate pe elemente componente, respectiv cheltuieli cu materialele şi cheltuieli cu amortizarea mijloacelor fixe.

• *Eficienţa cheltuielilor cu dobânzile*

Acestea reprezintă costuri ale capitalului împrumutat şi în consecinţă eficienţa lor prezintă interes în analiza economico-financiară (dobânzile plătite aferente împrumuturilor şi datoriilor asimilate).

Eficienţa lor poate fi evidenţiată prin nivelul la 1000 lei cifră de afaceri.

2. Analiza cheltuielilor variabile ale întreprinderii miniere

Cheltuielile variabile se împart în:

• cheltuieli proporţionale;

• cheltuieli progresive;

• cheltuieli regresive;

• cheltuieli flexibile.

În categoria cheltuielilor variabile se includ:

✓ cheltuieli cu materiile prime şi materialele directe;

✓ cheltuieli cu manopera directă;

✓ alte categorii de cheltuieli care variază relativ proporţional cu volumul de activitate.

Cheltuielile fixe propriu-zise sunt acele cheltuieli a căror mărime rămâne relativ constantă, indiferent dacă, în cadrul unei capacităţii de producţie, volumul producţiei creşte sau scade.

În această categorie se includ:

- cheltuieli privind amortizările;
- cheltuieli privind serviciile telefonice;
- cheltuieli cu abonamentele radio-tv;
- cheltuieli cu primele de asigurare;
- cheltuieli cu impozite şi taxe locale.

Cheltuielile relativ-fixe sunt formate din acele cheltuieli de producţie care manifestă o mare sensibilitate faţă de modificarea volumului fizic al producţiei, respectiv în raport cu măsura în care este utilizată capacitatea de producţie.

În această categorie se cuprind:

- cheltuieli cu salariile personalului;
- cheltuieli de deservire a secţiilor întreprinderii;
- cheltuieli cu protecţia mediului înconjurător;
- cheltuieli de natură administrativă.

3. Analiza cheltuielilor cu personalul în întreprinderea minieră

Cheltuielile cu personalul sunt structurate în funcţie de criterii precum:

• În funcţie de elementele componente:

- salarii tarifare sau negociate;
- sporuri acordate;
- taxe de protecţie socială;
- impozite.

• În funcţie de categoriile de personal:

- pentru marcarea mutaţiilor ce s-au produs în structura personalului sau pentru eventualele comparaţii cu firme similare);

• În funcţie de formele de salarizare practicate

- pentru a caracteriza eficienta acestora.

• În raport cu modul de includere în costuri:

- localizarea rezervelor existente pentru sporirea eficientei cheltuielilor cu salarii.

Modificarea cheltuielilor cu salariile în mărimi absolute se determină ca diferenţa între cheltuielile cu salariile realizate şi cele aferente perioadei luata ca baza de comparaţie.

$$\Delta Cs = Cs_1 - Cs_0 \quad (1)$$

în care:

Cs - cheltuieli cu salariile.

$$\Delta Csr = Cs_1 - Cs_a \quad (2)$$

ΔCsr – modificarea relativă a cheltuielilor cu salariile;

Cs_1 - cheltuieli cu salariile realizate;

Cs_a - cheltuieli cu salariile admisibile.

$$Cs_a = \frac{Cs_0}{100} \quad (3)$$

cu notaţia: I_v - indicele volumului de activitate (cifra de afaceri sau producţia exerciţiului)

În practică pot fi întâlnite următoarele situaţii:

$Cs1 < Cs_a \longrightarrow$ reprezintă o economie relativă;

$Cs1 > Cs_a \longrightarrow$ reprezintă o depăşire relativă;

$Cs1 > Cs_a \longrightarrow$ reprezintă o cerinţă de bază pentru menţinerea ratei de eficienţă a cheltuielilor cu salariile la 1000 lei volum de activitate.

Pentru analiza factorială se pot utiliza următoarele modele:

$$\text{I. } Cs = \overline{Ns} * \frac{Ve}{\overline{\overline{Ns}}} * \frac{Cs}{Ve} \quad (4)$$

$\frac{Ve}{\overline{\overline{Ns}}}$ - productivitatea medie anuală ($\overline{Wa}$);

$\frac{Cs}{Ve}$ - cheltuieli medii cu salariile la 1 leu venituri de exploatare ($\overline{Cs}$).

$$\text{II. } Cs = \overline{Ns} * \frac{T}{\overline{\overline{Ns}}} * \frac{Cs}{T} \quad (5)$$

$$\frac{T}{\overline{\overline{Ns}}} = \bar{t} \quad (6)$$

$\frac{Cs}{T} = \overline{Csh}$ - cheltuieli medii cu salariul orar;

$$Cs = \overline{Ns} * \bar{t} \ \overline{Csh} \quad (7)$$

4. Analiza cheltuielilor cu dobânzile în întreprinderea minieră

În analiza cheltuielilor cu dobânzile se urmăreşte evoluţia acestora, comparativ cu perioada anterioară, explicându-se modificarea lor prin prisma factorilor care le determină.

Pentru finanţarea activităţii de producţie minieră şi investiţii miniere, întreprinderile miniere pot apela la împrumuturi bancare, purtătoare de dobânzi care se includ sau nu în costuri, şi de regulă afectează profitul net al firmei.

Pentru credite aferente activităţii de exploatare, suma dobânzilor se exprimă prin relaţia:

$$Sd = \frac{\overline{ACR} * K * \overline{Pd}}{100^2} \quad (1)$$

unde: $\overline{ACR}$ - soldul mediu al activităţii circulante;

K - cota procentuală de participare a creditului la finanţarea activelor circulante.

$$K = \frac{CR}{ACR} * 100 \quad (2)$$

unde: CR - soldul mediu al creditului pe termen scurt;

$\overline{Pd}$ - procentul mediu de dobândă.

$$\overline{Pd} = \frac{\sum g_{ki} * Pd_i}{100} \quad (3)$$

unde: g_{ki} - structura creditelor pe categorii;

P_{di} - procentul de dobândă pe categorii de credite.

5. Analiza cheltuielilor cu amortizarea în întreprinderea minieră

Amortizarea este expresia valorică a uzurii mijloacelor fixe inclusă în costul produselor. Cheltuielile cu amortizarea fac parte din categoria cheltuielilor fixe.

Analiza lor se justifică a fi efectuată ca nivel, la 1000 lei venituri de exploatare şi 1000 lei cifra de afaceri.

4. Concluzii

În analiza cheltuielilor cu dobânzile se urmăreşte evoluţia acestora, comparativ cu perioada anterioară, explicându-se modificarea lor prin prisma factorilor care le determină.

Pentru finanţarea activităţii de producţie minieră şi investiţii miniere, întreprinderile miniere pot apela la împrumuturi bancare, purtătoare de dobânzi care se includ sau nu în costuri, şi de regulă afectează profitul net al firmei.

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ANALIZA COSTULUI PE PRODUS MINERAL ÎN CADRUL ÎNTREPRINDERII MINIERE. COSTURILE ŞI VALOAREA ADĂUGATĂ/ COST OF MINERAL PRODUCT IN MINING COMPANY. COSTS AND ADDED VALUE

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ABSTRACT

The article states that permit assessment of value added contribution to the achievement of crude mining company and highlights the degree of vertical integration by reference to production. However, it is noted that the mining company cost analysis in phase involves the following: Determination of mineral products to be analyzed (mineral products are researched priority to which costs have exceeded pre-calculated or normal); Explanation of the amendment cost each mineral product in terms of expenditure categories (articles and items). It establishes absolute and percentage contribution of each category to total change in product cost mineral / mining.

KEYWORDS

mineral products, costs, mining company, added value and cost analysis

1. Analiza costurilor în cadrul întreprinderii miniere

Analiza costurilor în cadrul întreprinderii miniere presupune parcurgerea următoarelor faze:

- Stabilirea produselor minerale care urmează a fi supuse analizei (sunt cercetate cu prioritate produsele minerale la care s-au depăşit costurile antecalculate sau normale);

- Explicarea modificării costului pe fiecare produs mineral prin prisma categoriilor de cheltuieli (articole sau elemente). Se stabileşte contribuţia absolută şi procentuală a fiecărei categorii la modificarea totală a costului pe produs mineral/ minier.

În principal, se recurge la următorul sistem de analiză:

• *Analiza elementelor de cheltuială (prin prisma factorilor direcţi de influenţă* în cadrul întreprinderii miniere).

Practic, trebuie determinate abaterile pe fiecare categorie de cheltuială în parte, procedându-se la analiza acestora prin prisma factorilor de influenţă în cadrul întreprinderii miniere. Aceste demersuri oferă posibilităţi concrete de acţiune în vederea reducerii lor.

• *Analiza cheltuielii cu materii prime si materiale directe (C_m)*

Aceste cheltuieli sunt dependente de consumul specific şi de preţul de aprovizionare al materialului respectiv în cadrul întreprinderii miniere.

$$\overline{C_m} = Cs_j * P_j \qquad (1)$$

Cs_j - consumul specific din resursa materială j;

P_j - preţul de aprovizionare a resursei materiale j.

• *Analiza cheltuielilor cu salariile directe (C_{sd})*

$$\overline{Csd} = \bar{t} * \overline{Csh} \qquad (2)$$

La nivelul unităţii de produs mineral/minier, aceste cheltuieli sunt dependente de productivitatea muncii exprimată prin timpul consumat pe unitatea de produs ($\bar{t}$) şi salariul mediu orar ($\overline{Csh}$).

• *Analiza cheltuielilor indirecte pe produs ($\overline{Ci}$)*

Aceste cheltuieli în cadrul întreprinderii miniere se analizează în funcţie de volumul fizic al producţiei extrase (q) şi suma cheltuielilor indirecte astfel (Ci):

$$\overline{C_i} = \frac{C_i}{q} \qquad (3)$$

• *Analiza costului pe produs in funcţie de gradul de utilizare a capacităţii de producţie minieră*

Între evoluţia volumului de activitate în cadrul întreprinderii miniere şi costul pe produs extras există o legătura de inversă proporţionalitate.

Costul unitar se exprimă după cum urmează:

$$C = C_v + \frac{C_f}{q} \qquad (4)$$

C_v - cheltuieli variabile;

C_f - cheltuieli fixe;

Q - valoarea producţiei.

2. Analiza valorii adăugate în cadrul întreprinderii miniere

Valoarea adăugată permite aprecierea contribuţiei întreprinderii miniere la realizarea produsului brut şi evidenţiază gradul de integrare pe verticală prin raportarea la producţie.

Principalele metode de determinare a valorii adăugate se referă la:

1. Metoda diferenţei;

Presupune scăderea din producţia exerciţiului sau din cifra de afaceri a consumurilor intermediare provenite de la terţi.

Relaţiile de calcul sunt:

$$Qa = Qe - C \qquad (5)$$

cu: Qa - valoarea adăugată;

Qe - producţia exerciţiului;

C - consumul intermediar provenit de la terţi.

$$Qa = (Qe + MC) - C' \qquad (6)$$

în care: MC - marja comercială;

C - consumul intermediar provenit de la terţi pentru activitatea de producţie şi comerţ.

2. Metoda aditivă

Presupune însumarea următoarelor componente:

- salariu;

- contribuţiile pentru asigurări şi protecţie socială;
- amortizări;
- provizioane;
- cheltuieli cu impozite şi taxe (fără impozitul pe profit);
- rezultatul exploatării;
- cheltuieli financiare;

3. Analiza performanţelor de producţie şi comercializare în cadrul întreprinderii miniere

Principalii indicatori de analiză în cadrul întreprinderii miniere sunt:

Cifra de afaceri (CA); reprezintă suma totală a veniturilor din vânzarea produselor minerale extrase şi producţiei miniere într-o anumită perioadă determinată;

Producţia marfă fabricată (Qf); reprezintă valoarea bunurilor, serviciilor şi lucrărilor care sunt destinate livrării;

Valoarea adăugata (Qa); reprezintă valoarea realizată de activitatea firmei miniere, respectiv capacitatea acesteia de a avea bogăţie;

Producţia exerciţiului (Qe); reprezintă volumul total de activitate productive dintr-o anumită perioadă.

Modalităţile principale de caracterizare a activităţii de producţie minieră şi comercializare se referă la:

• *Corelaţia dintre indicii principalilor indicatori valorici;*

$$\geq \quad < \qquad (7)$$

- dacă $I_{ca} > I_{Qf}$ rezultă reducerea stocurilor de produse finite de nivelul de comparaţie;
- dacă $I_{ca} = I_{Qf}$ rezultă reducerea stocurilor de producţie neterminată şi a consumului intern până la limita desfăşurării normale a activităţii;
- dacă $I_{Qa} > I_{Qe}$ rezultă reducerea ponderii consumurilor de la terţi în volumul total de activitate productivă;

dacă $I_{Qf} > I_{Qe}$ rezultă că se reduc stocurile, respectiv, se reduc consumurile interne ale firmei.

• *Raportul static dintre principalii indicatori valorici.*

Principalele raporturi statice sunt:

$\frac{CA}{Qf} \gtrless 1 \Rightarrow$ se reflectă modificările intervenite în stocurile de produse finite şi la nivelul altor venituri din exploatare;

$\frac{Qf}{Qe} \gtrless 1 \Rightarrow$ se reflecta evoluţia stocurilor de producţie in curs de execuţie, precum si a consumurilor interne;

$\frac{Qa}{Qe} \gtrless 1 \Rightarrow$ se evidenţiază modificarea ponderii consumurilor de la terti, iar in cadrul acesteia a consumurilor de materiale.

Analiza cifrei de afaceri înseamnă evidenţierea veniturilor totale obţinute din operaţiile comerciale miniere, respective din vânzări de mărfuri şi produse, executarea de lucrări şi prestarea de servicii, într-o anumită perioadă de timp.

• *Analiza factorială a cifrei de afaceri*

Se pot utiliza următoarele modele:

I) $$CA = \Sigma qv * p \quad (2)$$

cu notaţiile: q_v - volumul fizic al producţiei vândute;

p - preţul unitar de vânzare, exclusiv TVA.

II) $$CA = \bar{N}s * \frac{Qf}{Ns} * \frac{CA}{Qf} \quad (3)$$

în care: $\bar{N}s$ - numărul mediu de salariaţi;

Qf - producţia marfă fabricată;

$\frac{Qf}{Ns}$ - productivitatea muncii;

$\frac{CA}{Qf}$ - gradul de valorificare a producţiei marfă fabricată.

III) $$CA = \bar{N}s * \frac{\bar{M}f}{\bar{N}s} * \frac{\overline{M'f}}{\bar{M}f} * \frac{Qf}{\overline{M'f}} * \frac{CA}{Qf} \quad (4)$$

Cu notaţiile: $\frac{\bar{M}f}{\bar{N}s}$ - gradul de înzestrare tehnică a muncii;

$\frac{\overline{M'f}}{\bar{M}f}$ - ponderea mijloacelor fixe direct productive;

$\frac{Qf}{\overline{M'f}}$ - randamentul mijloacelor fixe direct productive

IV) $$CA = T * \overline{Cah} \quad (5)$$

în care: T - fondul total de timp de muncă;

$\overline{Cah}$ - cifra de afaceri medie orară.

$$T = \overline{Ns} * \bar{t} \quad (6)$$

în care: t - numărul mediu de ore lucrate de un salariat.

4. Analiza situaţiei financiare patrimoniale a întreprinderii miniere

Obiectivele principale ale analizei financiare în cadrul întreprinderii miniere a patrimoniului sunt:

- stabilirea patrimoniului net, respectiv a valorii contabile a averii acţionarilor/statul;

-determinarea sănătăţii financiare a întreprinderii miniere, respectiv detectarea unor eventuale situaţii de dezechilibru financiar care pot periclita continuitatea exploatării;

-stabilirea lichidităţii şi solvabilităţii în cadrul întreprinderii miniere;

-determinarea flexibilităţii financiare în cadrul întreprinderii miniere pe baza tabloului fluxurilor de trezorerie;

-caracterizarea eficienţei elementelor patrimoniale în cadrul întreprinderii miniere;

-întocmirea bugetelor de venituri şi cheltuieli şi a planurilor de finanţare;

evaluarea performanţelor în cadrul întreprinderii miniere.

Bilanţul este documentul contabil principal care prezintă situaţia patrimonială în cadrul întreprinderii miniere la un moment dat.

În *activul* bilanţului sunt înregistrate toate drepturile de proprietate şi de creanţă ale întreprinderii, în ordinea inversă a lichidităţii, iar în pasiv se înregistrează toate obligaţiile, respectiv angajamentele asumate, angajate în ordinea crescătoare a exigibilităţii (timpul cât sursa respectivă rămâne la dispoziţia întreprinderii).

Pasivul reflectă sursele fondurilor în cadrul întreprinderii miniere iar activul constituie utilizările cărora le sunt afectate aceste fonduri, în consecinţă, nici o sursă nu poate rămâne fără alocare, după cum nici o nevoie de finanţare nu poate exista fără surse de fonduri.

Egalitatea bilanţieră în cadrul întreprinderii miniere este necesară deoarece activul şi pasivul sunt două reprezentate ale aceleiaşi mărimi economice.

În practica economică în cadrul întreprinderii miniere se întâlnesc aplicaţiile ale două teorii fundamentale:

• *Teoria bilanţului patrimonial (financiar).* Are la bază analiza lichiditate - exigibilitate, numită în practică „analiza patrimonială". Aceasta pune în evidenţă riscul de insolvabilitate în cadrul întreprinderii miniere, adică incapacitatea firmei de a-şi onora obligaţiile de plată faţă de terţi.

• *Teoria bilanţului funcţional.* Acest tip de bilanţ se obţine în urma regrupării elementelor de activ si pasiv după criteriul de lichiditate si exigibilitate în cadrul întreprinderii miniere.

Patrimoniul reprezintă totalitatea drepturilor şi obligaţiile în cadrul întreprinderii miniere ce pot fi exprimate în banii aparţinând unei persoane fizice sau juridice ale căror nevoi le satisfac, precum şi bunurile la care se referă.

În cazul unei întreprinderi miniere, patrimoniul se defineşte ca fiind activele întreprinderii negrevate de datorii sau averea acţionarilor stabilita pe baza bilanţului patrimonial.

Patrimoniul net sau *activul net* contabil în cadrul întreprinderii miniere se poate stabilii astfel:

1. Ca diferenţă între activul total şi datoriile totale (reprezintă o exprimare materială a patrimoniului net);

2. Ca sumă a elementelor de capitaluri proprii.

Patrimoniul net în cadrul întreprinderii miniere este pozitiv şi crescător ca urmare a unei gestiuni sănătoase. Această situaţie reflectă atingerea obiectivului major, şi anume maximizarea valorii patrimoniale a acesteia.

Creşterea patrimoniului net în cadrul întreprinderii miniere se va înregistra în situaţia în care ritmul activelor totale devansează ritmul datoriile totale.

În practica economică în cadrul întreprinderii miniere se pot întâlni situaţii în care dinamica cea mai accentuată o înregistrează sursele constituite pe baza rentabilităţii firmei.

Capitalul social în cadrul întreprinderii miniere se modifică prin noi aporturi şi/sau prin conversia unor datorii în capital social (stingerea unor datorii în schimbul unui pachet de acţiuni).

Rezultatul reportat poate fi profit nerepartizat, fapt ce determină creşterea patrimoniului net, sau pierdere neacoperită, caz în care patrimoniul va fi diminuat.

Patrimoniul net poate să crească pe seama surselor interne (rentabilitatea în cadrul întreprinderii miniere şi pe baza unor surse externe (aporturi, primirea cu titlu gratuit a unor active, conversia unor datorii în capital social.

➢ *Bilanţul patrimonial* are la bază criteriul de lichiditate şi exigibilitate.

Se înregistrează următoarele situaţii:

a. Activul imobilizat se diminuează cu valoarea activelor imobilizate fictive sau nonvalori (cheltuieli de constituire, cheltuieli de repartizat asupra exerciţiilor financiare viitoare, primele pentru rambursarea obligaţiunilor, debitori din capitalul subscris şi nevărsat, diferenţe de conversie activ), elemente care din punct de vedere al lichidităţii nu au nici o valoare deoarece nu dau naştere unui flux de numerar.

Activele imobilizate se majorează cu partea de active circulante cu termen de lichiditate mai mare de 1 an.

b. Activul circulant se diminuează cu valoarea activelor circulante cu termen de lichiditate mai mare de 1 an şi se majorează cu valoarea imobilizărilor financiare cu termen de lichiditate mai mic de 1 an.

➢ II. *Bilanţul funcţional*

Oferă o imagine asupra modului de funcţionare din punct de vedere economic al întreprinderii, evidenţiind atât utilizările cât şi sursele corespunzătoare fiecărui ciclu (de investiţii, de exploatare, de finanţare şi de trezorerie):

1. Ciclul de investiţie cuprinde achiziţionarea de active imobilizate, astfel imobilizările regrupate în funcţie de investiţie constituie nevoi (alocări) stabile (aciclice) care sunt finanţate în mod necesar din resursele durabile existente în pasivul bilanţului.

2. Ciclul de exploatare cuprinde fluxurile de aprovizionare, producţie şi distribuţie sub formă de fluxuri fizice cât şi financiare.

3. Ciclul de finanţare se referă la ansamblul operaţiunilor dintre întreprindere şi proprietarii de capital (acţionarii) şi creditorii întreprinderii.

În practica financiară există principii care stau la baza întocmirii bilanţului funcţional, şi anume:

1) Activele sunt luate în calcul la valoarea lor brută, adică la valoarea de intrare în patrimoniu, iar în pasiv se iau în considerare amortizările (rulajul contului 681) şi provizioanele.

2). Imobilizările închiriate, deţinute în leasing sau în locaţie de gestiune sunt integrate în activ şi corespunzător în pasiv la împrumuturi şi datorii asimilate deoarece ele servesc ciclului de exploatare.

3). Conceptul de activ fictiv nu mai este operaţional.

4) Cheltuielile care privesc exerciţii financiare viitoare se asimilează activelor imobilizate.

5) Efectele scontate neajunse la scadenţă, debitorii privind capitalul subscris şi nevărsat, primele privind rambursarea obligaţiunilor şi diferenţele de conversie a activelor şi pasivelor se tratează în acelaşi mod ca şi la elaborarea bilanţului patrimonial.

6) Amortizarea şi provizioanele sunt incluse în pasivul bilanţului funcţional ca surse aciclice (care rămân la dispoziţia întreprinderii o perioada mai mare de 1 an).

5. Concluzii

Patrimoniul net în cadrul întreprinderii miniere este pozitiv şi crescător ca urmare a unei gestiuni sănătoase. Această situaţie reflectă atingerea obiectivului major, şi anume maximizarea valorii patrimoniale a acesteia.

Creşterea patrimoniului net în cadrul întreprinderii miniere se va înregistra în situaţia în care ritmul activelor totale devansează ritmul datoriile totale.

În practica economică în cadrul întreprinderii miniere se pot întâlni situaţii în care dinamica cea mai accentuată o înregistrează sursele constituite pe baza rentabilităţii firmei.

Capitalul social în cadrul întreprinderii miniere se modifică prin noi aporturi şi/sau prin conversia unor datorii în capital social (stingerea unor datorii în schimbul unui pachet de acţiuni).

Rezultatul reportat poate fi profit nerepartizat, fapt ce determină creşterea patrimoniului net, sau pierdere neacoperită, caz în care patrimoniul va fi diminuat.

Patrimoniul net poate să crească pe seama surselor interne (rentabilitatea în cadrul întreprinderii miniere şi pe baza unor surse externe (aporturi, primirea cu titlu gratuit a unor active, conversia unor datorii în capital social.

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ELEMENTE PRACTICE ÎN ORGANIZAREA ȘI FUNCȚIONAREA FIRMEI MINIERE/

ELEMENTS OF PRACTICE IN MINING COMPANY FOR ORGANIZATION AND OPERATION

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ABSTRACT

The general schematic of a mine is expressed through a flexible structure aimed at the market, production and finance. Almost always, a functional structure of a mine is not in full (ideally) diversified activities that occur quasi-permanently and to be organized and managed. A mining company may increase (may develop), diversifying products and accessing new markets. The phenomenon is contemporary and assists in an explosion of business complexity, in which organizational structures can be increasingly difficult to separate business structures. By modeling the structural organization ensures procedural organization of a mine. Organization structure of a mine is the inside within which management tasks are completed and production. The organizational structure of a mine is a plan of organization which the company is headed, being established lines of authority and communication between departments and managers. To this are added the data and information flowing in the respective lines.

KEYWORDS

mining company, organizational structure, structural organization, procedural organization modeling.

1. Elemente de practica organizarii structurale a unei întreprinderi miniere

Managerii se află în fruntea unei organizaţii/ a unei întreprinderi miniere.

Orice organizaţie/ întreprindere minieră este un tip de sistem, care reprezintă un ansamblu de unităţi (abstracte sau concrete) legate între ele.

Funcţiunea reprezintă ansamblu de activităţi, omogene şi/sau complementare, desfăşurate de personal specializat, prin folosirea metodelor şi tehnicilor specifice, în scopul realizării obiectivelor.[8]

Funcţiunile unei întreprinderi miniere sunt: *a)* cercetare-dezvoltare, *b)* producţie, *c)* comercială, *d)* financiar-contabilă si e) de personal.

Activitatea unei întreprinderi miniere reprezintă ansamblul de atribuţii omogene care se îndeplinesc de personalul specializat, în domenii mai restrânse.

Atribuţia unei întreprinderi miniere presupune un nivel mai mare de detaliere şi reprezintă ansamblul sarcinilor executate periodic de personal specializat, în domeniu restrâns.

Sarcina unei întreprinderi miniere este componenta elementară a unui proces de muncă complex sau simplu, desfăşurat cu scopul realizării scopului individual şi care se atribuie unei persoane.

Organizarea procesuală a unei întreprinderi miniere trebuie să pornească de la sistemul de obiective ale firmei care reprezintă caracteristicile cantitative şi calitative ale scopurilor urmărite.

Caracteristicile manierei de conducere (a managementului) unei întreprinderi miniere sunt determinate de: *1)* componenţă (oameni, utilaje, materiale, bani); *2)* structură; *3)* comunicare; *4)* control. [8]

Organizarea structurală a unei întreprinderi miniere reprezintă gruparea funcţiilor, atribuţiilor şi salariilor, în raport cu anumite criterii, şi repartizarea acestora pe grupuri de angajaţi pentru executare.

Compartimentele, serviciile, sectoarele, secţiile, diviziile, birourile ş.a. reprezintă produsul organizării structurale ale unei întreprinderi miniere.

Prin organizarea structurală se asigură modelarea organizării procesuale a unei întreprinderi miniere.

Structura organizării a unei întreprinderi miniere este cadrul în interiorul în interiorul căruia sunt realizate sarcinile de conducere şi producţie.

Structura organizatorică a unei întreprinderi miniere este un plan al organizării prin care firma este condusă, fiind instituite linii de autoritate şi comunicaţii între compartimente şi manageri. La acestea se adaugă datele şi informaţiile care circulă prin liniile respective. [8]

Structura organizatorică a unei întreprinderi miniere are două structuri:

- cea de conducere şi
- cea de producţie.

Elementele principale componente ale structurii organizatorice a unei întreprinderi miniere sunt:

Postul reprezintă un grup de obiective, sarcini, competenţe şi responsabilităţi ce revin spre execuţie unui singur angajat. Raţionalitatea unui post este evidenţiată prin corelaţia "sarcini – competenţe – responsabilităţi pentru îndeplinirea obiectivelor individuale" (triunghiul de aur al organizării) (fig. 1).

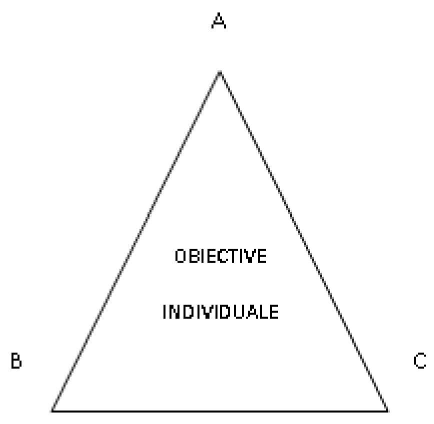

Figura. 1 – Triunghiul de aur al organizării

AB = responsabilităţi; BC = sarcini; CA = competenţe

Funcţia este desemnată de totalitatea posturilor unei întreprinderi miniere care sunt caracterizate de aceleaşi trăsături principale. Funcţia poate fi *a)* de conducere şi *b)* de execuţie.

Ponderea ierarhică desemnează numărul de angajaţi (persoane) ai unei întreprinderi miniere conduse (coordonate) nemijlocit de un manager.

Compartimentul reprezintă ansamblul persoanelor care prestează munci omogene sau complementare, de regulă pe acelaşi amplasament.

Nivelul ierarhic este compus din totalitatea subdiviziunilor organizatorice (posturi, compartimente) stabilite prin reglementări oficiale.

Relaţiile organizaţionale ale unei întreprinderi miniere pot fi de autoritate, de cooperare şi de control. [8]

Variabilele organizaţionale sunt factori interni şi externi firmei care îi condiţionează într-o anumită măsură caracteristicile organizării.

Organigrama unei întreprinderi miniere este reprezentarea grafică a structurii organizatorice. Dreptunghiurile reprezentând posturi şi compartimente legate prin linii desemnează raporturile ierarhice şi funcţionale între componentele structurii organizatorice. [8]

Regulamentul de organizare şi funcţionare al unei întreprinderi miniere este o redare cu următorul conţinut:

- în prima parte sunt inserate date privind baza legală a constituirii şi funcţionării firmei;

- se realizează o prezentare succintă a obiectului de activitate;

- se include organigrama generală a firmei;

- sunt relatate în continuare principalele caracteristici organizaţionale (obiective, sarcini, competenţe, responsabilităţi);

- se prezintă în detaliu compartimentele firmei, funcţiile şi posturile.

Descrierea postului (fişa postului) cuprinde: *1)* denumirea postului, *2)* obiectivele individuale, *3)* sarcinile, *4)* competenţele, *5)* responsabilităţile, *6)* relaţiile postului cu alte posturi, *7)* cerinţe specifice ale postului (calităţi, aptitudini, cunoştinţe ş.a.). [8]

Structura organizatorică a unei întreprinderi miniere se clasifică în:

- *structură ierarhică (liniară).* Are un număr redus de compartimente. Fiecare persoană este subordonată unui singur manager (şef);

- *structura funcţională*. Titularii posturilor de execuţie primesc decizii atât din partea managerilor ierarhici direcţi, cât şi de la compartimentele funcţionale, prin dubla subordonare;

- *structura ierarhică – funcţională* reprezintă o combinaţie între elementele organizatorice descrise anterior.

Realizarea unei structuri organizatorice într-o întreprindere minieră are în vedere aplicaţii ce rezultă din conţinutul unor principii precum:

- conducerea participativă, colectivă;

- supremaţia scopurilor;

- unitatea de decizie şi acţiune;

- apropierea conducerii de execuţie;

- interdependenţa minimă;

- economia de comunicaţii;

- armonizarea posturilor şi a funcţiilor;

- concordanţa cerinţei postului cu calităţile titularului;

- flexibilitate;

- eficienţa structurii;

- varianta structurală optimă.

2.Principii de formalizare a structurii organizatorice a unei întreprinderi miniere

Sistematizarea bazelor de formalizare a structurii organizatorice a unei întreprinderi miniere se referă la [8]:

1) Principiul diviziunii activităţii firmei;

2) Principiul suprematiei obiectivelor si unitatii de actiune;

3) Principiul unităţii de decizie şi acţiune;

4) Principiul apropierii conducerii de executie;

5) Principiul interdependentei minime;

6) Principiul permanentei conducerii;

7) Principiul economiei de comunicatii;

8) Principiul concordantei cerintelor postului cu caracteristicile titularului;

9) Principiul eficientei structurii;

10) Principiul flexibilitatii structurii;

11) Principiul variantei optime;

12) Principiul reprezentării structurii.

Structura organizatorică reprezintă legăturile existente într-o întreprindere minieră (întreprindere, asociaţie ş.a.), care constituie infrastructură pentru circulaţie şi aplicaţie regulilor, normelor şi procedurilor ce stau la baza previzionării conducerii şi controlului. [8]

Definiţia generalizată a structurii organizatorice a unei întreprinderi miniere derivă din formulări diferite, dintre care se amintesc:

- coordonarea planificată a activităţilor unui număr de persoane pentru atingerea unui obiectiv comun, munca şi funcţiunile fiind împărţite, iar autoritatea şi responsabilitatea ierarhizate *(E. Schein);* [8]

- schemă a etajelor ierarhizate şi de comunicare între diverse niveluri şi administratori, în cadrul acestei scheme circulând informaţiile necesare, căutate şi utilizate pentru atingerea unor obiective *(A.D. Chandler);* [8]

- un mijloc de diviziune a muncii, între sarcini şi coordonarea lor *(H. Mintzberg);* [8]

- descriere a raporturilor dintre servicii şi a legăturilor ierarhice între administratori de pe diferite niveluri (*I.A. Krier*); [8]

- schemă de repartizare a sarcinilor şi responsabilităţilor în interiorul firmei *(G. Predaglio).* [8]

Structura organizatorica a unei întreprinderi miniere este formată dintr-un sistem coerent de elemente materiale (unităţi, amenajări, depozite, căi de acces, echipamente, utilaje) şi nemateriale (factorul uman, relaţiile dintre angajaţi), alcătuit pe baza unor principii, norme prin care se creează cadrul activităţii economice în condiţii de raţiune şi eficienţă.

Structura organizatorica a unei întreprinderi miniere de ansamblu a unei firme cuprinde doua parti:

- *structura de conducere*, sau functionala, care este ansamblul persoanelor si compartimentelor si relatiilor dintre ele, astfel constituite si ordonate incat sa asigure conditiile economice, tehnice si de personal necesare desfasurarii proceselor de conducere si de executie.

- *structura de productie*, sau operativa, care este alcatuita din ansamblul persoanelor, compartimentelor si relatiilor organizatorice prin care se asigura realizarea directa a produselor si/sau serviciilor care constituie obiectul specific de activitate al organizatiei.

Structura organizatorică a unei întreprinderi miniere descrie:

a) formula de conducere sau funcţională şi

b) formula de producţie sau operaţională.

Părţile componente ale structurii organizatorice sunt: postul, funcţia, compartimentul, relaţiile ocazionale, nivelul ierarhic, ponderea ierarhică.

Proiectarea structurii organizatorice a unei întreprinderi miniere se bazează pe aplicaţia decizională a unor principii:

- principiul *obiectivului* (concentrarea pe un scop, ţel, obiectiv);
- principiul *specializării* (folosirea personalului şi a infrastructurii specia-lizate);
- principiul *combinat* (focalizarea specializată pe un obiectiv).

Diagrama organizaţională a unei întreprinderi miniere este schema care reglementează cooperarea şi controlul în cadrul unei firme, vizând sarcini, responsabilităţi, autoritate ş.a.

Constituirea diagramei organizaţionale se bazează pe caracteristica funcţionalităţii (respectiv, un angajat are mai mulţi superiori) şi pe caracteristica liniarităţii (un angajat are un singur superior).

Nivelurile ierarhice ale unei întreprinderi miniere reprezintă etaje în cadrul diagramei organizaţionale, cărora le sunt alocate sarcini, responsabilităţi, autoritate şi restricţii.

Distribuţia activităţilor pe niveluri este:

- strategică (ideea de bază şi obiectivele firmei, investiţii, informatizare, coordonarea între funcţiuni);
- tactică (buget şi planificare, conducerea unei funcţiuni pe orizontală);
- operaţională (cadrul decizional deja trasat, acţiuni pe termene imediate şi scurte);
- executivă (sarcini individuale).

Transpunerea practică a proiectelor şi coordonarea funcţionării sistemului productiv economic al unei întreprinderi miniere se regăsesc în *linia operatorie* a structurii manageriale.

Cea de-a doua linie de acţiune este pentru *concepţie*, prin iniţierea şi elaborarea proiectelor de organizare.

Managementul unei întreprinderi miniere asigură, prin organizarea de ansamblu a întregului sistem, condiţii necesare desfăşurării normale a activităţii în fiecare loc de muncă.

Proiectarea structurii manageriale a unei întreprinderi miniere se bazează pe *funcţiunile unităţii economice* şi anume [8]:

- funcţiunea comercială;
- funcţiunea de producţie;
- funcţiune financiar-contabilă;
- funcţiunea de cercetare-dezvoltare;
- funcţiunea de resurse umane.

Structura unei întreprinderi miniere cuprinde *organismele* prin care se exercită funcţiunile de mai sus, integrate într-un sistem optimizabil. Organismele acţionează prin intermediul *oamenilor*, între care se nasc relaţii sociale de producţie.

Structura unei întreprinderi miniere se conturează pe orizontală (nivel managerial distinct) şi pe verticală (subordonare ierarhică). Fiecare etaj al întreprinderii se caracterizează prin funcţiunile sale proprii şi nivelul ierarhic la care se situează.

Relaţii sociale de producţie ale unei întreprinderi miniere pot fi:

• relaţii de *conducere operativă* (B primeşte dispoziţii numai de la A faţă de care răspunde);

• relaţii de *participare la conducere* (B este membru cu drept de vot în consiliul de administraţie);

• relaţii de *conducere funcţională* (B primeşte dispoziţii de la A cu privire la o problemă de specialitate, faţă de care răspunde);

• relaţii de avizare;

• relaţii de *îndrumare tehnică*, de informare, de cooperare etc.

Structura unităţilor operative pleacă de la un loc de muncă atelier, raion, perimetru, sector, ş.a.

Structura unităţilor funcţionale se diferenţiază calitativ prin: post (funcţionar), birou, divizie, compartiment, direcţie, serviciu ş.a.

Efectele structurii se regăsesc în managementul propriu-zis al unei întreprinderi miniere. Acesta se desfăşoară sub trei aspecte:

• management liniar;

• management funcţional;

• management mixt.

Structura managerială a unei întreprinderi miniere derivă şi din [8]:

• analiza deficienţelor constatate (paralelisme între compartimente, niveluri ierarhice numeroase, lipsa de coordonare între compartimente, fărâmiţarea funcţiunilor, neglijarea unor sarcini neechilibrate, precizări incomplete de atribuţii şi influenţe schimbarea activităţii s.a.);

• precizarea obiectivelor urmărite frecvent. Într-un astfel de caz are loc schimbarea structurii producţiei prin concentrare (comasare) sau specializare – în sectoare noi, specializate;

• *transformarea unor subunităţi descentralizate* (cum sunt transporturile, atelierele, bazele de aprovizionare ş.a);

• proiectarea variantelor care cuprinde:

- proiectarea managementului operativ;
- proiectarea managementului funcţional;
- elaborarea unui regulament de funcţionare;
- formularea organigramei;
- întocmirea schemei de resurse umane.

În principiu, se urmăreşte definirea completă a fiecărui domeniu ce ţine de: activităţi, competenţe, relaţii, responsabilităţi, autoritate, delegări.

Pe baza analizelor complete se alege varianta cu cele mai mari avantaje.

Modelul schematic general al unei întreprinderi miniere se exprimă printr-o structură flexibilă ce vizează piaţa, producţia şi finanţele.

Aproape întotdeauna, o structură funcţională a unei întreprinderi miniere nu corespunde în totalitate (ideal) activităţilor diversificate ce apar cvasi-permanent şi care trebuie organizate şi conduse.

O întreprindere minieră poate creşte (se poate dezvolta), diversificând produsele şi accesând pieţe noi. Fenomenul este contemporan şi se asistă la o adevărată explozie a complexităţii afacerilor, situaţie în care structurile organizatorice pot fi tot mai greu separate de structurile afacerilor.

4. Concluzii

Proiectarea si perfectionarea structurii organizatorice este in stransa legatura cu restructurarea sistemului informational al unei întreprinderi miniere.

Structura organizatorica a unei întreprinderi miniere determina orientarea fluxurilor informationale in legatura cu sarcinile si competentele diferitelor posturi, pe niveluri ierarhice.

Sistematizarea principalelor principii care stau la baza proiectarii structurilor organizatorice a unei întreprinderi miniere sunt urmatoarele:

a) *Principiul obiectivelor:* Organizarea în ansamblu a unei întreprinderi miniere şi fiecare componentă a acesteia trebuie să servească realizării sistemului de obiective stabilit.

b) *Principiul specializării:* In cadrul unei întreprinderi miniere procesele de muncă trebuie să fie pe cât posibil restrânse, pentru a contribui la formalizarea practica a unei singure funcţii, respectiv a celei de conducere sau a celei de execuţie.

c) *Principiul coordonării:* Scopul specific al organizării structurale a unei întreprinderi miniere este de a facilita coordonarea şi a realiza unitatea eforturilor membrilor entitatii, deopotriva manageri si executanti.

d) *Principiul autorităţii:* Orice persoana/angajat, grup sau compartiment se subordonează unei autorităţi, care permite trasarea unei linii precise a autorităţii pentru fiecare componentă a structurii organizatorice in cadrul firmei.

e) *Principiul definirii:* In conţinutul fiecărui post, atribuţiile, sarcinile, autoritatea şi responsabilitatea, respectiv relaţiile cu alte posturi trebuie precis formulate în scris şi aduse la cunoştinţa titularului (manager/executat).

f) *Principiul corespondenţei*: Fiecare post trebuie să reflecte concordanţa între sarcini, autoritate şi responsabilitate.

g) *Principiul limitei de control*: O persoană poate să controleze un numar limitat de alte persoane aflate în relaţii de interdependenţă.

h) *Principiul echilibrului:* Componentele structurii organizatorice in cadrul firmei trebuie proiectate şi menţinute în echilibru.

i) *Principiul continuităţii:* Reorganizarea trebuie sa fie un proces continuu, prin care se asigură adaptarea firmei la cerinţele mediului extern.

Principalele tipuri de structuri organizatorice in firme sunt:

a) *Ierarhică.* Se aplica in firme mici cu un grad redus de dotare tehnică. Are urmatoarele trasaturi: număr redus de compartimente cu caracter operaţional unde se desfăşoară principalele activităţi; fiecare persoană este subordonată unui şef; conducătorul fiecărui compartiment exercită în exclusivitate toate atributele conducerii.

b) *Funcţională.* Se aplica in firmele cu variatia marimii gradului de mărime sau de complexitate. Trăsături acestui tip de structura sunt: cuprinde, in egala masura, compartimente operaţionale cât şi funcţionale; conducătorii pot fi specializaţi pe un anumit domeniu, beneficiind de asistenţa compartimentelor funcţionale;executanţii primesc ordine atât de la şefii ierarhici cât şi de la conducătorii compartimentelor funcţionale.

c) *Ierarhic–funcţională.* Se aplica în firmele mari şi mijlocii. Structura cuprinde compartimente funcţionale cât şi operaţionale, iar executanţii primesc decizii şi răspund numai în faţa şefului ierarhic.

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STADIUL ACTUAL ȘI TENDINȚE ÎN APLICAREA SISTEMELOR GIS/GPS ÎN MINERIT

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ABSTRACT

Această lucrare prezintă stadiul actual şi perspectivele aplicării tehnologiilor GIS/GPS în minerit, ca cel mai important adjuvant tehnologic recent intrat în sfera activităţii minere, fiind de natură să confere un spor de productivitate, eficienţă, siguranţă şi performanţă acestei ramuri industriale. În afară de aceasta se impun cu tot mai multă fermitate cerinţe de protecţie a mediului, care impun acţiuni şi costuri suplimentare atât în faza de exploatare cât şi mai ales după încetarea activităţii miniere.

Nevoia de competitivitate economică a companiilor minere, impune de asemenea, în mod obligatoriu măsuri de eficientizare a tehnologiilor de exploatare şi o atenţie deosebită pentru conducerea proceselor de producţie în vederea reducerii costurilor.

Acest deziderat impune şi pretinde folosirea celor mai moderne concepte, tehnologii şi utilaje. Acest lucru se pot realiza eficient folosind mijloacele tehnicii moderne actuale, care fac apel inclusiv la sistemele moderne de comunicaţie şi de poziţionare prin satelit.

Datorită specificului său, activitatea din industria minieră prezintă un caracter conservator datorită amplorii proceselor şi costurilor tehnologiilor şi utilajelor, urmare a căreia, introducerea progresului tehnic privind aplicarea de tehnici şi tehnologii noi precum şi extinderea tehnologiilor inovative se desfăşoară mai lent şi cu dificultăţi mai mari decât în alte ramuri industriale.

Cu toate acestea, în ultimele două decenii s-au schimbat nu numai paradigmele tehnologice privind raportul intensiv/extensiv în procesul de dezvoltare, de tratare a constrângerilor induse de caracterul limitat al resurselor, consumul de energie, criza forţei de muncă, nevoia de securitate, restricţiile de mediu şi intensitatea de capital, competiţie şi costuri. S-a schimbat mult şi perspectiva privind tendinţele de viitor, extrapolarea liniară a situaţiei actuale nu mai este utilă pentru elaborarea de strategii, nici pilonul exclusiv tehnologic nu mai este suficient.

KEYWORDS

GIS, GPS, sistem informatic, productivitate, eficienţă, minerit

1.Introducere

Industria minieră rămâne şi va fi în continuare un furnizor de bază de materii prime minerale, energetice, metalifere şi nemetalifere. La ora actuală, în marea majoritate a ţărilor cu activitate minieră importantă se pune un accent deosebit pe implementarea progresului ştiinţific şi tehnologic emergent în toate fazele acestei activităţi.

Industria extractivă are ca obiect extragerea substanţelor minerale utile, care servesc ca materii prime pentru industrie. La toate categoriile de substanţe minerale utile, de la cele energetice la cele pentru construcţii, cererea înregistrează o continuă creştere. În ceea ce priveşte substanţele minerale utile metalifere şi energetice fosile, se constată epuizarea în mare măsură a zăcămintelor bogate, ceea ce impune trecerea la exploatarea celor cu conţinuturi mai scăzute, fapt ce are ca rezultat extragerea unui volum mult mai mare de rocă şi ca urmare pretinde costuri şi consumuri mai mari de muncă, energie şi materiale şi produce un impact din ce în ce mai sever asupra mediului.

Toţi aceşti factori restrictivi impun cu necesitate optimizarea proceselor de extracţie şi a fluxului de transport al produsului minier către beneficiari. Extragerea substanţelor minerale utile în cadrul exploatărilor miniere – atât subterane și prin lucrări la zi - se realizează preponderent cu ajutorul maşinilor, utilajelor şi echipamentelor miniere. Procesul tehnologic presupune un număr impus de operaţii unitare şi anume: tăierea (derocarea, excavarea, dislocarea) substanţelor minerale utile, încărcarea şi transportul materialului (masei miniere), susţinerea (respectiv asigurarea taluzurilor) urmate de preparare –sortare – depozitare-livrare.

SISTEMELE INFORMATICE GEOGRAFICE, cu toate componentele lor aplicative: sistem de poziţionare, sistem orientare şi sistem de navigaţie au pătruns în ultimul timp în multe domenii cum ar fi: energetica, transporturile, ingineria mediului, apărare etc. şi încep a fi utilizate şi în minerit. Capacitatea acestor sisteme de a colecta, stoca, prelucra şi utiliza informaţii de natură deopotrivă spaţială şi nespaţială a făcut posibilă în ultimii ani aplicarea lor şi în domeniul ingineriei resurselor minerale.

Identificarea, evaluarea, localizarea şi referenţierea acestor resurse în faza preliminară de prospecţiune şi explorare, precum şi în fazele ulterioare de extragere şi valorificare precum şi în cea finală de refacere a zonelor afectate necesită colectarea, stocarea, prelucrarea, gestionarea şi utilizarea unor cantităţi şi varietăţi enorme de date.

Din acest motiv, în ultimii ani s-a înregistrat un progres continuu de implementare în industria extractivă a sistemelor informatice geografice.

Majoritatea aplicaţiilor existente şi preconizate se referă în special la domeniul cadastrului geologic şi minier şi mai puţin la conducerea şi gestionarea procesului propriu-zis de extragere şi la urmărirea funcţionării respectiv conducerea infrastructurii tehnologice.

Există încercări şi realizări în domeniul controlului şi supravegherii echipamentelor mari, al urmăririi în teren şi a navigaţiei vehiculelor de transport, al dispecerizării şi alocării resurselor tehnologice, acestea însă sunt realizări punctuale şi nu integrate într-un sistem global de geomatică.

Există de asemenea încercări de predicţie a variaţiei proprietăţilor geologo-miniere ale zăcământului şi de utilizare a datelor georeferenţiate pentru optimizarea funcţională şi energetică a echipamentelor.

În afară de volumul imens din punct de vedere cantitativ şi tipologic al datelor necesar a fi gestionate, care poate conduce la sub- sau supra-dimensionarea resurselor hardware şi software implicate, utilitatea folosirii eficiente acestui instrument modern este grevată de lipsa unor cercetări integrative în domeniu.

În România, deocamdată, principala zonă de interes se localizează în exploatările miniere de lignit la zi şi carierele de zăcăminte metalifere sau materiale de construcţii. Din cele arătate se poate concluziona că tema propusă este actuală atât ca domeniu de aplicabilitate cât şi ca pretext pentru avansarea cunoaşterii în domeniu.

În acest context, cunoaşterea stadiului actual pe plan mondial şi în ţară al utilizării SIG în minerit este esenţială pentru direcţionarea viitoare a cercetărilor.

2.Stadiul actual privind evoluţia Sistemelor Informatice Geografice

Reprezentările actuale moderne cu caracter geografic sau adaptat cerinţelor actuale în continuă diversificare şi dinamicii performanţelor instrumentelor hardware şi software, oferind mijloace moderne culegerii, stocării, procesării şi valorificării volumului imens de date şi numărului mereu crescut de utilizatori, diversificari atât ca preocupări cât şi ca cerinţe.

În acest context, etapa cea mai laborioasă şi costisioare a unui GIS, (cifrat la cca. 70 % din costuri) îl reprezintă culegerea primară a datelor de pe teren. Tehnologiile spaţiale sunt foarte eficiente dar sunt costisitoare necesitând investiţiile mari dar informaţiile culese din spaţiu trebuie confruntate şi completate cu date culese de pe teren.

Toate aceste informaţii sunt reunite şi închegate în Geographic Information Systems (GIS) cunoscut şi sub denumire Sistemele Informatice Geografice (SIG) şi prescurtat SIG / GIS sau mai nou Geomatică (Geomatics). Termenul generic *Geographic Information Systems (GIS) este tot mai frecvent folosit în lume şi este considerat „acrominul din limba engleză a Sistemelor Informatice Geografice a apărut în SUA (Geographic Information Systems), Marea Britanie, Australia, Canada (Geographic Information Systems) şi Geographic Information Science (componenta fundamentului științific)”* (Săvulescu şi colab., 2000) termen care datează de mai bine de 50 de ani al cărui conţinut însă a evoluat şi s-a diversificat de-a lungul timpului.

O altă terminologie care are aproximativ aceeaşi semnificaţie, utilizată preferenţial în diferite țări este următoarea: (*Buku Ajar. 2009*)

• *Geographical Information System*, este terminologia utilizată în Europa;

• *Geomatique*, terminologie folosită în Franța și Canada francofonă;

• *Georelational Information System*, terminologie referitoare la tehnologie;

• *Natural Resources Information System*, terminologia utilizată în domeniul Managementului resurselor naturale;

• *Spatial Information System*, terminologia referitoare la culegerea datelor prin tehnologii spațiale sau referitoare la localizare geografică;

• *Multipurpose Geographic Data System*, terminologie comună sau generală care subliniază diversitatea câmpului de aplicații.

Sistemele Informatice geografice pot fi încadrate într-o sferă mai largă, pe baza caracteristicii lor principale determinată de modul privind *„tratarea informaţiei ţinând cont de localizarea sau amplasarea ei spaţială, geografică, în teritoriu, prin coordonate”.(Florin Petrescu 2007)*

Desprindem din cele arătate două tendințe constante cu accentuare continuă a impactului lor: impactul noilor tehnologii spațiale care au ieșit din conul de umbră al secretomaniei, devenind tehnologii de utilitate comună și diversificarea continuă, aproape în avalanșă a domeniilor de aplicație.

Astfel, tehnologiile spaţiale furnizează abordări integrative pentru îndeplinirea cerinţei actuale din toate domeniile pentru „a face mai mult cu mai puţin”. Printre aplicațiile cele mai noi amintim pe cele din domeniul Economiei spațiale (teoria localizării) care servesc optimizarea *„investiţilor privind dezvoltarea forţei de muncă, a tehnologiie, a resurslor financiare, a colaborării, comunicării, a analizei surselor de informaţii (accesibilitate, securitate, persistenţă, fiabilitate, confidenţialitate). Putem spune în esenţă că tehnologia geospaţială „este privită ca o componentă de bază în gestionarea informaţiilor din dorinţa de a oferi soluţii rapide cu resurse financiare reduse”. Acest domeniu al „ tehnologiilor geospaţiale se află la un punct de cotitură în evoluţia sa, prezentând o oportunitate de a regândi implementarea şi utilizarea acestor resurse pentru a îmbunătăţi capacitatea noastră de a rezolva rapid și cu costuri reduse probleme pe baza informaţiilor geografice*". (FGDC,2013)

Se remarcă în cele arătate în ultimele paragrafe că deși investiția inițială în sistemele geospațiale este relativ ridicată, avantajul rapidității și economiei de efort compensează aceasta, și în final beneficiul net total este semnificativ. Deși oarecum mercantiliste, referințele citate sunt utile pentru orientarea viitoare a cercetărilor, întrucât se pare că în ultimul timp știința ca exercițiu euristic este umbrită de știința care produce efecte financiare prin aplicațiile în tehnologia care devine bun vandabil.

În prezent există mai multe definiţii ale Sistemelor Informatice Geografice, în continuare redăm câteva dintre cele mai relevante existente în literatura de specialitate de diverşi autori :

- *Borrough (1986)* [menţionată în Săvulescu şi colb.,2000 – fundamente GIS] consideră GIS ca *„un set de instrumente pentru culegerea, stocarea, transformarea, analiza şi vizualizarea datelor spaţiale ale lumii reale*".

- *A.M. Imbroane şi D. Moore* definesc Sistemul Informatic Geografic ca fiind *„un sistem de calcul (hardware), un sistem de programe (software), şi date geografice, care permit captarea, stocarea, integrarea, manipularea, analiza şi vizualizarea datelor care au referinţă spaţială*". *(A. M. Imbroane, D. Moore, 1999)*

-*M. Băduţ* enunţă o definiţie concretă a Sistemul Informatic Geografic ca fiind *„un sistem organizat pe baza tehnicii de calcul – adică un ansamblu coerent constituit din echipamente de calcul (hardware), programe (software), informaţii, persoane, reguli şi metode de lucru – care permit conceperea, definirea, construirea şi exploatarea unei hărţi geo – topografice asociate cu informaţii descriptive cu repartiţie teritorială". (M.Băduţ, 2007)*

-*G. Dumitru* consideră Sistemul Informatic Geografic ca fiind *„sistemul informatic care cuplează o bază de date care operează cu obiecte geometrice (spaţială) cu o bază de date care operează cu atribute ale informaţiei conţinută în prima bază de date".(G. Dumitru, 2007)*

- *Aranoff (1989:39)* consideră că GIS este definit ca *„ un sistem bazat pe calculator, care oferă următoarele patru seturi de capacităţi pentru a folosi datele georeferenţiate: 1) deculegere; 2) de gestionare a datelor (stocare şi regăsire); 3) manipulare şi analiză şi 4) de ieşire - vizualizare".*

- Chrisman (1999) defineşte GIS ca activităţi organizate care :

• măsoară aspecte ale fenomenelor şi proceselor geografice;

• reprezintă măsurători, de obicei sub forma unei baze de datepe calculator, pentru a stoca date spaţiale, entităţi, atribute ale acestora şi relaţii între ele;

• operează asupra acestor reprezentări pentru a produce mai multe informații și a descoperi noi relații, prin integrarea unor surse diferite;

• şi transformă aceste reprezentări în mod adecvat utilizării lor.

-Goodchild (2010) consideră că GIS este o ştiinţă şi acest lucru este subliniat prin două definiţii: o definiţie relativ succintă adoptată de Consorţiul Universitar pentru Geographic Information Science *„Dezvoltarea şi utilizarea de teorii, metode, tehnologii, şi date pentru a înţelege procesele geografice, relaţii şi modele"*, și definiția GIS ca știință considerat a fi *„Domeniu cercetării de bază care urmăreşte să redefinească conceptele geografice şi utilizarea lor în cadrul sistemelor informaţionale geografice*".

Analizând perspectivele variate a numeroaselor definiţii existente în literatura de specialitate enumerate mai sus remarcăm faptul că se regăsesc importante elemente cheie cum ar fi : date, informaţii spaţiale, geografic, sisteme de programe, sisteme de calcul, tehnologie, o metodologie, profesie.

Din multitudinea și diversitatea definiţiilor existente în literatura de specialitate, enumerate mai sus privind Sistemul informatic geografic (SIG) sau Geografic Information Systems (GIS) se observă că acest termen poate avea conotaţii diferite și de aceea este considerat şi înţeles de diverşii autori în moduri diferite:

• prima diviziune este între cei care consideră GIS ca *„un instrument*", *„set de instrumente*", *„instrumente perfectibile*" şi cei care îl privesc ca fiind *„o ştiinţă*" (Bănică S şi colab 2008, *Goodchild (2010)*, (*Săvulescu* şi colab., 2000));

• o altă diviziune se referă la abordarea din perspectiva utilității datelor-predictivă sau explicativă;

• şi în cele din urmă o diviziune din punct de vedere al nivelului sistematizării (*Chrisman 1999*).

Disputa filozofică și epistemologică continuă, literatura de specialitate este invadată de lucrări sectare sau împăciuitoriste, dar certitudinea prezenței pe piață a sistemelor GIS cu aplicabilitate în diverse domenii este o confirmare a faptului că necesitatea este imperioasă, și ca in multe alte domenii dezbaterile savante academice devin la un moment dat sterile și tehnologia cucereste teren până când va cere la rândul ei o cale de iesire tot de la mediul științific.

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3. Dezvoltarea şi Evoluţia Tehnologiei Sistemelor Informatice Geografice

Utilizarea tehnologiilor informatice geografice a suferit numeroase transformări datorită progresului, evoluţiei şi transformărilor pozitive ale tehnicii de calcul, cuantificată generic în parametrii ca viteză de prelucrare, capacitate de stocare a datelor și informaţiilor, costuri in scădere ale echipamentelor şi programelor care au permis în timp utilizarea informaţiilor geografice şi în industria minieră.

Epoca actuală beneficiază de realizări şi progrese tehnologice deosebite în tehnologia spaţială ca instrumente de culegere a datelor, o deosebită importanţă în acest sens având şi evoluţia din domeniul tehnicii de calcul. Progresele în aceste domenii sunt uriaşe şi au oferit noi facilităţi şi proceduri care au revoluţionat în primul rând activitatea de reprezentare şi cunoaştere a datelor spaţiale.

Pornind de la informaţii geografice complexe sub diferite forme în coordonate tridimensionale sistemele GIS colectează, prelucrează, acumulează şi pune la dispoziţia celor interesaţi informaţii detaliate şi exacte despre caracteristicile entităţilor referenţiate geografic.

Aceste informaţii constituie suportul pentru proceduri şi algoritmi de conducere operativă şi de optimizare a activităţii în toate fazele lor de desfăşurare. Cunoaşterea, descrierea obiectelor geografice, a caracteristicile lor şi mai ales a poziţiilor lor au fost şi sunt în permanenţă în centrul de interes al oamenilor din cele mai vechi timpuri.

Aceste cunoştinţe au fost şi vor fi necesare în cunoaşterea teritoriului, a formei şi dimensiunilor, a localizării elementelor de relief şi ulterior a construcţiilor şi a suprafeţelor amenajate. Metodele de culegere a datelor şi prelucrare şi de reprezentare a lor au evoluat în timp în conformitate cu posibilităţile tehnologice ale momentului respectiv.

Bartelme face o incursiune privind evoluţia GIS de la începuturi până în prezent şi stabileşte două mari etape : GIS clasic şi GIS modern. *(Bartleme 2012)*, sintetizate astfel:

• un sistem informatic, în sensul clasic *„constă dintr-o bază de date reprezentând miezul interior al sistemului, care este gestionat de un sistem de management de baze de date (DBMS), precum şi de un înveliş exterior de instrumente care pot fi utilizate de către utilizator pentru manipularea şi analiza acestor date*".

• GIS modern care funcţionează pe o structură client-sever permiţând lucru unui număr mare de utilizatori (care cer şi introduc informaţii) *„Configurarea tradiţională a unui GIS a fost modificată în mai multe moduri, ca urmare a apariției de noi tehnologii şi concepte. Internetul, oferind instrumente, şi aplicaţii WEB a influenţat foarte mult şi a modificat întreaga arenă a IT. Al doilea impuls a fost iniţiat de tehnologia mobilă şi miniaturizarea componentelor hardware.*

Prin urmare, paradigmele de GIS s-au schimbat, iar arhitectura unui GIS în zilele noastre este destul de diferită de ceea ce a fost în urmă cu câţiva ani.

• *Datele nu mai sunt limitate la domeniul principal de interes şi de control al utilizatorulu, ele pot fi în principiu, importate de pretutindeni, oricând, precum şi pe orice dispozitiv. Vorbim despre informaţii geografice /geospaţiale omniprezente ca disponibilitate pe dispozitivele mobile, cum ar fi telefoanele mobile, cum ar fi hărţi, imagini din satelit, informații de poziţionare, servicii de rutare, şi chiar simulări 3D care câştigă un segment tot mai mare pe piaţa de consum.*

• *De asemenea, spre deosebire de perioadele anterioare, când un GIS consta dintr-o combinaţie bine echilibrată de hardware, software, şi surse de date, astăzi frontierele între funcţionalitatea unui browser obişnuit de Internet şi funcţionalitatea unui GIS profesional sunt din ce în ce mai greu de trasat.*

O altă abordare privind dezvoltarea tehnologiei GIS este cea a lui [1]*Barry* care consideră că tehnologia GIS, în evoluţie sa de-a lungul anilor a suferit numeroase transformări:

1. Cartografia asistată de calculator (Computer Mapping , anii 70);
2. Managementul bazelor de date spaţiale (anii 80) ;
3. Analiza spațială a hărților / modele (anii 90);
4. Cartografiere multimedia (Multimedia Mapping ,anii 2010);

3.1. Proiectarea sau cartografierea asistată pe calculator (Computer Mapping anii 70).

Datează de la începutul anilor 1970, când utilizarea GIS este văzută ca un sistem de proiectare/cartografiere asistată de calculator în vederea creării de hărţi. Harta sau planul, considerate ca element de reprezentare a datelor geografice constituie elementul de bază al oricărui GIS. Harta este considerată ca fiind componenta cea mai importantă a entităţii spaţiale geodezice, care se stochează în diferite moduri: ca puncte, linii, poligoane, reţele (combinaţie de puncte şi linii) sau suprafeţe (combinaţie de reţele şi altitudini), transpuse pe un display ca pixeli, şi prezentate matematic printr-un set organizat de coordonate (X,Y). Aceste date direcţionează dispozitive de plotare sau printare care pot efectua rapid şi repetat într-o varietate de culori, scări, extensii şi sisteme de proiecţie hărţile digitizate.

În această perioadă considerată de pionierat a GIS s-au definit multe dintre conceptele şi procedurile instituite ale GIS-ul modern. *Berry* menţionează că avantajul tehnologiei de cartografiere asistată de calculator este capacitatea de a schimba o porţiune a unei hărţi şi reformularea rapidă a întregii zone de interes. Actualizările hărţilor, care înainte ar fi putut dura săptămâni, acum se pot efectua în câteva ore.

3.2. Managementul bazelor de date spaţiale (Spatial Database Management anii 80).

Deceniul 8-lea este considerat ca fiind etapa de adolescenţă a GIS şi practic în acestă perioadă dezvoltarea mijloacelor informatice de gestionare a bazelor de date a deschis noi posibilităţi pentru gestionarea elementelor de relief şi a obiectelor asociate hărţilor, oferind noi posibilităţi atât pentru reprezentări grafice cât şi pentru elementele descriptive mult îmbogăţite în conținut și atribute (cantitative și calitative).

Datorită progresul tehnologiilor spaţiale şi a sistemelor de gestiune a bazelor de date se utilizează generalizarea utilizării acestora şi apar cerinţe atât pentru date în format raster cât şi

[1] This chapter is based on http://www.innovativegis.com/basis/mapanalysis/Topic27/Topic27.htm

vectorial. Aria de acoperire a GIS trece de la nivel local şi naţional la nivel global şi se întreprind acţiuni de unificare prin norme a formatului informaţiei a procedurilor.

Creşterea cererii pentru datele cartografiate a concentrat atenţia asupra disponibilității, acurateței și standizării datelor, precum și asupra aspectelor structuralee. Furnizorii de hardware au continuat să-și îmbunătățească echipamentele de digitalizare, permițând trecerea de la tabletele manuale de digitizare la scanere automate și multe alte facilităţi orientate GIS.

O nouă industrie pentru codarea hărțior și proiectare a bazelor de date și-a făcut apariția, ca și o piață pentru vânzările de produse de hărţi digitale. Organizaţiile regionale, naţionale și internaţionale au început să abordeze standardele necesare pentru hățile digitale pentru a asigura compatibilitatea între sisteme.

3.3.Analiza spațială şi modelare cartografică (Anii 90)

Evoluţia GIS a continuat accentul punându-se de la interogarea descriptivă la analiza prescriptivă a hărţilor. Odată cu apariţia sa, tehnologia GIS a dus la înlocuirea mijloacelor tradiţionale care se foloseau în perioadele anterioare, constând în tehnici manuale care trebuie să fie efectuate în mod repetat, cu soluţii matematice.

Dacă elaborarea, corectarea şi multiplicarea hărţilor în format clasic lor pretindea un consum mare de muncă, iar stocarea şi manipularea lor era dificilă tehnologiile informatice au schimbat radical situația.

Apariția acestor noi procedee de cartografiere a dus în plan teoretic la apariția a două noi forme de studii spaţiale: analiza spațială și statistica spaţială.

Matematica spaţială s-a dezvoltat şi a evoluat, harta tematică spaţială oferind noi posibilităţi de prelucrare şi manipulare a valorilor din date spaţiale prin crearea de noi concepte cum ar fi distanţa efectivă, căile optime de rutare, vizualizarea altor atribute ale reliefului, în afară de formă şi structură. Menţionăm că utilizarea *acestor noi instrumente şi abordări de modelare a informaţilor spaţiale combinat* cu sisteme de înregistrare şi de evidenţă şi extins cu modele de luare a deciziilor a revoluționat sistemele de adoptare a deciziilor eficiente.

3.4.Multimedia Mapping (2010s)

Epoca anilor 2010, în care GIS a evoluat în doar trei decenii de la simpla ştiinţă emergentă într-o adevărată țesătură socială care devine din ce în ce mai dependentă de produsele sale, înregistrând o dezvoltare rapidă de aplicaţii care pot fii utilizate pe calculatoare, Smartphone, PDA şi tablete PC. O altă caracteristică a noului mediu de prelucrare este integrarea deplină a sistemului de poziţionare globală şi imagini de teledetectie cu GIS. GPS (GNSS) şi harta digitală aduce poziţionarea geografică la îndemâna oricui. Este clar că tehnologia GIS a schimbat foarte mult perspectiva noastră despre o hartă. Acesta a trecut de la cartografiere de la un rol istoric de furnizor de date de intrare, la un ingredient activ şi esenţial în procesul de luare a deciziilor. Profesioniștii de astăzi sunt provocați să înţeleagă acest nou mediu şi să formuleze aplicaţii inovatoare care satisfac complexitatea nevoilor crescânde ale secolului al XXI-lea.

În plus faţă de schimbările din mediul de prelucrare, harta contemporană are noi forme radicale de a prezenta informaţii spaţiale cum este imaginea 3D a terenului.

Realitatea virtuală poate schimba informaţia în funcţie de modul în care se doreşte a fi prezentat obiectul, până la un realism aproape fotografic.

Hyperlink-urile încorporate pot accesa în timp real fotografii, clipuri video, audio, text şi date asociate cu harta. Imagistica permite utilizatorului în mod interactiv să oferă o imagine de ansamblu a obiectivului studiat evidenţiind atât aspectele de sub nivelul solului cât și cele de la de la înălţime şi posibilitatea de mărirea la scară (zoom) în toate direcţiile pe display.

4D GIS (XYZ şi timp) este următoarea frontieră majoră de dezvoltare viitoare. În prezent, timpul este tratat ca o serie de straturi de hărţi stocate care pot fi efectiv animate pentru a vedea modificările asupra peisajului.

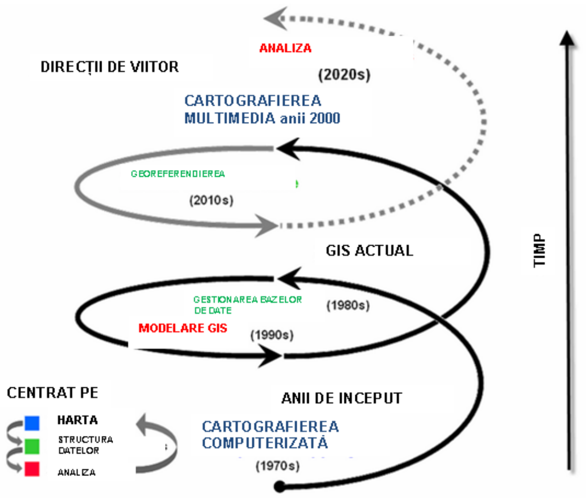


Figura 1. Ciclurile de inovare / dezvoltare ale GIS.

Figura 1 ilustrează o evoluție a GIS mai degrabă ciclică decât liniară, sugerată de perspectiva de 30 de ani a evoluției sale. În anii 1970 cercetarea şi aplicaţiile incipiente erau centrate pe cartografierea computerizată, care au condus ulerior, în următorii zece ani la managementul datelor spaţiale și api la conectarea hărţilor digitale cu atributele din bazele de date apte pentru interogare. Începând cu 1990 GIS a fost centrată pe de modelare (analiză), care a pus bazele unor modalităţi cu totul noi de evaluare a modelelor spaţiale şi a relaţiilor dintre elemente, precum şi la aplicaţii în domenii noi, cum ar fi agricultura şi geografia economică. În zilele noastre, GIS este centrat mai ales pe cartografia multimedia, evoluţie careînchide cercul la un nivel superior. (Barry)

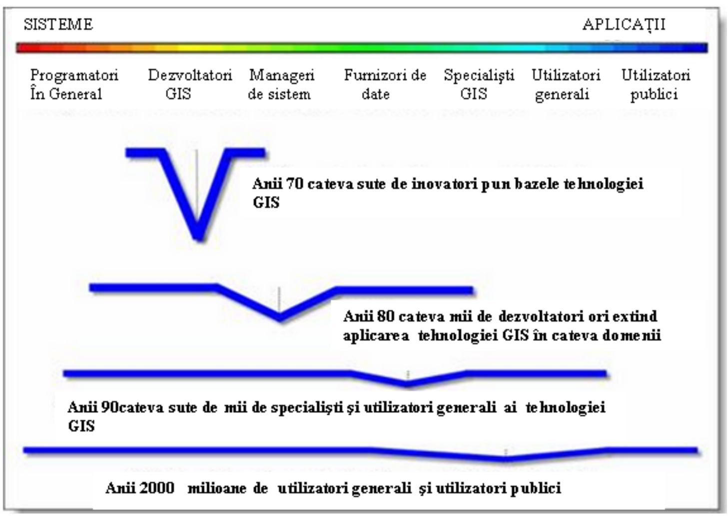


Figura 2. Evoluţia implicării diverselor comunităţi din domeniul tehnologiilor GIS

Impactul dezvoltării tehnologiei GIS asupra comunității de specialiști GIS, de la câteva sute la milioane de utilizatori poate fi urmărită în fig. 3. Devine evident rolul de raționament spațial și comunicare vizuală al GIS. În trecut, modelele analitice s-au concentrat pe gestionarea unor opţiuni optime din punct de vedere tehnic. Însă în realitate, există și un alt set de perspective care trebuiesc considerate, și anume soluţiile social-utile. Această perspectivă utilizează indicatori vagi, ca valori umane, atitudini, convingeri, judecată, încredere şi înţelegere. Acestea nu sunt de obicei indicatori cantitativi care pot fi supuși algoritmizării de calculator şi utilizați în modelele tradiţionale de luare a deciziilor. Pasul de la punctul de vedere al fezabilității tehnice spre opţiunile social acceptabile nu este atât de natură științifică și economică cât de comunicare.

Geomatica. Aplicaţiile generate de tehnologia sistemelor informatice geografice a condus la apariţia unui nou concept sau putem spune disciplină geomatica. Disciplină nouă apărută numită geomatică ce formalizează şi descrie aplicaţiile tehnologice spaţiale, domeniul sau de cuprindere rezultă din semnificaţia cuvintelor ce o compun respectiv *"geo„sugerează ideea de pământ şi de date georeferenţiate iar "matică „ reprezintă prelucrarea automată datelor cu ajutorul tehnici de calcul* .(Badea Gh, Badea A 2013).

4. Aplicarea GIS/GPS diferite faze ale activităţii miniere

Cu toate acestea, în ultimele două decenii s-au schimbat nu numai paradigmele tehnologice privind raportul intensiv/extensiv în procesul de dezvoltare, de tratare a constrângerilor induse de caracterul limitat al resurselor, consumul de energie, criza forţei de muncă, nevoia de securitate, restricţiile de mediu şi intensitatea de capital, competiţie şi costuri. S-a schimbat mult şi perspectiva privind tendinţele de viitor, extrapolarea liniară a situaţiei actuale nu mai este utilă pentru elaborarea de strategii, nici pilonul exclusiv tehnologic nu mai este suficient.

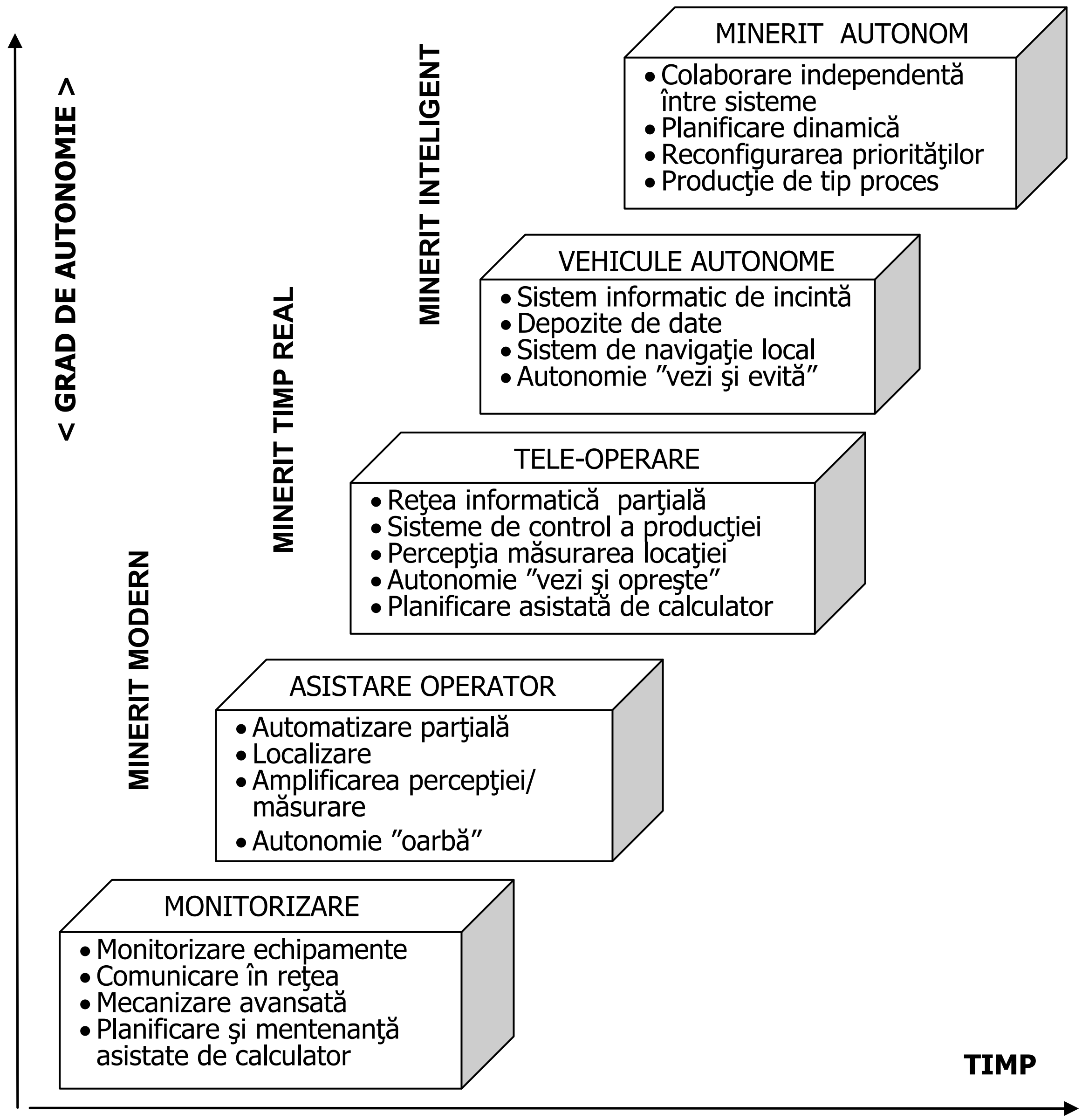
Conform Thompson (2011), la începutul secolului al 21-lea, mineritul a evoluat la ideea de „modern‟, pentru ca apoi să fie agreată sintagma „în timp real‟, şi în ultimul timp se vehiculează atributul „inteligent‟.

Vectorul de progres este reprezentat de variabila "autonomie" , care gradual, transformă mecanizarea simplă în operare autonomă, ceea ce impune accentuarea aspectelor de intercomunicare și de coordonare. Figura 3 arată sugestiv această evoluţie, cu modificările calitative ale diferitelor atribute ale procesului. Realizările actuale în domeniul cunoaşterii ştiinţifice şi al tehnologiilor emergente aplicate în industria minieră, au permis definirea şi materializarea conceptului de exploatare minieră inteligentă. Mină inteligent care gândeşte, execută şi exploatează conform noilor tehnologii cu aportul însemnat al inteligenţei adus de nivelul actual al ştiinţei şi tehnicii.

Aceasta trebuie să înglobeze o mare cantitate de inteligenţă, aplicată în toate fazele de viaţă ale sale: concepţie, execuţie, exploatare, închidere şi post-închidere.

Tehnicile informatice actuale permit accesul rapid la informaţii unui număr mare de utilizatori, independent de distanţele dintre ei şi sursa de proveniență a informaţiei.

Conducerea inteligentă pretinde un volum uriaş de informaţii în prelucrarea şi utilizarea lor într-un timp real prin folosirea mijloacelor moderne prelucrare şi vizualizare a datelor, modelare care utilizează sisteme performante de comunicare, culegere, prelucrare şi valorificare a informaţiilor pentru gestionarea eficientă a activităţilor şi proceselor.



igura. 3. Tendințele de evoluţie ale mineritului

Macfarlane figurează unele perspective privind cât va dura şi va influenţa *„ nivelul de dezvoltare a tehnologie care este adecvat acum, şi în viitor, indicând astfel o strategie pentru cercetare şi dezvoltare pentru mine în domeniul mecanizare şi automatizare "* tabelul 1. Problematica proiectării unei *„ Mine Inteligente "* în industria minieră *în care rezultatul cercetării conduce practic la un proces tehnologic definit pe trei trepte în funcţie de gardul de automatizare a industriei miniere şi care are trebui dezvoltat, acest lucru este menţionat în Figura 4 care prezintă această evoluţie. Ca o remarcă putem argumenta că se încearcă să ofere o viziune asupra identificării tehnologiei de exploatare adecvate aflate la momentul prezent sau respectiv precum şi obiectivele, cerinţele, schimbările tehnologice necesare care impun a fi realizate în industria minieră pentru dezvoltarea în viitor.*

Nivele de dezvoltare şi automatizare			
Nivel	Timp perioada	Etapa de dezvoltare	Tehnologie
0	Curentă	Gata de folosire	Sistem de control al proceselor
1	1- 3 ani	Transfer tehnologiei	Mijloace de mecanizare
2	3-5 ani	Dezvoltare de proces	Procese automate

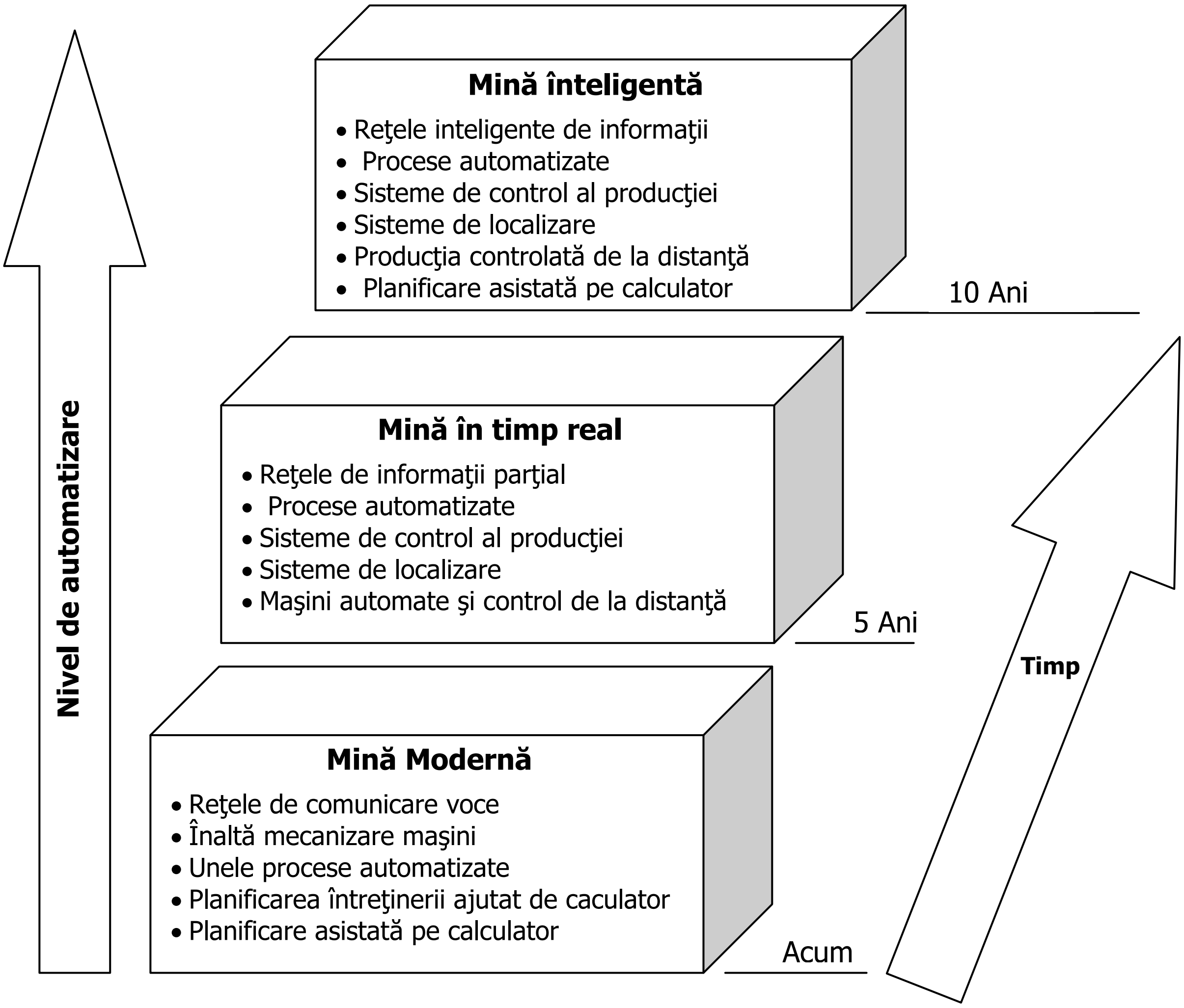


Figura. 4. Evoluţia spre mină inteligent

3	5-7 ani	Cercetare	Telecomanda maşinilor
4	7-10 ani	Concepere	Comandă de la distanţă a producţiei

Tabelul :1. Nivele de dezvoltare şi automatizare

Utilizarea tehnologiei GPS în sectorul minier constituie suportul pentru aplicarea şi generarea de aplicaţii utile şi posibile în industria minieră cum sunt: controlul şi sincronizarea deplasării excavatoarelor şi a mijloacelor de transport precum şi de a monitoriza locaţia echipamentelor, identificarea zonelor ce urmează a fi excavate în adâncime, posibilitatea evaluării în timp real a volumelor excavate, elaborarea de prognoze privind producţia viitoare, precum şi determinarea coordonatele precise care sunt utile în toate fazele unei cariere în lucrările de proiectare, deschidere şi ulterior de exploatare sunt necesare lucrări topografice şi foraj.

Un al doilea aspect este integrarea mai strânsă a operaţiunilor de producţie şi prelucrare a minereului.(Figura 5)

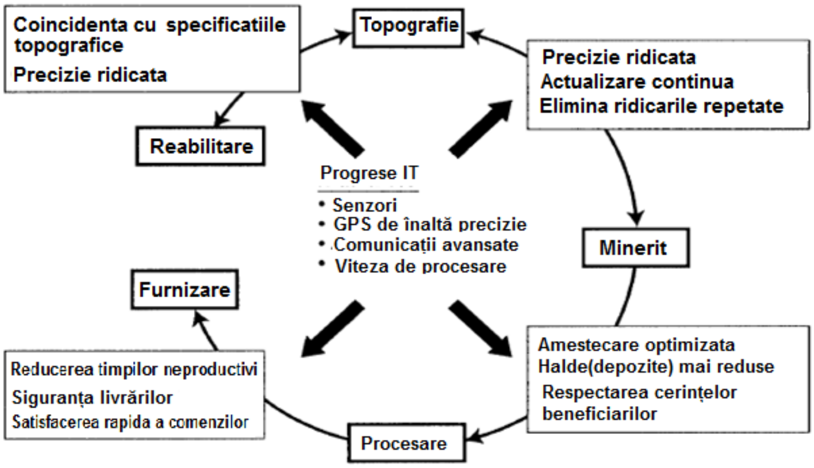


Figura 5—Aplicații TIC in ineri

Pornind de la informaţi geologice, geofizice şi pe baza lor se pot face şi evalua economice finaciare şi chiar contrului managementul costului. Datele cuprinse GIS pot fi extrase şi utilizate în toate instrumentele de analiză şi evidenţă finaciară al resurselor, al utilajelor şi activităţilor.

Estimările de rezerve, producţia planificată anual, statistici sau costul pe tone pot fi legate de sau corelate cu tehnologii geospaţiale complementare, cum ar fi GPS. GIS poate fi aplicat atât pe termen scurt cât şi programarea pe termen lung a ajuta la optimizarea producţiei la operaţiuni.

GIS este utilizat de planificatorii de mine pentru a stabili care este locaţia optimă pentru galerii de exploatare, tăiere sub nivele, ventilaţie puţuri. Pentru serviciu şi sisteme auxiliare, inginerii şi proiectanţii utilizează GIS pentru a găsi calea cu cel mai mic costuri rute de livrare de bunuri la zonele de lucru, şi a găsi cea mai apropiată facilitate, care să stabilească zonele care sunt în raza de lucru, atribui proximitate, modelul inaccesibil în zone şi modelul ventilaţie reţele miniere.

În planificarea producţie, GIS poate ajuta la site şi interogare citat locaţia şi amplasarea infrastructurilor de serviciu în raport cu principale centre de producţie.

Evaluarea conţinutului de minerale utile dintr-o locaţie şi distribuţia lor pe teren constituie o etapă importantă în activitatea minieră. Pentru acesta există programe specializate (Datamine Studio, Vulcan, şi altele) care folosesc algoritm matematic eficient de evaluare. Dar trebuie menţionat şi faptul că aceste valori sunt valori estimative şi apar diferenţe în procesul exploatarii.

4.1 Aplicaţii în minerit folosind tehnologia GIS/GPS

La nivel conceptual, sistemele de navigaţie globală sunt rodul unor viziuni fundamentale capabile care să asigure raţionalizări în contextele care definesc situaţia. Aceste raţionalizării sunt expresii tehnologice ale adaptării umane în şi la mediul lor. Tehnologia în sine a devenit o ubicuitate. Acest domeniu al industriei minere în care introducerea în sectorul minier şi aplicarea de tehnici şi tehnologii noi a fost considerată un pionier faţă de alte domenii de activitate industriale şi un lider în răspândirea aplicării tehnologiei GPS de poziţionare prin satelit în care GPS-ul asigură localizarea în timp real oferind precizii bune (centimetru în timp real) oriunde în lume (în funcţie de utilizator), şi putem spune că este considerat un instrument valoros (singurele diferenţe constând numai în tipul receptorului şi metoda de lucru utilizată), utilizat pe scară largă în activitatea minieră de producţie şi chiar în procesele din operaţiunile minere au scopul de a da un randament şi disponibilitate de producţie crescută de până la 15-30% şi o scădere a costurilor 30-40% , util în toate fazele unei cariere în lucrările de proiectare, deschidere şi ulterior de exploatare, oferind eficienţă, rapiditate şi fiind un mijloc economic, considerată ca o soluţie ideală care este disponibilă în orice moment indiferent de starea vremii având contribuţii în mod semnificativ privind introducerea, dezvoltarea în automatizarea de operaţiuni minere.

CONCLUZII

In lucrare am prezentat **stadiul actual și posibilitățile de extindere a utilizării SISTEMELE INFORMATICE GEOGRAFICE**, în industria minieră.

Am analizat evoluția, dezvoltarea și extinderea aplicațiilor industriale in general ale sistemelor GIS și GPS. Am prezentat și exemplificat componentele aplicative ale acestora: sistem de poziţionare, sistem orientare şi sistem de navigaţie.

Am studiat utiliattea acestor sisteme în diferite domenii de activitate ca: energetica, transporturile, ingineria mediului, apărare etc.

Capacitatea acestor sisteme de a colecta, stoca, prelucra şi utiliza informaţii de natură deopotrivă spaţială şi nespaţială a făcut posibilă în ultimii ani aplicarea lor şi în domeniul ingineriei resurselor minerale.

Din acest motiv, în ultimii ani s-a înregistrat un progres continuu de implementare în industria extractivă a sistemelor informatice geografice.

Din acest punct de vedere am analizat aplicarea sistemelor GIS / GPS în toate fazele activității de extragere a substantelor minerale utile: explorarea, extragerea și inchiderea /reabilitarea ecologică.

Identificarea, evaluarea, localizarea şi referenţierea acestor resurse în faza preliminară de prospecţiune şi explorare, precum şi în fazele ulterioare de extragere şi valorificare precum și în cea finală de refacere a zonelor afectate necesită colectarea, stocarea, prelucrarea, gestionarea şi utilizarea unor cantităţi şi varietăţi enorme de date.

Majoritatea aplicaţiilor existente şi preconizate se referă în special la domeniul cadastrului geologic şi minier şi mai puţin la conducerea şi gestionarea procesului propriu-zis de extragere şi la urmărirea funcţionării respectiv conducerea infrastructurii tehnologice.

Există încercări şi realizări în domeniul controlului şi supravegherii echipamentelor mari, al urmăririi în teren şi a navigaţiei vehiculelor de transport, al dispecerizării şi alocării resurselor tehnologice, acestea însă sunt realizări punctuale şi nu integrate într-un sistem global de geomatică.

Există de asemenea încercări de predicţie a variaţiei proprietăţilor geologo-miniere ale zăcământului şi de utilizare a datelor georeferențiate pentru optimizarea funcţională şi energetică a echipamentelor.

În afară de volumul imens din punct de vedere cantitativ şi tipologic al datelor necesar a fi gestionate, care poate conduce la sub- sau supra-dimensionarea resurselor hardware şi software implicate, utilitatea folosirii eficiente acestui instrument modern este grevată de lipsa unor cercetări integrative în domeniu.

În România, deocamdată, principala zonă de interes se localizează în exploatările miniere de lignit la zi şi carierele de zăcăminte metalifere sau materiale de construcţii.

Din cele arătate se poate concluziona că tema propusă este actuală atât ca domeniu de aplicabilitate cât şi ca pretext pentru avansarea cunoaşterii în domeniu.

În acest context, cunoașterea stadiului actual pe plan mondial și în țară al utilizării SIG în minerit este esențială pentru direcționarea viitoare a cercetărilor.

Am ilustrat cu exemple din literatura de specialitate diferitele aplicații existente precum si perspectivele de extindere și dezvoltare.

Se remarcă două moduri de abordare: pe de o parte cel comercial, promovat de firmele producătoare de componente hardware si software și al firmelor de consultanță care le utilizează, iar pe de alta parte cel academic (științific) care pe de o parte este focalizat pe identificarea de noi domenii si subdomenii de aplicare (punct de vedere al specialistilor mineri) , iar pe de alta parte cel al tezvoltării suportului informațional și al bazelor teoretice (specialistii în GIS, GPS, comunicații, geomatică, geografie spațială) etc.

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MINIMIZING TRANSPORTATION STARTING FROM FORD'S ALGORITHM

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ABSTRACT

To determine the optimal length of a network of transportation use a strategy initiated by Ford and optimized for this material where it was implemented and informatics algorithm.

KEYWORDS

transport

1. Introducere

1 *Algoritmul lui Ford* (drumuri într-un graf)- se utilizează în special pentru grafurile care admit circuite.

Fie un graf G = (X , U) unde X –mulţimea vârfurilor şi U –mulţimea arcelor.

Pentru orice arc (x_i , x_j) asociem un număr L_{ij} = L(u)>0 numit lungimea sa.

Notăm un drum de la nodul x_0 la xn cu drum şi fie $L_{drum} = \sum_{u \in drum} L$ u–lungimea drumului sau distanţa de la x_0 la x_n.

Pas1. Se asociază oricărui nod x_i o valoare L_i ;

-atribuim fiecărui vârf o marcă L_I,care să reprezinte lungimea unui drum arbitrar de la vârful x_0 la x_n ;iniţial $L_0 = 0$ $L_i = +\infty$ $1 <= i <= n$

Pas2. Pentru orice arc u = (x_i,x_j) se calculează diferenţa L(j)-L(i) dacă are sens (nu are sens pentru $\infty - \infty$) ,obţinând o reducere de fiecare dată pentru marca vârfului x_j

dacă L(j)-L(i) <= a[i,j] (unde A-matricea de adiacenţă asociată grafului) pentru toate arcele (x_i , x_j) care aparţin lui U ,algoritmul s-a terminat şi se trece la pasul 3

dacă există L(j)-L(i) > a[i,j] se înlocuieşte L(j)=L(i)+ a[i,j] şi se reia pasul2

Pas3. Cazul1 : $L_n = \infty$;în acest caz nu există un drum de la x_0 la x_n ,căci un astfel de drum plecând dintr-un vârf x_0(L_0),cu marcă finită L_0 trebuie să aibă un ultim vârf cu marcă finită şi atunci marca vârfului următor s-ar putea reduce.

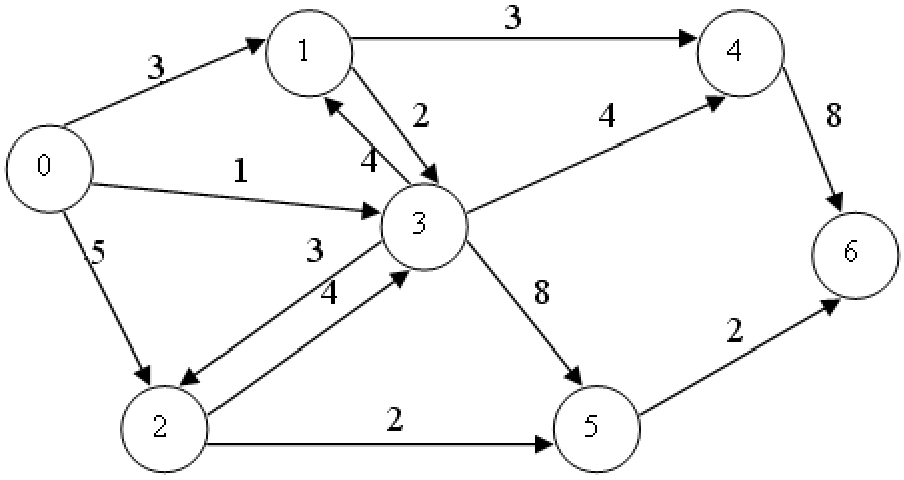
Cazul 2. Se consideră mulţimea arcelor (x_i,x_j) cu L(j)-L(i) = a[i,j] şi plecând de la L(n) putem determina în această mulţime un drum (pentru care Lj-Li=A[i,j]) drum = (x_n, x_{k1},........x_{kp},x_0) care să unească x_0 cu x_n- iar acest drum este de valoare minimă

Dacă se caută drumul de lungime maximă atunci :

Pas 1 se modifică $Li = -\infty$ $1 <= i <= n$

Pas 2 condiţia de optim L(j)-L(i)>= a[i,j] pentru toate arcele şi dacă există L(j)-L(i) < a[i,j] se înlocuieşte L(j)=L(i)+ a[i,j]

Exemplul 1 : se consideră următorul graf:



L_1-L_0 = ∞ -0>3 => L_1=0+3=3

L_1-L_0 = ∞ -0>5 L_2=0+5=5

L_3-L_0 = ∞ -0>1 L_3=0+1=1

L_3-L_1 = 1-3 = -2

L_2-L_3 = 5-1 = 4>3 L_2=1+3=4

L_4-L_1= ∞-3>3 L_4=3+3=6

L_4-L_3 = 6-1>4 L_4=1+4=5

L_5-L_2= ∞-4>2 L_5=4+2=6

L_6-L_4= ∞-5>8 L_6=5+8=13

L_6-L_1=13-6>2 L_6=6+2=8

-lungimea drumului minim este egală cu L_6=8;în nodul final x_6 se observă că L_6-L_5=8-6=2 rezultă că arcul (x_5 x_6) intră în drumul minim.În nodul x_5 avem L_5-L_3=6-1<8, L_5-L_2=6-4=2 atunci arcul (x_5 x_2) intră în drumul minim….

Drumul de lungime minimă va fi (x_0 x_3 x_2 x_5 x_6) =8

Observatia 1 In calcul se ia întotdeauna ultima valoare L_i determinată

2.Aplicaţia informatica

```
const m=32000;
type mat=array[1..10,1..10]of byte;
     vec=array[1..10]of word;
var a:mat;
    l,dr,viz:vec;
    i,j,n,k:byte;
    f,g:text;
    vb:boolean;
```

```
procedure drum(nod:byte);
begin
viz[nod]:=1;
inc(k);
dr[k]:=nod;
i:=n-1;
if nod=1 then vb:=false
         else vb:=true;
while (i>=1)and vb do
 begin
 if (l[nod]-l[i]=a[i,nod])and(viz[i]=0) then
                        begin
                        vb:=false;
                        drum(i);
                        end;
   i:=i-1;
 end;
end;
begin
assign(f,'ford.in');
assign(g,'ford.out');
reset(f);
rewrite(g);
readln(f,n);
for i:=1 to n do
begin
 for j:=1 to n do
 read(f,a[i,j]);
readln(f);
end;
l[1]:=0;
for i:=2 to n do l[i]:=m;
repeat
vb:=false;
for i:=1 to n do
  for j:=1 to n do
  if a[i,j]<>0 then
              begin
              if (l[j]>a[i,j]+l[i])and (l[i]<>m) then
                                   begin
                                   l[j]:=a[i,j]+l[i];
                                   vb:=true;
                                   end;
```

```
               end;
until not(vb);
if l[n]=m then
writeln(g,'nu exista drum de la x1 la xn')
          else
          begin
          drum(n);
          for i:=k downto 1 do
           write (g,dr[i],' ');

          end;
close(f);close(g);end.
```

Varianta C

```
#include <iostream.h>
#include <fstream.h>
const int m = 32000;
int a[10][10],i,j,n,k,vb;
unsigned int l[10],dr[10],viz[10];
ifstream f("graf.in");
ofstream g("graf.out");
void drum(int nod) {
viz[nod]=1;
k++;
dr[k]=nod;
i=n-1;
if (nod==1)  vb=0;
           else vb=1;
while ((i>=1)&& vb)
 {
 if ((l[nod]-l[i]==a[i][nod])&&(viz[i]==0))
                              {
                              vb=0;
                              drum(i);
                              }
   i=i-1;
 }
}
int main() {
f >> n >>"\n";
for( i=1; i <= n; i ++)
{
 for( j=1; j <= n; j ++)
```

```
 f >> a[i][j];
f >>"\n";
}
l[1]=0;
for( i=2; i <= n; i ++) l[i]=m;
do {
vb=0;
for( i=1; i <= n; i ++)
  for( j=1; j <= n; j ++)
  if (a[i][j]!=0)
               {
               if ((l[j]>a[i][j]+l[i])&& (l[i]!=m))
                                     {
                                     l[j]=a[i][j]+l[i];
                                     vb=1;
                                     }
               }
} while (vb);
if (l[n]==m)  g << "nu exista drum de la x1 la xn\n";
          else
          {
          drum(n);
          for( i=k; i >= 1; i --)
           g << dr[i] << ' ';

          }
f.close();
g.close();
return 0;
}
```

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IMPORTANŢA INSTALAŢIILOR DE DESULFURARE ÎN TERMOCENTRALE PE CĂRBUNE DIN ROMÂNIA PENTRU ASIGURAREA MENŢINERII UNEI PONDERI RAȚIONALE A HUILEI ÎN MIXUL ENERGETIC NAŢIONAL - EXPERIENŢA S.E. PAROȘENI

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ABSTRACT

Through the approval of the Kyoto Protocol, the ONU Convention held in Europe and has taken to reduce the emissions of sulfurin large combustion installations through the development of projects for desulphurization flue gas in coal burning power plants to improve the reports relating to the impact on the environment. Desulphurization technology represents stations through which combustion products are treatedinthe process of burning coal of fossil fuelsin order to reduce the concentration of SO2 (sulfurdioxide). The case study refers the Paroșeni power plant, one of the consumers of Jiul Valley hard coal, which, in these circumstances may remain a long run user of the local coal mines produced hardcoal. So, the presence of hardcoal in the energy mix of National Energy System could be preserved, taking into account the uncertain future of Mintia power plant, the second user of the mentioned above hardcoal.

KEYWORDS

desulfurare SE Paroșeni, protocol, Kyoto, energie, cărbune, emisii, șlam dens, absorbție, neutralizare, regenerare, oxidare , precipitații , calcar.

1. Introducere:

Prin aprobarea Protocolului de la Kyoto organizat la convenţia ONU, Europa şi-a asumat reducerea emisiilor de sulf în instalaţiile mari de ardere prin elaborarea unor proiecte de desulfurare a gazelor arse în termocentralele pe cărbune pentru a îmbunătăţi rapoartele ce privesc impactul asupra mediului înconjurător.

In urma asumării Protocolului de la Kyoto, Uniunea Europeana a emis Directiva 2001/80/CE a Parlamentului European şi a Consiliului privind emisiile industriale prin limitarea emisiilor în atmosferă a anumitor poluanţi provenind de la instalaţii de ardere de dimensiuni mari (putere egală sau mai mare de 50 MW) pentru reducerea emisiilor de SO2 până în 2012 sub 400 mg/Nm3, în urma căreia a apărut şi Directiva 2010/75/UE conform căreia de la 1 Ianuarie 2016 emisiile industriale de dioxid de sulf vor fi reduse sub 200 mg/Nm3, după care a apărut Decizia 2012/115/UE. Comisia Europeana a adoptat aceste directive şi decizii ţinând cont de Tratatul privind funcţionarea Uniunii Europene.

Pentru a răspunde cererii globale mereu crescânde de energie, toate sursele de energie vor fi necesare. Diferite surse de energie se vor potrivi diferitelor ţări şi diferitelor medii. În funcţie de disponibilitatea resurselor naturale, se poate lua o decizie între cărbune şi gaz, ca cea mai viabilă variantă de alimentare de bază cu energie electrică. În multe cazuri, ambele vor avea de jucat un rol important.

In prezent, pe plan mondial, cărbunele livrează în jurul a 30% din energia primara şi 41% din generarea globala de electricitate. Utilizarea cărbunelui este prognozată să crească la peste 50% pentru 2030, pentru 97% din aceasta creştere fiind responsabile ţările în curs de dezvoltare.

Îmbunătăţirea eficienţei include luarea, în cel mai scurt timp de măsuri pentru reducerea emisiilor provenite de la centralele pe cărbune.

Prin urmare, toate termocentralele din statele membre UE, cu o capacitate egală sau mai mare de 50 MW vor trebui prevăzute cu staţii de desulfurare până în 2016, altfel vor intra în procedura de infringement şi vor fi închise. Schema instalaţiilor ar trebui să arate în felul următor (Figura. 1):

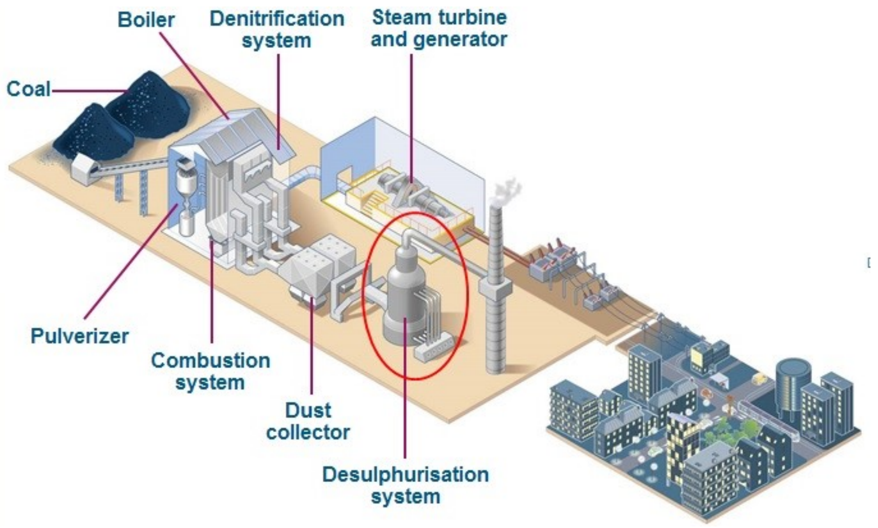


Figura:1. Schema generala a unei termocentrale cu staţie de desulfurare

Cărbunele este cel mai larg disponibil combustibil fosil ca resursă energetică. Spre deosebire de gaz şi petrol, este larg distribuit, atât geografic cat şi în termeni de resurse de proprietate. Abundenţa sa oferă securitate energetică pentru multe ţări deoarece furnizarea sa va dura semnificativ mai mult decât în cazul gazului sau petrolului. Se estimează că acesta va continua să joace un rol foarte important în cadrul cererii de energie primară din lume şi în viitor.

Cărbunele joacă un rol vital în generarea de electricitate din întreaga lume. S-a estimat că există peste 860 miliarde tone rezervă de cărbune dovedită în întreaga lume. Aceasta înseamnă că există suficient cărbune pentru a fi utilizat cel puţin 118 ani la rata curentă a consumului.

2. Ponderea cărbunelui în producţia de energie electrică

Centralele electrice pe bază de cărbune furnizează în prezent 41% din electricitatea globală. În unele ţări, cărbunele are un procent chiar mai mare în producţia de energie electrică.

După studiile IEA (International Energy Agency)consumul global de cărbune a crescut de la 4762 de milioane de tone în anul 2000 până la 7697 milioane de tone în 2012. Aceasta este o creştere de 60%, reprezentând o creştere medie anuală de 4%.

Ţările în care cărbunele are un procent ridicat în producerea de energie electrică, după IEA, sunt: Africa de Sud- 93% ;Polonia- 92%; China- 79%; Australia -77%; Kazahstan - 70%; India - 69%; Israel -63%; Republica Cehă- 60%; Maroc-55%; Grecia-52%; SUA-49%; Germania - 46%.

Importanţa deosebită a cărbunelui pentru producerea de electricitate se estimează a urma un trend crescător. În centrul Scenariilor Noilor Politici ale Agenţiei Internaţionale pentru Energie, se estimează că, cărbunele va oferi în jurul 33% din cererea globală de electricitate în 2030. Cu toate acestea, scenariul necesită punerea în aplicare a tuturor politicilor planificate în prezent de guverne şi de aceea vine cu mari incertitudini.

La ora actuală şi în Uniunea Europeana cărbunele reprezintă o pondere destul de ridicată în producţia de energie (Figura.2 şi Figura.3).

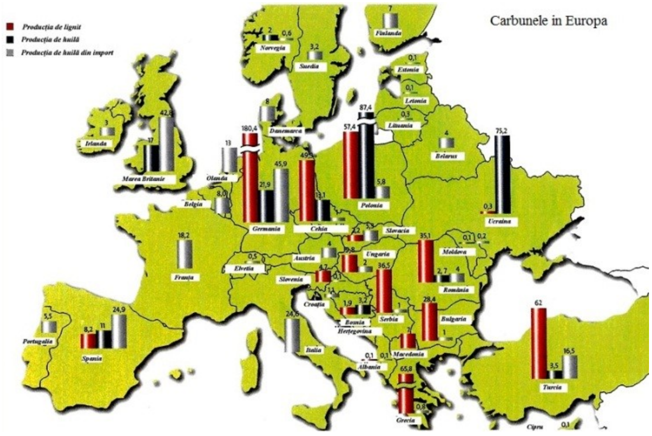


Figura 3: Repartiţia cărbunelui în ţările membre UE

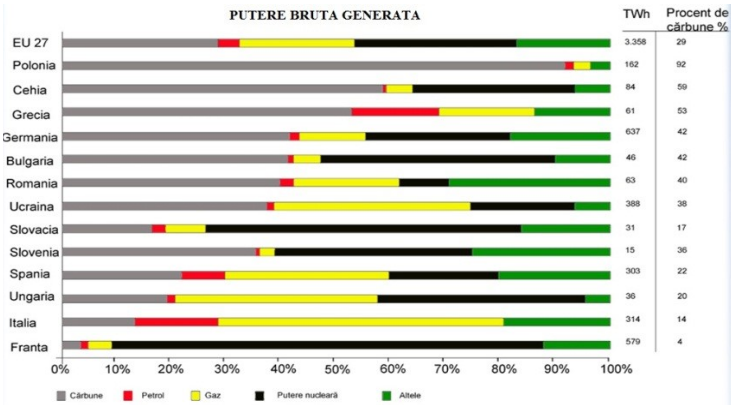


Figura: 2. Puterea brută generata de cărbune în Uniunea European

România dispune de o gamă diversificată de resurse de energie primara: ţiţei, gaze naturale, cărbune, minereu de uraniu, precum şi de un important potenţial valorificabil de resurse regenerabile. În ceea ce priveşte resursele de cărbune din România, conform datelor de la ANRM (Agenţia Naţională de Resurse Minerale) acestea sunt după cum urmează:

- Resursele de huilă din România cunoscute sunt de 755 milioane tone, din care exploatabile 105 milioane tone;
- Resursele de lignit din România sunt estimate la 1.490 milioane tone, din care exploatabile 445 milioane tone;

In România, puterea calorifica a lignitului este cuprinsă intre 6 – 15 MJ/kg în timp ce puterea calorifică a huilei este cuprinsa intre 16 – 29 MJ/kg.

In funcţie de tipul de cărbune folosit diferă şi emisiile de SO2, deoarece puterea calorifică a lignitului este mai mică decât a huilei şi prin urmare în funcţie de calitatea cărbunelui sunt şi valorile de SO2 emise de termocentrale în urma arderii cărbunelui, însă valorile admise trebuie să fie la fel conform directivei europene pentru toate termocentralele pe cărbune (Tabel 1).

Tabel: 1. Valori emisii SO_2 actuale şi valori necesare impuse

Tipul de Combustibil solid	Termocentrala	Valoare actuala a emisiilor de SO_2 (mg/Nm3)	Valoare limita admisa a emisiilor de SO_2 (mg/Nm3)
Huila	Paroşeni	7400	200
Lignit	Craiova II	6300	200

In România s-a realizat un studiu referitor la evoluţia participării procentuale a principalilor purtători de energie în producţia totală de energie în perioada 2003 – 2012 şi prognoza pana în 2020 care arată în felul următor (Figura.4):

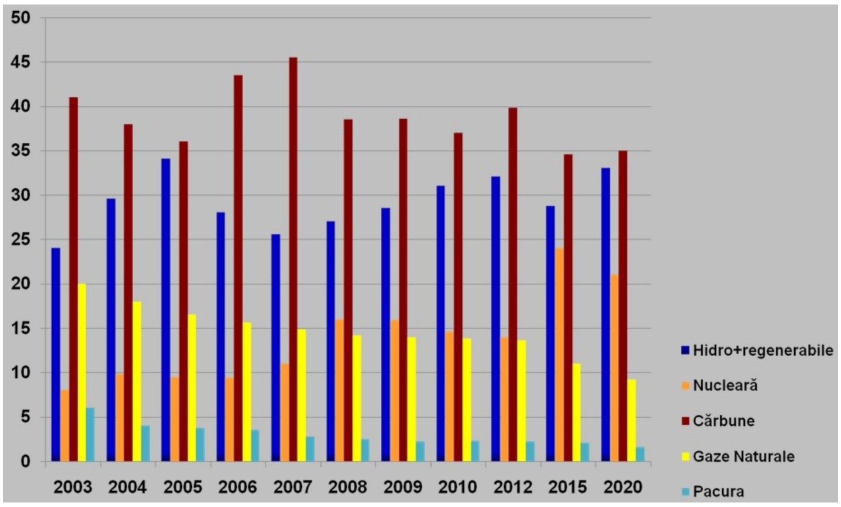


Figura: 4. Evoluţia procentuala a principalilor purtători de energie

Datorită rezervelor mari de cărbune existente în România, o mare parte din energia produsă aici se bazează pe termocentralele cu cărbune. Energia produsă de aceste termocentrale prezintă un rol deosebit în Securitatea Sistemului Energetic Naţional ţinând cont de faptul că energia produsă din resurse regenerabile (eoliene şi fotovoltaice), în pofida creşterii explozive din ultimii ani a puterii lor instalate, nu asigură o stabilitate în SEN (Sistemul Energetic Naţional).

In România, energia produsă pe bază de cărbune în termocentrale reprezintă aproximativ 30% din energia totală a ţării după cum se poate observa şi în graficele de mai jos (conform situaţiei din primele luni ale anului 2015) (Figura.5).

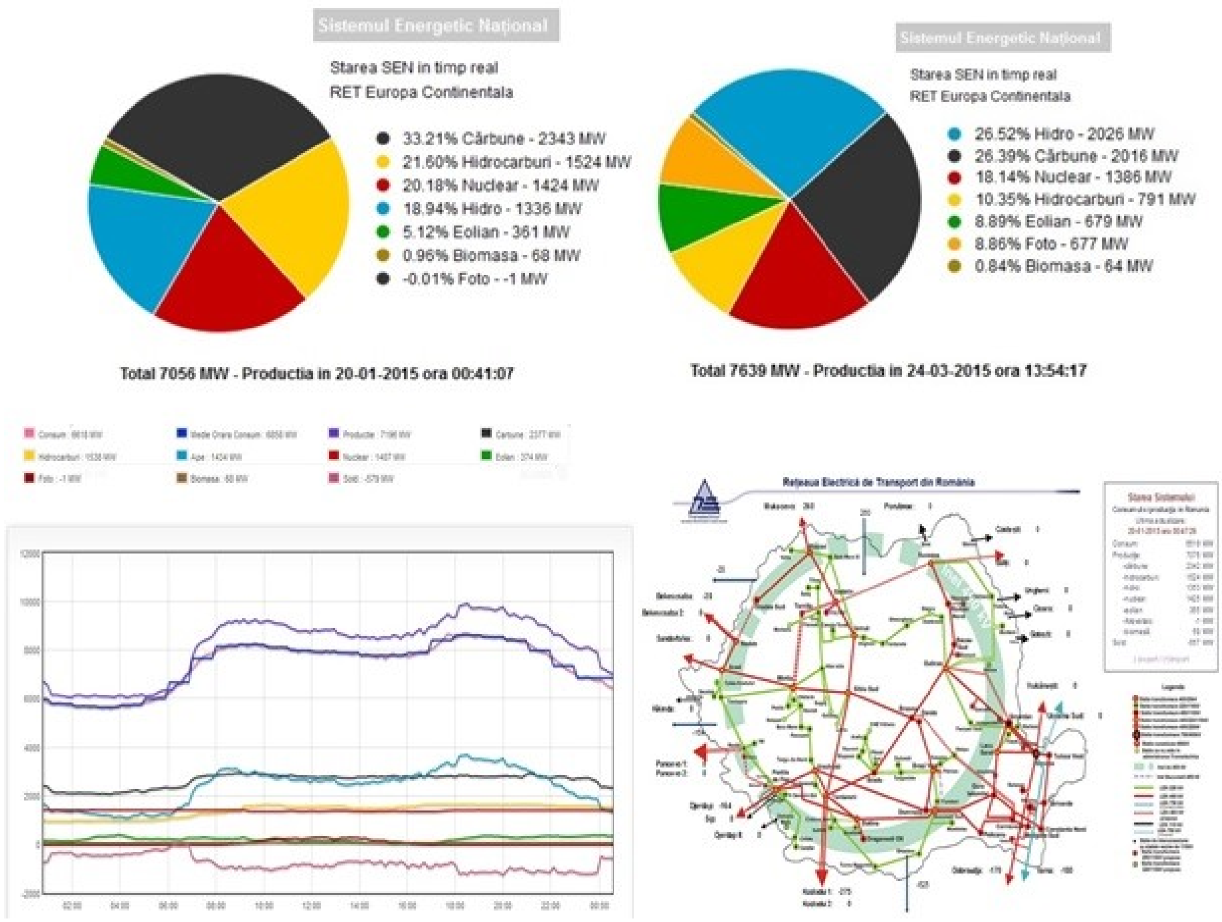


Figura.5. Graficele în timp real de la Transelectrica

3.Importanţa desulfurării gazelor de ardere

Instalaţiile de desulfurare reprezintă tehnologia prin care sunt tratate gazele arse, în urma procesului de ardere a cărbunelui sau a combustibililor fosili, pentru a reduce concentraţia de SO2 (dioxid de sulf). De asemenea sunt mai multe tipuri de staţii de desulfurare care pot fi aplicate de la caz la caz precum desulfurare uscată, desulfurare cu apă de mare etc. dar cea mai utilizată metodă este desulfurarea de tip umed bazată pe utilizarea pietrei de calcar ca şi reactant.

Ţinând cont de faptul că un combustibil fosil precum cărbunele conţine cantităţi destul de semnificative de sulf şi că la ardere în jur de 95% din conţinutul de sulf al cărbunelui se transformă în dioxid de sulf care la rândul lui ajunge în atmosferă şi interacţionează cu particulele de apă formând aşa numitele ploi acide cu efecte nocive asupra sănătăţii oamenilor şi asupra plantelor, concluzionăm ca foarte importanta instalarea staţiilor de desulfurare la termocentralele pe cărbune pentru a reduce semnificativ impactul SO2 asupra mediului înconjurător.

Instalaţiile de desulfurare sunt foarte eficiente având o rata de desulfurare cuprinsa intre 92% - 98%.

Rata de desulfurare reprezintă raportul dintre cantitatea de sulf care nu mai este emisă sub forma de SO2 în atmosferă de către termocentrală într-o anumită perioadă de timp şi cantitatea de sulf conţinută de combustibilul solid (in cazul nostru cărbunele) introdus în cazanul de ardere al termocentralei şi care este utilizat în instalaţie în aceeaşi perioada de timp (Figura.6).

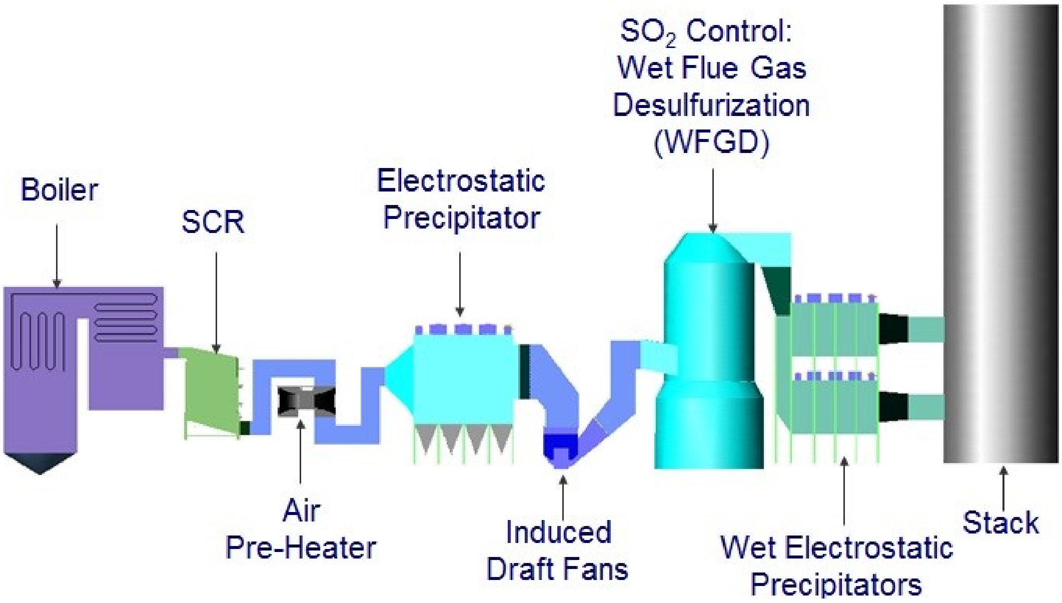


Figura : 6. Schema de principiu a unei termocentrale conform normelor de mediu ale EU

4.Proiectul 142/2010 de la SE Paroşeni-Instalaţia de desulfurare şi şlam dens

In România directiva 2001/80/CE a fost adaptată pentru legislaţia română prin HG 541/2003 intrând în vigoare în luna mai 2003.

Prin urmare, în România au fost implementate mai multe proiecte de mediu în special proiecte de desulfurare în mai multe termocentrale pe lignit precum cele de la Rovinari, Turceni şi Işalniţa, iar în acest moment este în desfăşurare un proiect la Craiova II. În ceea ce priveşte termocentralele pe huilă în acest moment este în desfăşurare un proiect la termocentrala Paroşeni pentru o instalaţie de desulfurare IDG (FGD în engleză) şi înlocuirea tehnologiei instalaţiei de transport zgură şi cenuşă SSD (DSS în engleză).

4.1.Descrierea generală şi situaţia actuală tehnico-economică

Prin studiul de prefezabilitate şi ulterior prin cel de fezabilitate s-a stabilit că în cazul SE Paroşeni să se aplice sistemul de desulfurare umedă a gazelor de ardere.

Astfel în 12.12.2012 a intrat în efectivitate (EDOC) contractul 142/2010 "**Instalaţia de desulfurare a gazelor de ardere de la grupul nr.4 de 150 MW şi CAF de 103,2 Gcal/h (IDG) şi Înlocuirea actualei tehnologii de colectare, transport şi depozitare a zgurii şi cenuşii (SSD)"** la Sucursala Electrocentrale Paroşeni. La momentul EDOC s-a plătit către contractorul principal 10% din valoarea totală a contractului, 6.530.000 Euro.

Proiectul din cadrul Contractului 142/2010 este în valoare de 65.300.000,00 Euro, fără TVA, și este impartit în două:

FGD – 49.070.000,00 Euro care reprezintă 75,15% din valoarea proiectului;

DSS – 16.230.000,00 Euro care reprezintă 24,85% din valoarea proiectului;

Plata TVA în valoare de 15.672.000,00 Euro se plateste esalonat din surse proprii în funcție de defalcarea prețului contractului.

In conformitate cu HG nr.549/2009 privind aprobarea indicatorilor tehnico-economici ai investiţiilor s-au obţinut banii de la BEI iar Contractorul CNIM a participat la licitaţia deschisă (conform OUG nr.34/2006) organizata de către Beneficiar pentru achiziţia „la cheie" a celor două investiţii menţionate şi a fost declarat câştigător.

Fondurile pentru acest proiect au fost obtinute printr-un contract de finanţare încheiat între statul român şi Banca Europeana de Investiţii (BEI), în valoare de 32.650.000 de euro, adică jumătate din valoarea totală a proiectului iar Ministerul Finanţelor Publice (MFP) a contribuit cu cealaltă jumătate, obţinută prin contractarea de instrumente de datorie publica de la băncile BRD şi BCR.

Instalaţia de desulfurare a gazelor arse (IDG) va colecta şi desulfura gazele de ardere de la cazanul nr. 4 şi CAF(cazan apa fierbinte). Şlamul de ghips rezultat din desulfurare, va fi trimis în totalitate la sistemul de şlam dens (SSD) care este o instalaţie de evacuare a zgurii şi cenuşii într-un amestec foarte dens care se întăreşte foarte repede şi previne împrăştierea cenuşii de către vânt.

Scopul acestui proiect „la cheie” de la SE Paroşeni, este reducerea emisiilor de oxizi de sulf în vederea respectării Directivei UE privind cerinţele de mediu pentru instalaţiile mari de ardere. Pentru această activitate (desulfurarea umedă a gazelor de ardere) există recomandări B.A.T. (Best AvailableTehniques - Cele mai bune Tehnici Disponibile) cu indicarea soluţiei tehnice optime pentru rezolvarea problemei şi care trebuie să fie respectată.

Scopul lucrării conţine proiectarea, furnizarea şi montarea instalaţiei de desulfurare umedă a gazelor de ardere, împreună cu instalaţiile conexe de procesare a reactivului şi de prelucrare şi depozitare a produsului secundar obţinut.

Lucrările pe şantier au început în data de 13.06.2013 şi au evoluat destul de bine urmând graficul de realizare al proiectului din punct de vedere al lucrărilor pe şantier cat şi defalcarea preţului contractului în ceea ce priveşte livrarea de echipamente.

La data de 16.03.2015, stadiul de realizare al proiectului era după cum urmează: IDG –fizic - 86,66 %, valoric -87,99 %, respectiv SSD fizic-37,38 %, valoric 43,64 %, iar în total 74,41 % fizic şi 76,97 % valoric.

4.2.Planificarea lucrărilor de proiectare şi Graficele de Execuţie

Contractorul a întocmit programul de lucrări şi graficele de Execuţie şi l-a înaintat Beneficiarului spre aprobare la 30 de zile de la intrarea în efectivitate a Contractului.

Aceste programe şi grafice vor respecta obligatoriu perioada de timp impusă prin Contract până la Punerea în Funcţiune a IDG.

Termenele de mai jos au fost maxim acceptate la ofertare şi se raportează la data de intrare în efectivitate a Contractului (EDOC):

- Ingineria de Bază – -3 luni;
- Documentaţia Tehnică pentru Autorizaţia de Construcţie - -2 luni;
- Proiectarea de Detaliu – - 8 luni;
- Începerea lucrărilor în şantier – -6 luni;
- Terminarea lucrărilor în şantier – -36 luni;
- Finalizare Probe de Punere în Funcţiune – - 39luni;
- Finalizare Teste de Performanţă - - 45 luni.

Contractorul va garanta emisia de 200 mg/Nm3 SO2 (la un conţinut de 6 % O2 în gaze uscate) pentru un debit de gaze de ardere de 607.900 Nm3/h uscat (100 % din sarcina nominala a cazanului 4) cu o concentraţie de SO2 de maxim 7400 mg/Nm3 (la un conţinut de 6 % O2 în gaze uscate).

Rata de desulfurare de minim de 94 % pentru tot domeniul de variaţie al debitului de gaze de ardere cuprins între 206.536 Nm3/h uscat (80 % din sarcina nominala a CAF_ului) şi 607.900 Nm3/h uscat (100 % din sarcina nominala a cazanului 4) şi pentru întreaga gama de cărbune utilizat, fără aport de gaze naturale (Tabel 2).

IDG realizează un consum de energie electrică la sarcina nominală, pentru întreaga gamă de cărbune utilizat și realizează un consum de calcar (cu concentraţia de CaCO3 de 92 %) la sarcina nominală, pentru întreaga gamă de cărbune utilizat.

Tabel: 2. Performanţele funcţionale garantate

Performanța garantată	**UM**	**Valoarea garantată**	**Penalizări**	
			UM	**Valoare**
Emisii SO_2	mg/Nm³	200		
Emisia de particule	mg/Nm³	50		
Rata de desulfurare	%	94	EUR /0.1 %	150.000
Consumul de energie electrica	kWh	2800	EUR /(50 kWh)	200.000
Consumul de calcar	t/h	8,046	EUR/(100 kg/h)	120.000
Consumul de metal bila raportat la cantitate calcar măcinata	Kg/t	0,1	EUR/(10 g/t)	30.000
Disponibilitatea de timp	%	96	EUR / 1%	300.000

4.3.Descrierea tehnico-funcţională a instalaţiei de desulfurare IDG

Principiul de funcţionare al instalaţiei de desulfurare umedă bazată pe utilizarea pietrei de calcar ca şi reactant este oarecum simplu. Practic se foloseşte o soluţie apoasă de calcar (H2O+CaCO3) ca şi reactiv intr-un reactor absorbant numit şi absorber sau scruber, care este un recipient vertical de dimensiuni mari în care gazele arse intră în contact cu soluţia de calcar.

Desulfurarea gazelor de ardere prin metoda umedă se realizează prin sprayerea gazului cu suspensie de calcar. Instalaţia de desulfurare este compusă din următoarele:

- Zona de desulfurare a gazelor arse ;
- Zona de preparare a suspensiei de calcar.

4.3.1 Zona de desulfurare a gazelor arse

Această zonă este compusă din următoarele:

- Canal de gaze arse
- Ventilator de gaze
- Suflante de oxidare – 3 buc.
- Absorber : - Ramuri de sprayere – 5 buc
- Eliminator de picături – 2 zone
- Agitatori – 3 buc
- Pompe de recirculare – 5 buc
- Pompe de şlam de ghips – 2 buc
- Hidrociclon – 1 buc.
- Rezervor de apă de urgenţă
- Lănci de sprayere
- Sistemul de monitorizare continuă a emisiilor (CEMS)

In această zonă gazele arse de la grupul nr. 4 ajung în absorber printr-un nou canal de gaze, iar viteza necesară gazelor pentru a ajunge în absorber este asigurată cu ajutorul unui ventilator montat pe canalul de gaze.

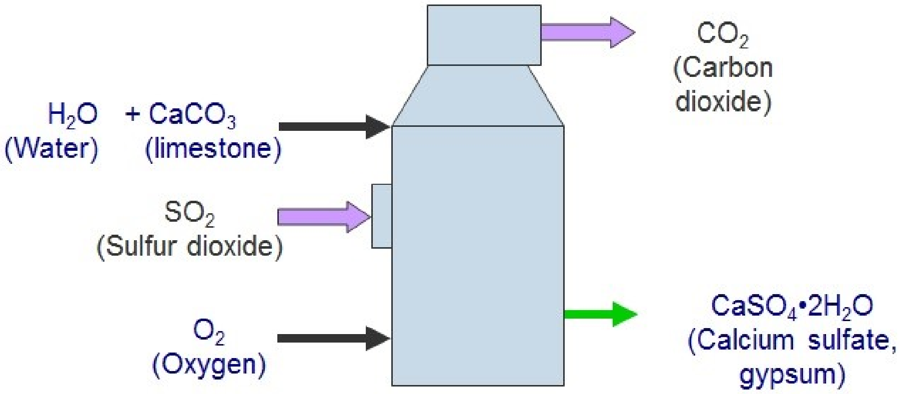
Gazele odată ajunse în absorber sunt sprayate cu suspensie de calcar prin cele 5 ramuri de sprayere montate în partea superioara a abosorber-ului.Sprayereasoluției de calcar se face în contracurent cu gazele de ardere având loc o reacţie chimică care formează un produs de reacţie ce se depune în partea de jos a absorberului.

Suspensia de calcar este preluată din absorber de cele 5 pompe de recirculare care asigura alimentarea bancurilor de sprayere cu suspensie de calcar. Prin două dintre cele 5 ramuri de sprayere se introduce suspensie de calcar proaspătă din rezervoarele de şlam de calcar pentru a menţine pH-ul la valoarea setată.

În urma reacţiei de desulfurare rezultă sulfit de calciu (CaSO3) care este apoi oxidat intrând în contact cu oxigenul, prin introducerea de aer în şlamul din absorber cu ajutorul celor 3 suflante de oxidare, obţinând sulfat de calciu (CaSO4) care se mai numeşte şi gips, iar acest proces va fi urmat de cristalizarea gipsului în soluţia suprasaturată.

Toate reacţiile chimice din procesul de desulfurare au loc în Absorber (reactor sau scruber).

Reacţiile chimice care au loc într-un sistem de purificare prin calcar umed, pot fi caracterizate printr-o serie de etape, iar principalele etape care pot apărea simultan sunt: de absorbţie, de neutralizare, de regenerare, de oxidare şi de precipitaţii.



$$SO_2 + CaCO_3 + \frac{1}{2}O_2 + H_2O \rightarrow CaSO_4 \cdot 2H_2O + CO_2$$

Figura: 7. Schema proces chimic în Absorber

Absorbţie: Acesta este primul pas în procesul de îndepărtare. Este absorbţia dioxidului de sulf în lichidul de spălare. Absorbţia este operaţia de transfer de masă, care are vapori solubili într-un lichid.

Neutralizare: în acest pas, SO2 absorbit reacţionează cu calcarul dizolvat şi alte specii alcaline prezente. Acest proces are loc în principal în turnul de pulverizare al absorberului. Dioxidul de carbon se formează în timpul acestei etape, şi este eliberat sub forma de gaz.

Regenerarea: este dizolvarea calcarului care oferă reactivul ce reacţionează cu SO2 pentru a forma sulfat de calciu, CaSO4. Calcarul este o bază şi ajuta la echilibrarea pH-ului în amestecul de şlam pentru a nu deveni prea acid.

Oxidarea: este procesul de combinare a unei substanţe cu oxigenul. Prin procesul de oxidare, sulfitul de calciu CaSO3 este transformat în sulfat de caliciu CaSO4, în gips.

oxidarea(2Ca2+2HSO3+O2=2CaSO4+2H) şi cristalizare(CaSO4+2H2O=CaSO4 x 2H2O).

Precipitaţii: este procesul prin care o substanţa se separă din soluţie prin modificări chimice. în rezervorul de recirculare Absorber, atunci când soluţia devine saturată, sulfatul de calciu precipită pe cristale de însămânţare.

Deoarece gazele rezultate în urma procesului de desulfurare sunt saturate cu apă, deasupra celor 5 ramuri de sprayere este montat un sistem de eliminare a picăturilor de apă din gaze (mast eliminator). Cei trei agitatori montaţi la partea inferioara a absorber-ului au rolul de a menţine calcarul şi gipsul în suspensie.

Pentru a evita creşterea densităţii şlamului din absorber acesta este preluat cu ajutorul celor două pompe de şlam de gips şi introdus intr-un hidrociclon unde are loc separarea gipsului din şlamul din absorber, partea grosiera(gipsul) este descărcată în mixerul de la SSD, iar partea mai subţire este reintrodusa în şlamul din absorber.

La partea superioară a absorberului este montat un rezervor de apă de urgenţă. Acesta are rolul de a reduce temperatura gazelor arse provenite de la grupul 4 în cazul unei avarii. Reducerea temperaturii gazelor este necesară pentru a nu deteriora cauciucul cu care este acoperit absorberul şi se realizează prin pulverizare apă, pulverizare realizată de lăncile de sprayere care sunt montate pe canalul de gaze înainte de intrarea acestuia în absorber.

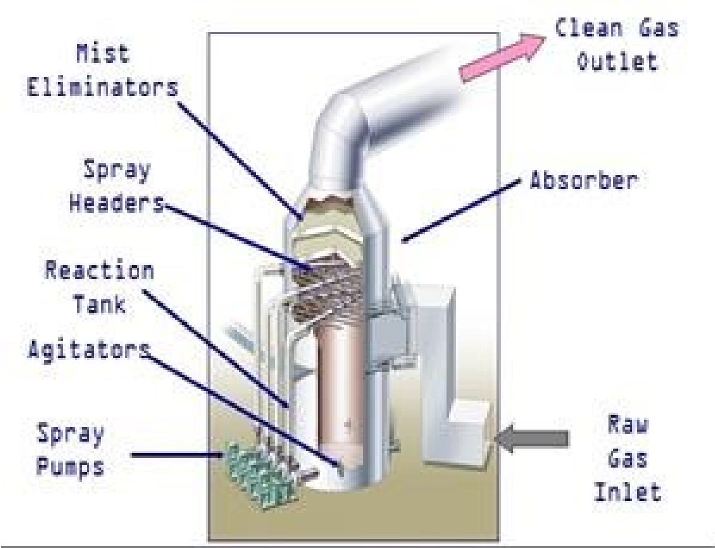


Figura.8. Schema interior Absorber

După ce gazele trec şi de separatorul de picături (Mist eliminator) acestea se îndreaptă spre coşul absorberului şi intra în contact cu mediul înconjurător.

Pe coşul de fum de pe absorber sunt montaţi mai mulţi senzori legaţi de CEMS, un sistem de monitorizare continua a concentraţiilor de SO_2, O_2 , pulberi, NO_x, CO_2 şi CO în gaze arse precum şi a debitului de gaze de ardere, la ieşirea din IDG.

4.4.Descriere tehnico funcţională a instalaţiei de preparare a şlamului dens (SSD)

Şlamul dens se realizează prin amestecul cenuşii cu apă, zgură şi şlam de ghips. Densitatea şlamului dens obţinut este 1,3~1,5 t/m^3

Instalaţia de şlam dens este compusă din următoarele:

- Instalaţia de colectare si transport cenuşă;
- Instalaţia de colectare si transport zgură;

4.3.2 Zona de preparare suspensie de calcar

Această zonă este compusă din următoarele:

- Pâlnie de descărcare calcar – 1 buc.
- Transportor cu raclete – 1 buc.
- Transportor cu banda – 1 buc.
- Elevator cu cupe - 1 buc.
- Transportor cu lanţ şi bare – 1 buc.
- Siloz de calcar – 1 buc.
- Transportoare cu banda şi cantar – 2 buc.
- Concasor – 2 buc.

- Moara de calcar cu bile – 2 buc.
- Pompa şlam de la moara – 2 buc.
- Hidrociclon – 2 buc.
- Rezervor de şlam de calcar - 2 buc.
- Pompa de şlam de calcar - 2 buc.
- Rezervor de apă de proces – 1 buc.
- Pompa de apă de proces – 2 buc.

Prepararea şlamului de calcar necesar realizării desulfurării gazelor de ardere se realizează în zona de preparare şlam de calcar astfel:

Calcarul este adus de la carieră cu autocamionul şi este descărcat în pâlnia de descărcare calcar. De acolo este preluat de transportorul cu raclete şi descărcat pe transportorul cu bandă unde se realizează o extragere a materialelor feroase şi neferoase din calcarul transportat cu ajutorul separatorului de metale. De pe acest transportor calcarul ajunge la elevatorul cu cupe care îl transportă până deasupra silozului, de acolo fiind preluat pe un transportor cu bare şi lanţ şi descărcat în silozul de calcar.

Silozul de calcar asigură depozitarea calcarului necesar pentru cinci zile de funcţionare a gospodăriei de calcar la capacitate maximă. Pentru a asigura redundanţa sistemului de la gurile de descărcare ale silozului sunt montate doua linii paralele şi identice pentru prepararea şlamului.

Fiecare linie este compusă dintr-un transportor cu bandă şi cântar care realizează dozajul de calcar introdus în procesul de realizare a şlamului de calcar, calcarul de pe acest transportor cu bandă ajunge în concasor unde se realizează reducerea granulaţiei calcarului pana la 15 mm, calcarul măcinat este apoi introdus în moara cu bile unde se realizează măcinarea umedă a acestuia.

Din mori, suspensia de calcar obţinută este golită într-un jomp de unde este preluată cu ajutorul unei pompe de şlam de moară şi pompat la hidrociclon unde are loc separarea părţii fine a suspensiei de calcar şi golirea acesteia în rezervorul de şlam de calcar aferent liniei care se află în funcţie. Partea grosieră a şlamului de calcar separată de hidrociclon se întoarce în moara cu bile. Din rezervorul de şlam de calcar acesta este preluat cu ajutorul unei pompe şi transportat spre cele 2 ramuri din absorber care permit introducerea şlamului de calcar proaspăt.

Rezervorul de apă de proces asigură necesarul de apă pentru întreaga instalaţie, având montate 2 pompe care realizează alimentarea cu apă de proces a întregii instalaţii.

După execuţia lucrărilor şi punerea în funcţiune a IDG, instalaţia mare de ardere va trebui să funcţioneze la parametrii iniţiali fără limitări sau restricţii datorate funcţionarii IDG (Tabel 5).

Caracteristici ale calcarului

$CaCO_3$	între	92	-	99,2 %
SiO_2	între	2,24	-	0,52 %
Fe_2O_3	între	0,41	-	0,17 %
Al_2O_3	între	1,01	-	0,45 %
MgO	între	0,79	-	0,54 %

Dimensiuni între 0-30 mm (80 %) şi 30-70mm (până la 20 %).

Tabel 5: Parametrii debitelor de gaze şi noxe înainte şi după IDG

	DESCRIPTION	FLUE GAS FROM BOILER - UNIT 4 LINE A	FLUE GAS FROM BOILER - UNIT 4 LINE B	FLUE GAS FROM HOT WATER BOILER (only during overhaul period of Boiler Unit No 4)	FLUE GAS TOTAL TO BOOSTER FAN	FLUE GAS TOTAL FROM BOOSTER FAN TO ABSORBER	CLEAN FLUE GAS FROM ABSORBER TO STACK	CLEAN FLUE GAS FROM STACK TO ATMOSPHERE	AMBIENT AIR TO OXIDATION AIR BLOWER	AIR FROM OXIDATION AIR BLOWER TO ABSORBER SUMP
	DESCRIERE									
Volume Flow	m^3/h STP dry	287650	287650	206536	575300	575300	590773	590773	7700	7700
	m^3/h STP wet	313300	313300	224510	626600	626600	682363	682363	7852	7800
Mass Flow	kg/h dry	394933	394933		789867	789867	809872	809872	9909	
	kg/h wet	415553	415553		831107	831107	883500	883500	10105	
Moisture Content	H_2O Vol..%	8,19	8,19	8,19	8,19	8,19	13,42	13,42		1,28
Temperature	°C	140	140	140	140	148	51,8	51,8	amb.	15
Pressure (rel.)	mbar	-0,5	-0,5		-9,8	13,4	1,3	0	amb.	943,2
Density	kg/m³ wet	0,876	0,876	0,876	0,876	0,85	1,1	1,1	1,267	1,13
SO_2-Concentration	mg/Nm³ dry (6%O2)	6793	6793	6793	6793	6793	200	200		
Dust-Concentration	mg/Nm³ dry (6%O2)	100	100	100	100	100	50	50		

IGD este proiectată pentru toate regimurile de operare care pot apărea, inclusiv pornire, oprire planificată, oprire accidentală şi funcţionare normală. Centrala este dotată cu 1 cazan de abur C4 de 540 t/h şi Cazanul de Apă Fierbinte de 103,2 Gcal/h. Grupul 4 de la Paroşeni a fost reabilitat în perioada 2004 – 2007 şi are o putere instalată de 150 MW (Figura.9).

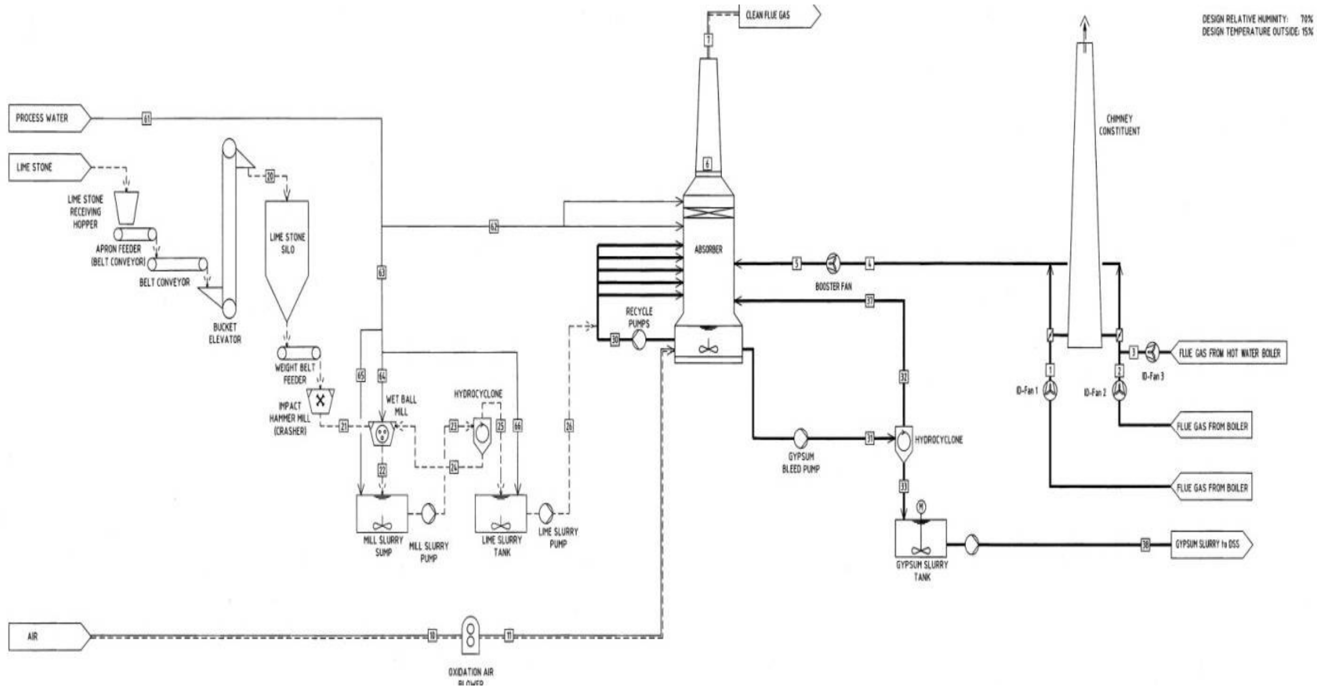


Figura. 9. Diagrama flux de proces a IDG

4.4.Descriere tehnico funcţională a instalaţiei de preparare a şlamului dens (SSD)

Şlamul dens se realizează prin amestecul cenuşii cu apă, zgură şi şlam de ghips. Densitatea şlamului dens obţinut este 1,3~1,5 t/m3

Instalaţia de şlam dens este compusă din următoarele:

- Instalaţia de colectare si transport cenuşă;
- Instalaţia de colectare si transport zgură;

4.4.1 Instalaţie de colectare şi transport cenuşă

Aceasta este compusă din următoarele:

Vase NuvaFeeder – 36 buc. (volum 552 l); Compresor transport cenuşă – 2 buc.; Siloz de cenuşă – 2 buc. (ar trebui să aibă volumul de 290m³); Instalaţie de descărcare cenuşă în camion – 1 buc.; Tobogan de transport cenuşă – 3 buc.; Ventilator de aerare – 3 buc. (debit de aer 330m³/h, putere motor 4,0 kW); Suflante de aerare 2 buc. (debit de aer 139,0 m³/h, putere motor 5,5 kW)

Cenuşa de la electrofiltre, preîncălzitorul de aer şi economizor este preluată de vasele NuvaFeeder şi transportată pneumatic în cele două silozuri de cenuşă. Pentru realizarea transportului pneumatic sunt utilizate cele două compresoare de aer. Prin intermediul celor trei tobogane se realizează descărcarea cenuşii din cele 2 silozuri spre cele două mixere sau spre instalaţia de descărcare cenuşă în camion.

Cele trei ventilatoare de aerare realizează fluidizarea cenuşii în tobogane iar cele 2 suflante de aerare realizează fluidizarea cenuşii în siloz.

4.4.2. Instalaţie de colectare si transport zgură

Aceasta este compusă din următoarele:

Concasor – 3 buc.; Pompa de zgura – 2 buc. (debit: 113.0 m³/h, viteză 1569 rpm); Sistem continuu de recirculare si deshidratare zgură acţionat hidraulic – 1 buc.; Rezervor de apă de serviciu – 1 buc.; Pompa de apă de serviciu – 2 buc. (debit: 120.0 m³/h, viteză 2451 rpm); Transportor cu bandă reversibil – 1 buc. (capacitate 9 t/h,)

Zgura provenită de la blocul 4 şi CAF (Cazan Apa Fierbinte) este transportată prin sistemul existent către cele trei concasoare, astfel fiind redusă granulaţia acesteia. După concasare, zgura ajunge în canalele existente de transport zgură si cenuşă, aceasta fiind transportată în hidroamestec spre cele trei bazine din clădirea pompelor Wedag. De acolo este preluată cu cele două pompe de zgură si transportată la sistemul conţinut de recirculare si deshidratare zgură.

Acest sistem realizează deshidratarea zgurii, supra plinul de apă de serviciu rezultat este acumulat în rezervorul de apă de serviciu. Această apă de serviciu este apoi reutilizată la transportul zgurii şi în mixere la obţinerea şlamului dens. Preluarea apei din rezervorul de apă de serviciu se face cu cele două pompe de apă de serviciu. După ce zgura este deshidratată, este transportată cu un transportor cu raclete spre o bandă reversibilă care descarcă zgura în unul dintre cele două mixere aferente instalaţiei de realizare a şlamului dens.

1) Instalaţie de preparare a şlamului dens:

Aceasta este compusă din următoarele:

Mixer – 2 buc. (volum 1 m³ , debit vehiculat 20 – 100m³/h); Jumbotrough – 2 buc. (volum 10 m³, viteză 25 rpm); Pompa cu piston acţionată hidraulic – 2 buc. (debitul vehiculat 54m³/h-105m³/h presiune maxima 80,00 bari).

Şlamul dens se obţine prin amestecarea apei cu cenuşa, acestea fiind componentele principale ale şlamului dens, iar zgura şi şlamul de ghips sunt componente secundare. Toate cele 4 elemente sunt amestecate in mixer. De acolo curg în Jumbotrough care are rolul de a menţine componentele in amestec (împiedică sedimentarea particulelor) şi de a asigura volumul de şlam dens necesar pentru funcţionarea pompei cu piston. Din Jumbotrough şlamul dens ajunge în pompa cu piston şi este pompat la depozitul de zgură şi cenuşă.

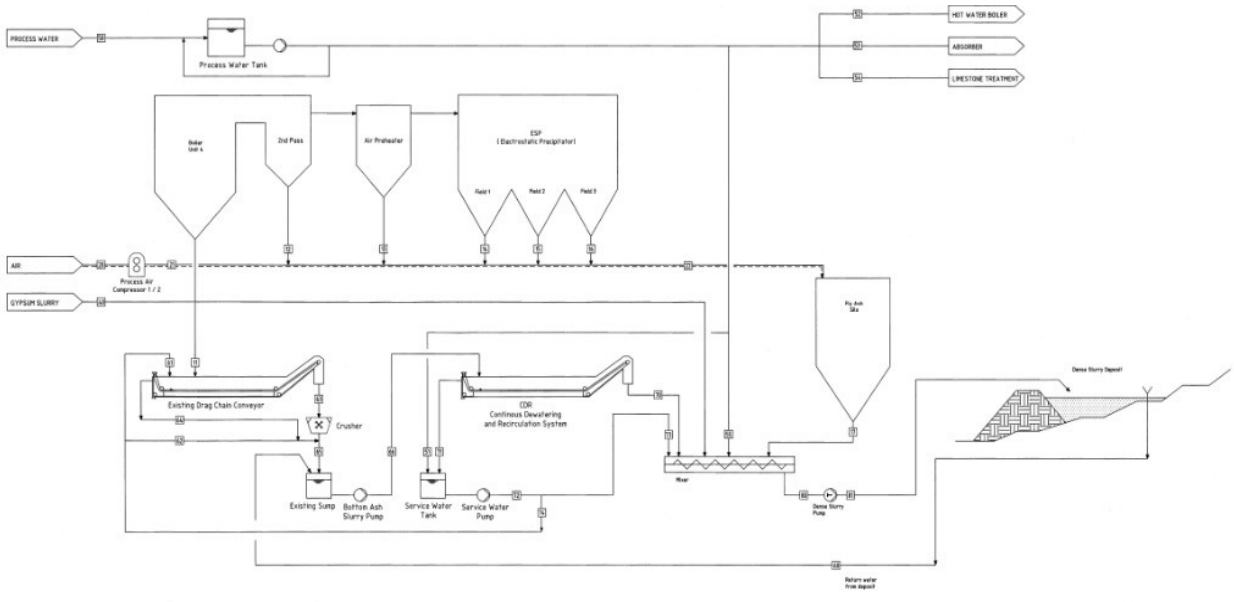


Figura. 10. Diagrama flux de proceş a SSD

5.CONCLUZII

Necesitatea cărbunelui în sistemul energetic global, european şi nu in ultimul rând naţional este absolut necesară pentru asigurarea siguranţei sistemelor energetice.

Instalaţiile de desulfurare în termocentralele pe cărbune sunt absolut necesare şi importante pentru asigurarea dezvoltării durabile a sectorului energetic naţional si european pentru îndeplinirea normelor de mediu.

Pentru menţinerea în funcţiune a SE Paroşeni, al cărui singur grup funcţional de 150 MW este, din punct de vedere al performanţei şi eficienţei la nivel mondial, s-a impus conformarea la normele europene prin realizarea instalaţiei de desulfurare a gazelor de ardere şi înlocuirea actualei tehnologii de colectare, transport şi depozitare a zgurii şi cenuşii.

Prin acesta se va asigura viabilitatea funcţionării SE Paroşeni, şi prin aceasta cantitatea de huilă aferentă produsă de minele CEH va avea asigurată utilizarea.

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ABC-UL IDENTIFICĂRII MĂSURILOR OPTIME de PREVENIRE și PROTECŢIE în CEEA CE PRIVEŞTE LUCRUL la ÎNĂLŢIME

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ABSTRACT

Ţinând cont de faptul că activităţile desfăşurate la înălţime sunt prezente în majoritatea sectoarelor de activitate, identificarea măsurilor optime care să ofere un un compromis rezonabil între siguranţă şi confort depinde de o serie de factori cum ar fi frecvenţa activităţilor la acel post de lucru, durata intervenţiei, numărul lucrătorilor care îşi desfăşoară activitatea la acel post de lucru, configuraţia locului de muncă şi nu în ultimul rând analiza cost-beneficiu.

KEYWORDS

evaluare risc, analiza cost-beneficiu, lucru la înălţime.

Definit ca "activitatea desfăşurată la minim 2 m măsuraţi de la tălpile picioarelor lucrătorului până la baza de referinţă naturală (solul) sau orice altă bază de referinţă artificială, bază faţă de care nu există pericolul căderii în gol" (1), lucrul la înălţime este prezent în majoritatea sectoarelor de activitate la lucrări de ridicare a cofrajelor, la demolări, la lucrări de întreţinere şi reabilitare a clădirilor, a instalaţiilor, la lucrări în cabine de macarale amplasate la mare înălţime, la activităţi efectuate la nivelul solului lângă un şanţ /o groapă neacoperit/ă; la lucrări în puţuri şi canalizări, etc.

Fie că este vorba de lucrări efectuate pe o schelă, structură, acoperiş, sau la nivelul solului lângă un şanţ /o groapă neacoperit/ă, lucătorii se confruntă adesea cu pericolul de cădere, întrucât în timpul desfăşurării activităţii pot pierde contactul cu suprafaţa pe care se sprijină şi pot cădea şi suferi diferite leziuni. În timpul desfăşurării activităţilor la înălţime, riscul de cădere poate fi datorat atât diferenţei de nivel între postul de lucru şi sol, cât şi sarcinii de lucru specifice ce urmează a fi efectuată şi poate conduce fie la deces, fie la leziuni sau afecţiuni ale stării de sănătate. Gravitatea leziunilor fiind determinată de viteza de impact a persoanei, depinde atât de înălţimea de cădere, cât şi de natura suprafeţei de impact şi partea corpului care loveşte suprafaţa.

Măsura în care este compromisă securitatea lucrătorilor care îşi desfăşoară activitatea la înălţime este determinată de acţiunea factorilor de risc existenţi la postul de lucru, care poate fi amplificată de o serie de influenţe (cum ar fi planificarea şi pregătirea, materialele şi echipamentele, supravegherea, managementul proiectului, cultura privind securitatea la locul de muncă). Alocarea unei singure cauze specifice pentru un accident sau incident este rareori exactă şi este considerată adesea o abordare eronată, deoarece nu reuşeşte să identifice cauzele reale. În general, identificarea factorilor care generează căderile de la înălţime se realizează în timpul unui proces de evaluare a riscurilor şi este considerată cea mai importantă etapă în identificarea măsurilor de prevenire şi protecţie.

Totuşi, investiţiile în activităţile de prevenire şi protecţie nu contribuie numai la reducerea pagubelor posibile ci şi la îmbunătăţirea proceselor de producţie în cadrul întreprinderii. Datorită complexităţii măsurilor care stau în spatele existenţei unui "loc de muncă sănătos" şi "productivităţii" aceste concepte devin dificil de definit şi de măsurat. Mai mult decât atât, înţelegerea relaţiei dintre sănătatea şi bunăstarea lucrătorilor, a condiţiilor organizatorice care susţin acest lucru, şi a productivităţii la nivel de întreprindere necesită o perspectivă interdisciplinară. (2)

Deoarece conceptul de productivitate este legat de calitatea forţei de muncă, de gestionarea şi condiţiile de lucru, pentru a avea o influenţă efectivă asupra performanţei întreprinderii, programul de sănătate şi securitate la locul de muncă ar trebui să fie aliniat cu obiectivele acesteia. O astfel de abordare ar trebui să facă parte din strategia de afaceri şi din cercul de îmbunătăţire continuă care duc o companie spre excelenţă.

1. Metodologia de evaluare a riscurilor

În ceea ce priveşte activităţile desfăşurate la înălţime, în fiecare moment al lucrului, angajatorii trebuie să se asigure că expunerea la risc a fost redusă la minimum, în special pentru acele riscuri care pot provoca decesul sau vătămarea permanentă.

Punctul de plecare în optimizarea activităţii de prevenire a accidentelor de muncă şi îmbolnăvirilor profesionale datorate căderilor de la înălţime îl constituie evaluarea riscurilor existente la locul de muncă. Pentru a minimiza riscurile la care sunt expuşi lucrătorii care îşi desfăşoară activitatea la înălţime fiecare pericol trebuie să fie tratat într-o manieră prin care să fie eliminat, sau, în cazul în care nu este posibil, să se reducă la un nivel acceptabil.

Măsurile necesare pentru protecţia securităţii şi sănătăţii lucrătorilor se bazează pe următoarele principii generale de prevenire:

a) evitarea riscurilor de cădere care pot apărea în timpul accesului la sau de la postul de lucru sau în timpul lucrului prin:

- utilizarea măsurilor de prevenire intrinsecă (măsuri care se referă la caracteristici constructive); dispozitive de protecţie (echipamente de lucru - ex. utilizarea unor platforme de lucru, balustrade; dispozitive de protecţie a marginilor, sisteme de restricţionare a accesului, etc.);
- utilizarea echipamentelor de lucru sau a altor măsuri pentru a reduce înălţimea de cădere şi implicit consecinţele unei eventuale căderi, dacă riscul nu se poate elimina (ex. să se folosească plase de protecţie, perne pneumatice sau umplute cu granule PVC, sau sisteme de oprire a căderii);

b) evaluarea riscurilor care nu pot fi evitate prin examinarea atentă a situaţiilor în care lucrătorii sunt expuşi la diferite pericole în timpul deplasării la sau de la posturile lor de lucru sau în timpul desfăşurării activităţii. Evaluarea riscurilor este de fapt un proces de examinare sistematică a tuturor aspectelor muncii, care ia în considerare: ce anume ar putea cauza rănirea sau vătămarea lucrătorilor, dacă pericolele identificate ar putea fi sau nu eliminate, iar dacă nu, ce măsuri preventive sau de protecţie ar trebui să fie adoptate pentru a diminua riscurile. Evaluarea riscurilor este de fapt un instrument utilizat pentru identificarea măsurilor preventive, permiţând atât angajatorilor, cât şi angajaţilor să înţeleagă acţiunile pe care trebuie să le întreprindă pentru a îmbunătăţi sănătatea şi securitatea la locul de muncă.

Indiferent de metoda utilizată, evaluarea cantitativă a riscurilor presupune parcurgerea următoarelor etape:

I. *Identificarea factorilor de risc* (pericolelor) – etapă în care se constituie echipa de evaluare, se delimitează posturile de lucru şi se identifică pericolele (existenţa surselor care pot afecta starea de sănătate, precum şi modul în care aceste pericole acţionează asupra lucrătorilor);

II. *Evaluarea riscurilor – etapa în care se stabilesc* consecinţele maxime previzibile asupra organismului uman, se stabileşte clasa de gravitate, frecvenţa şi nivelurile de risc parţial şi global pentru fiecare post de lucru. Dintre elementele care trebuie luate în considerare la evaluarea riscului în vederea definirii măsurilor de prevenire, se menţionează:

- configuraţia locului de muncă (localizare, utilaje, echipamente, materiale, mediu, etc.);
- sursa de risc (înălţimea de lucru, apropierea de gol, alte lucrări efectuate în apropiere etc.);
- activitatea lucrătorului (sarcină, durată, frecvenţă, postură, etc.);
- lucrătorul (competenţa, experienţă, vârstă, aptitudini fizice, absenţa vertijului, etc.).

De asemenea, importanţa agăţării în stare de inconştienţă nu ar trebui să fie subestimată, deoarece aceasta poate duce la complicaţii, care ar putea afecta funcţiile vitale: în astfel de condiţii, atârnarea lucrătorului mai mult de 30 min., poate provoca boli grave,ca urmare a acţiunii exercitate de chingi.

Documentul de evaluare a riscurilor trebuie să prevadă riscul care apare în urma atârnării şi măsurile de urgenţă şi procedurile necesare reducerii timpului de atârnare la câteva minute.

III. *Ierarhizarea riscurilor şi stabilirea măsurilor de prevenire şi protecţie;*

IV. *Implementarea măsurilor (decizii luate în Comitetul de Securitate şi Sănătate în Muncă pentru elaborarea planului de prevenire şi protecţie);*

V. Monitorizarea aplicării măsurilor şi reevaluarea (control intern).

Rezultatele evaluării riscurilor la posturile de lucru stau la baza elaborării planurilor de prevenire şi protecţie, precum şi la realizarea instrucţiunilor proprii de securitate şi sănătate în muncă.

Dacă în urma evaluării riscurilor, la un loc de muncă se constată existenţa posturilor de lucru la înălţime - unde există pericolul/riscul de cădere în gol şi dacă lucrul la înălţime nu poate fi evitat, distanţa potenţială de cădere trebuie să fie redusă prin toate mijloacele disponibile.

Există o ierarhie a măsurilor care se iau atunci când se planifică activităţi la înălţime. Alături de măsurile organizatorice de prevenire a accidentelor (selecţia personalului, instruirea, informare-documentare şi organizarea activităţii şi a locului de muncă), măsurile tehnice intrinseci, şi măsurile de protecţiecolective (3) au prioritate faţă de măsurile individuale de protecţie.

Tabelul: 1 este prezentată ierarhia măsurilor de protecţie în cazul lucrului la înăţlime.

Selectarea priorităţilor	Categorii de echipament	Măsuri colective	Măsuri individuale
ÎNALTĂ	Echipament de lucru care previne o cădere	Platforme de protecţie Balustrade Bariere *Platforme mobile elevatoare pentru mai mulţi utilizatori*	Sisteme de limitare şi prevenire a căderii, *Platforme mobile elevatoare pentru un singur utilizator*
	Echipament de lucru care reduce înălţimea consecinţele unei căderi	Plase cu nivel înalt de siguranţă şi sisteme de aterizare moi aranjateîn apropierealocurilor de muncă)	Alte echipamente individuale de protecţie împotriva căderii şi sisteme de oprire a căderii
	Echipamentele de lucru care minimizează consecinţele unei căderi	Plase cu nivel scăzut de siguranţă şi sisteme de aterizare moi	Alte sisteme de prevenire a rănirii (veste de salvare gonflabile şi veste de salvare)
SCĂZUTĂ	Alte categorii care nu sunt considerate echipamente de lucru (cum ar fi scări cu trepte, capre, schelă)	Instruirea, supravegherea şi instruirea utilizatorilor pentru a minimiza riscul suferit în cazul unei căderi	

*Sursa:*http://www.aber.ac.uk/en/media/departmental/healthsafetyenvironment/bs_8437_2005_fallarrestselection.pdf

Identificarea unor măsuri de prevenire corespunzătoare care să ofere un un compromis rezonabil între siguranţă, confort şi profitabilitate nu se poate realiza decât prin coroborarea rezultatelor obţinute în urma unei evaluări a riscului cu cele rezultate în urma unei analize cost-beneficiu.

- In case of two authors: (Roger, Youth, 2012)
- In case of three or more authors: (Smith et al., 2010).

2. Analiza Cost-beneficiu

În general, o analiză cost-beneficiu prezintă un real avantaj pentru angajatori, în luarea unei decizii în ceea ce priveşte alocarea de fonduri pentru măsurile de protecţie.

Majoritatea studiilor existente în literatura de specialitate au demonstrat în mod clar că alocarea de fonduri în măsuri de prevenire şi protecţie la nivel de întreprindere conduce la indicatori economici pozitivi, iar o perioadă de recuperare mai mică de trei ani indică în mod clar faptul că securitatea şi sănătatea la locul de muncă nu este necesară doar din punct de vedere legal ci şi din punct de vedere economic.

La nivel de întreprindere, utilizarea indicatorilor economici poate ajuta la adoptarea deciziei cu privire la investiţiile cele mai atractive, realizând posibilitatea comparării între mai multe alternative, în cadrul cărora alternativa ‚nici o acţiune' este întotdeauna inclusă. De fapt, majoritatea analizelor cost-beneficiu în cazul msurilor de prevenire şi protecţie se bazează pe diferenţa dintre rezultatele acţiunii de prevenire şi o estimare a costurilor atunci când nu are loc nici o acţiune de prevenire.

Prin analiza datelor existente în literatura de specialitate (4), (5), s-a observat că utilizarea cazurilor de afaceri prezintă un real avantaj pentru angajatori, în luarea unei decizii în ceea ce priveşte alocarea de fonduri pentru măsurile de protecţie. În general, un caz de afaceri poate examina o intervenţie propusă (ex ante) sau o intervenţie care a fost deja pusă în aplicare (ex post). Principalul avantaj al studiilor "ex ante" este marea disponibilitate în a face estimări financiare vis-a-vis de o intervenţie, fãra ca aceasta să fie de fapt efectuată. Totuşi, în multe studii, intervenţiile în domeniul sănătăţii şi securităţii la locul de muncă sunt anticipate şi se bazează pe estimarea în valori monetare a tuturor costurilor şi beneficiilor unui proiect propus, utilizând ca şi indicatori economici:

- valoarea actualizată netă, calculată ca diferenţă între suma tuturor beneficiilor şi cheltuielile de judecată; este utilizată frecvent în afaceri pentru a compara diferite intervenţii, sau pentru a se obţine valoarea curentă a fluxurilor viitoare de numerar nete; cât şi
- raportul cost-beneficiu, calculat ca raport dintre beneficii şi costurile totale.

Studiile efectuate de Jos Verbeek (4) au arătat că un proiect "ex ante" se dovedea benefic din punct de vedere financiar şi putea fi implementat dacă valoarea actualizată netă calculată era mai mare decât "0" sau raportul beneficiu-cost a fost mai mare decât"1".

În ceea ce priveşte căderile de la înălţime un alt scenariu s-a bazat pe analiza cost–beneficiu, prin gruparea categoriilor de costuri în categorii HEEPO (6): umane (H), echipamente (E), mediu (E), produse (P) şi organizare (O), a unui caz severitate medie, cu 16 zile de absenteism, în care un lucrător în vârstă de cca. 40 ani ce a căzut de la aproape 2 m înălţime într-un şanţ şi şi-a luxat glezna dreaptă. Pentru a facilita utilizarea practică a metodei, a fost proiectată o listă de verificare, care a reunit 40 de elemente de cost legate de accidente de muncă sau legate de problemele de sănătate de la locul de muncă subdivizate în cele cinci clustere HEEPO.

Ţinând cont de salariu, de timpul de lucru şi de costurile pe oră s-au calculat costurile pentru fiecare element de cost. Pentru acest accident au fost identificate doar consecinţe umane şi de organizare legate de:

- absenţa victimei;
- o productivitate redusă atunci când lucrătorul a revenit la locul de muncă;
- ore suplimentare pentru colegi;
- timp alocat pentru primul ajutor;
- timp pentru a reorganiza activitatea.

Măsurile de prevenire, investiţiile iniţiale şi costurile anuale recurente au fost înscrise într-o foaie de lucru şi reprezintă combinaţii de măsuri tehnice, organizatorice şi individuale. De asemenea, prin prezentarea diferitelor măsuri şi a costurilor lor şi rezultatele diferite pot fi comparate.

În cazul prezentat măsurile de prevenire au constat în:

- achiziţionarea unui echipament nou/auxiliar - balustrade, centuri de siguranţă, instrucţiuni aferente;
- măsuri organizatorice - Producerea de filme, împreună cu angajaţii, în care să se prezinte atât acţiunile incorecte care au dus la determinarea accidentului cât şi comportamentul corect în timpul lucrului; urmată de analiza acestora;
- acordarea echipamentului individual de protecţie, iar costurile şi beneficiile sunt prezentate în tabelul 2.

Tabelul 2: Analiza cost –beneficiu

Costuri						
	Investitia initiala	**studiu**	€400.00			
		adaptarea org/metoda	€-			
		echipament	€5,000.00			
		implementare	€250.00			
		instruire	€1,500.00			
	total		€7,150.00			
	Costuri anuale		**anul 1**	**anul 2**	**anul 3**	**anul 4**
	intretinere		€500.00	€500.00	€500.00	€500.00
	echipament		€-	€-	€-	€-
	instruire		€200.00	€200.00	€200.00	€200.00
			€700.00	€721.00	€742.63	€764.91
	total					€800.00
Beneficii						
	cresterea productivitatii		**anul 1**	**anul 2**	**anul 3**	**anul 4**
	extra productie		€-	€-	€-	€-
	costuri mai mici		€-	€-	€-	€-
	timp castigat		€-	€-	€-	€-
	Costuri evitate		€5,321.53	€5,321.53	€5,321.53	€5,321.53
			€5,321.53	€5,481.18	€5,645.61	€5,814.98
	total					€21,286.13

Sursa: http://www.internationalsosfoundation.org/?wpfb_dl=21

Prin interpretarea datelor înscrise în tabelul 2 al analizei cost beneficiu a rezultat că:

- Investiţia se amortizează în 2,2 ani
- rata internă de rentabilitate este de 35,1% ;
- suma beneficiilor actualizate este cu 4.277,48 € mai mare decât suma investită;
- Indicele de profitabilitate este de 1,60- pentru fiecare euro investit în proiect;
- randamentul este de 1,6 €;
- raportul beneficiu-cost este de 7,60.

Activităţile de prevenire şi protecţie determină nu numai reducerea pagubelor posibile dar poate determina şi îmbunătăţirea proceselor de producţie în cadrul întreprinderii. La fel ca toate investiţiile, intervenţiile în măsurile de prevenire a accidentelor detorate căderilor de la înălţime, includ atât costurile de intervenţie (cheltuielile necesare pentru implementarea intervenţiei), cât şi beneficii legate de rezultatul intervenţiei (inclusiv îmbunătăţirea sănătăţii).

Costurile activităţii de prevenire pot fi estimate prin calcularea costului şi a investiţiilor de timp ale personalului. Astfel, la nivelul întreprinderii costurile activităţilor de prevenire (investiţii iniţiale) depind de următoarele variabile:

- investiţii determinate de costuri ale echipamentelor de prevenire sau costuri suplimentare în materie de sănătate şi securitate în muncă (abreviat în continuare SSM), expimate în costuri prin preţuri de piaţă, cotaţii de costuri, facturi;

- investiţii suplimentare reprezentate de modificări ale bunurilor capitale necorelate cu activitatea de SSM şi realizate pentru permite funcţionarea echipamentelor în condiţii optime (de ex. reconstruirea clădirilor) exprimate prin preţuri de piaţă, cotaţii de costuri, facturi;

- costuri de inginerie, consultanţă şi planificarea costurilor în legătură cu investiţiile, determinate de cheltuielile pentru proiectarea şi punerea în funcţiune a echipamentelor noi sau implementarea procedurilor de lucru noi, exprimate prin preţuri de piaţă, cotaţii de costuri, facturi, salarii totale pentru timpul petrecut la locul de muncă;

- costuri suplimentare pentru produse de substituire (costuri recurente) datorate diferenţelor de preţ, exprimate prin preţuri de piaţă, cotaţii de costuri, facturi;

- achiziţionarea de echipamente individuale de protecţie (costuri recurente), exprimată prin preţuri de piaţă, cotaţii de costuri, facturi;

- costurile suplimentare pentru proceduri de lucru şi întreţinere modificate (costuri recurente) cauzate de diferenţa de preţ între modurile anterioare de lucru şi cele noi, în mod direct sau indirect legate de activitatea de prevenire; de reţinut că modalităţile noi conduc, de asemenea, la economii de costuri (de ex. costuri suplimentare pentru lucrul în conformitate cu normele de securitate), exprimate prin preţuri de piaţă, cotaţii de costuri, facturi;

- program de lucru suplimentar al personalului direct implicat (costuri de recuperare) - ore petrecute în şedinţe, instruire, inspecţii în materie de securitate, dezvoltare participativă- exprimate prin salarii totale pentru timpul petrecut la locul de muncă;

- costuri ale serviciilor interne sau externe în materie de SSM, alte servicii de prevenire (costuri de recuperare), exprimate prin preţuri de piaţă, cotaţii de costuri, facturi;

- activităţi interne ale întreprinderii (managementul resurselor umane, promovarea sănătăţii, politica în materie de SSM şi management), exprimate prin salarii;

- alte costuri ale locului de muncă generate de orice aspect care nu este inclus în capitolele anterioare, sunt exprimate prin preţuri de piaţă, cotaţii de costuri, facturi, salarii totale pentru timpul petrecut la locul de muncă.

3.Concluzii

Astfel, dacă la nivel organizaţional, adoptarea unor măsuri în ceea ce priveşte sănătatea şi securitatea la locul de muncă pot conduce la crearea unor condiţii mai bune de lucru, la îmbunătăţirea climatului social şi a procesului de organizare; la nivel individual, un program de măsuri privind securitatea şi sănătatea la locul de muncă pot duce la o motivaţie mai bună şi la un angajament pe termen lung. Acest cadru teoretic subliniază că atât angajatorii, cât şi angajaţii ar trebui să aibă interese egale în îmbunătăţirea condiţiilor de muncă şi în realizarea de investiţii în domeniul securităţii şi sănătăţii la locul de muncă. De asemenea, alături de considerentele umanitare şi obligaţiile legale, investiţiile în SSM pot genera beneficii cum ar fi:

- reducerea ratelor de boală şi absenteism;
- creşterea productivităţii;
- îmbunătăţirea imaginii faţă de potenţialii clienţi;
- păstrarea personalului calificat pe termen lung.

Demonstrarea unor astfel de beneficii în afaceri este esenţială pentru a arăta impactul pe care îl au investiţiile în domeniul securităţii şi sănătăţii în muncă asupra rezultatelor financiare cuantificabile.

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ENERGIA REGENERABILĂ, SOLUŢIA UNUI MEDIU CURAT

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ABSTRACT

Articolul tratează viziunea unui susţinător al mediului curat, susţinător ce reprezintă marea categorie a nespecialiştilor tehnici, dar utilizatori ai energiei care, doreşte să se implice în grupuri de lucru de combatere a poluării generate de industria clasică energetică activã, prin căutarea de soluţii bazate pe informare şi educaţie. Punctul de vedere al unui astfel de susţinător poate oferi teme de gândire şi chiar contribui la redirecţionarea strategiei energetice locale în sensul atingerii unui scop concret: producerea de energie curatã la preţuri competitive, accesibile consumatorilor.

KEYWORDS

energie

Factorul energie este fără doar şi poate cel mai important motor al industriei pentru că fără energie nu pot exista economie, locuri de muncă, investiţii şi, implicit, nici dezvoltare economică. Energia este indispensabilă la fel ca şi aerul pe care îl respirăm sau apa pe care o consumăm.

În ziua de astăzi nu mai este de ajuns să ne bazăm pe energia produsă din combustibilii fosili (cărbune) care a fost ani de-a rândul principala sursa de producere a energiei la noi în ţară. Pe lângă faptul că aceasta a venit cu dezvoltare economică şi locuri de muncă, a venit şi cu un "preţ": poluarea aerului prin poluanţii gazoşi, pulberile metalice şi cenuşa purtată de vânt care rezultă de la termocentralele pe cărbune, poluarea solului cu plumb, nichel, sulf, cenuşã care fac solul mai neroditor, cât şi afectarea incontestabilã a sãnãtãţii celor ce beneficiazã de locurile de muncã ale industriei extractive.

Practic existã o alternativã: energia produsă din surse regenerabile: vânt, soare, apă, biomasă, etc). Este energia inepuizabilă, energia verde care ne poate ajuta să asigurăm un procent important din necesarul de energie la nivelul ţării, să respirăm aer curat şi sã trăim într-un mediu curat.

Noua politică energetică a UE prevede printre obiectivele sale: reducerea emisiilor de gaze cu efect de seră cu 20% până în 2020, cât şi creşterea utilizării resurselor de energie regenerabilă de la mai puţin de 7% cât era estimat pentru 2006 la 20% din totalul consumului de energie al UE până în 2020.

Conform Directivei UE cu privire la energia regenerabilã 2009/28/EC, RES Directive publicatã în Jurnalul Oficial al UE şi care a intrat în vigoare la 25 iunie 2009 susţine producerea energiei din surse regenerabile utilizând panourile fotovoltaice, turbinele eoliene, microcentralele pe bază de biomasă, aceasta fiind singura formă de energie care poate contribui la reducerea încălzirii globale și a temperaturilor care au ca efect dezgheţarea gheţarilor, la creşterea nivelului mărilor şi oceanelor, la dispariţia multor specii de păsări şi peşti datorită modificării habitatului lor – efecte generate de poluare, iar pentru poluare este responsabilã într-un procent considerabil şi industria energeticã!

Soluţia pentru a stopa toate aceste efecte constã în utilizarea unui mix energetic al tuturor resurselor de producere a acesteia, singura viabilă care să ne permită să avem energie în orice moment al zilei şi pentru toate tipurile de procese, inclusiv cele industriale avansate, bazate pe control prin sisteme de automatizãri de ultimã generaţie - fãrã poluare a aerului şi solului.

Este adevărat că, pentru a beneficia de aceste surse de energie regenerabilă, trebuie să avem în vedere anumite zone din ţară precum: zona Dobrogea, unde o mare parte dintre fermele eoliene sunt deja instalate, zonele de câmpie pentru instalarea panourilor fotovoltaice şi nu numai, acestea putând fi instalate şi pe acoperişurile caselor de locuit. Microcentralele pe bază de biomasã (arderea lemnului împreună cu gunoiul menajer) sunt cele care se pretează cel mai bine la micile comunităţi sau gospodarii.

Factorul determinant al realizării acestor obiective sunt capitalurile de investiţii, iar pentru a face aceste investiţii este nevoie de o informare şi încurajare a publicului cât şi o susţinere financiară a acestuia prin care amintim acordarea de împrumuturi cu dobânzi mici.

În ceea ce priveşte impactul instalarii de centrale eoliene asupra faunei, specialistii de mediu recomanda ca trebuie avut în vedere traseul păsărilor pentru a se evita ciocnirile acestora în anumite perioade din an de turbinele eoliene. Instalarea unor senzori pe aceste turbine care să detecteze de la mare distanţă apariţia păsărilor şi sã determine oprirea acestora, ar putea fi una dintre soluţii care ar putea evita moartea acestora.

Nevoia de susţinere a dezvoltãrii sistemelor de producere a energiei din resurse noi şi regenerabile vine din importanţa susţinerii schimbãrii, iar această schimbare nu este posibilã fãrã contribuţia tuturor utilizatorilor de energie. Este necesarã adaptarea la noi condiţii de a produce şi utiliza energia, la noi obişnuinţe şi aşteptãri din partea noastrã a tuturor.

Doar dându-ne mâna în angajamentul pentru o Românie curată, putem obţine acest deziderat. Schimbarea este desigur dificilã şi înseamnă determinare, cãutarea, găsirea şi punerea în aplicare a soluţiilor optime pentru a avea energie la costuri competitive. Schimbarea implică de asemenea, parteneriate între mediul public şi cel privat, solicitã implicarea instituţionalã ce deţine expertiza tehnicã şi autoritatea decizionalã, implicã planuri clare şi corecte pe termen mediu și lung pentru atragerea investitorilor (atât a celor strãini dar şi a celor locali, chiar dacã sunt valori mai mici şi chiar a publicului larg ce poate contribui la dezvoltarea de microsisteme de generare a energiei).

Practic este un întreg ciclu în care fiecare sector economic reprezintă o verigă iar disfuncţionalitatea parţialã duce la disfuncţionalitatea întregului.

România nu este a noastră, este a copiilor noştrii şi a generaţiilor viitoare. Depinde de fiecare dintre noi să le lăsăm o Românie curată, competitivã şi propice dezvoltării.

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PRACTICA PROCESULUI COMUNICĂRII ŞI PARTICIPĂRII ÎN MANAGEMENTUL FIRMEI MINIERE/

PRACTICE OF PARTICIPATION OF PROCESS COMMUNICATION TO MINING COMPANY MANAGEMENT

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ABSTRACT

Pentru a-şi atinge obiectivele, managerul trebuie să participe la definirea obiectivelor, să transmită informaţiile către personal, să cunoască şi să înţeleagă obiectivele individuale ale angajaţilor, să creeze un mediu propice compatibilităţii dintre obiectivele organizaţionale şi cele personale. Personalul angajat trebuie să cunoască misiunea şi obiectivele firmei productiv-economică minieră, să înţeleagă şi să accepte rolul lui în atingerea obiectivelor, să îşi apropie aceste obiective pentru a putea participa proactiv la îndeplinirea lor, să identifice calea de armonizare a obiectivelor firmei cu cele personale. În practica firmelor productiv-economice miniere se întâlnesc forme specifice de comunicare managerială pentru fiecare etapă a evoluţiei productiv-economice. Managerii dezvolta şi promovează politicile firmei productiv-economice miniere bazate pe sisteme de comunicare ce permit ajustarea structurii şi a procesului organizaţional. Comunicarea managerială este o formă a comunicării interumane, un instrument al conducerii care pune în circulaţie informaţii despre rezultatul deciziilor productiv-economice miniere.

KEYWORDS

comunicarea managerial, comunicarea productiv-economică minieră, management, firma minieră.

1. Terminologie generală în transmisia informaţiilor productiv-economice miniere

Informaţia fiind un mesaj, o comunicare sau o ştire se referă la producerea unor evenimente din mediul productiv-economic minier, la situaţiile, condiţiile şi dimensiunile manifestării acestora.

Natura evenimentelor este diversă: economică, socială, ecologică ş.a.

Informaţiile productiv-economice miniere trebuie să îndeplinească diferite condiţii pentru a fi eficiente şi operative în procesul decizional: 1) să fie veridice; 2) să fie exacte; 3) să fie necesare; 4) să fie complete; 5) să fie oportune; 6) să aibă o vârstă cât mai redusă; 7) să fie transmise celor interesaţi cu frecvenţă raţională; 8) să aibă fiabilitate corespunzătoare; 9) să aibă dublu caracter: obiectiv (conţinut intrinsec) şi subiectiv (exprimat prin valoarea lor pentru factorii de decizie din domeniul diplomaţiei). [7]

Informaţiile *analitice* productiv-economice miniere semnalează fapte şi evenimente culese direct de la surse, fără nicio intervenţie.

Informaţiile sintetice productiv-economice miniere exprimă situaţii rezultate din confruntări cu alte informaţii, generalizări, interpretări ş.a.

Semnalul productiv-economic minier, într-o accepţie largă, este o manifestare fizică propagată prin mediul productiv-economic dat.

De regulă, noţiunea de semnal se utilizează într-un sens mai restrâns, excluzând manifestările care afectează procesul de transmisiune şi care se numesc perturbaţii.

Mesajul productiv-economic minier este un semnal ce corespunde unei reţineri particulare din ansamblul de idei, imagini. Datele care trebuie transmise (secvenţe) dintr-un mesaj constituie, la rândul lor, prin compunere, un mesaj.

Interpretarea mesajelor productiv-economice miniere este legată de raţionamentul logic şi se bazează pe: a) *deducţie* (extragerea de judecăţi particulare din judecăţi generale) şi b) *inducţie* (ajungerea la judecăţi de valoare pornind de la judecăţi, fapte particulare). [7]

Între sursă (partenerii din mediul local) şi utilizare (firma productiv-economică minieră), mesajul suferă, în general, transformări al căror rezultat constituie un semnal – în sens restrâns.

Sursa productiv-economică minieră este reprezentată de mecanismul prin care, din mulţimea mesajelor posibile, se alege într-un mod imprevizibil un mesaj particular, destinat a fi transmis etajelor superioare de conducere a firmei. [7]

Utilizatorul este constituit din destinaţia finală la care trebuie să ajungă mesajul respectiv.

Canalul (sau *calea*) este reprezentat de totalitatea mijloacelor destinate transmisiunii semnalului.

Prin mijloace se înţelege atât aparatura, cât şi mediul prin care se efectuează transmisiunea. În general, prin mediu se pot transmite semnale aparţinând mai multor căi.

Modularea înseamnă transformarea unui mesaj productiv-economic minier într-un semnal, cu scopul de a facilita transmisiunea prin mediul dat sau de a realiza transmisiuni multiple cu conţinut extins prin acelaşi mediu.

Scopul secundar al modulaţiei este de a spori eficienţa transmisiunii prin micşorarea erorilor (reducerea frecvenţei aducerii la cunoştinţă în firmă a conţinutului unor evenimente productiv-economice miniere, percepute nerelevant de către conducătorii delegaţi).

Demodularea este transformarea inversă modulării. În firmă, semnalele productiv-economice miniere primite din exterior sunt transformate în mesaje, care se supun prelucrării în sistemul informaţional-decizional. [7]

Codarea (codificarea) înseamnă transformarea unui mesaj productiv-economic minier într-un semnal discret, efectuat cu scopul de a mări eficienţa transmisiunii.

Decodarea constituie operaţia inversă codării, respectiv revenirea de la semnalul discret la mesajul continuu sau discret corespunzător.

Informaţia productiv-economică minieră se obţine printr-un mecanism de alegere a unui eveniment dintr-un număr de evenimente posibile, egal probabile. Sursele, prin mecanismul de alegere din mulţimea mesajelor posibile a unui mesaj oarecare, generează informaţia (adică sunt surse de informaţie productiv-economice). [7]

Perturbarea informaţională productiv-economică minieră este reprezentată de un semnal care modifică semnalul productiv-economic aleator util, purtător de informaţie, micşorând cantitatea de informaţie transmisă.

2. Comunicarea managerială productiv-economică minieră [7]

Comunicarea managerială productiv-economică minieră se regăseşte în conţinutul managementului.

Comunicarea productiv-economică minieră este un proces *bidirecţional* între oameni aflaţi la diferite niveluri ierarhice, în cadrul tuturor funcţiunilor care au loc în sus, în jos sau pe orizontală.

Comunicarea productiv-economică minieră se analizează din perspectiva mediului extern firmei (clienţi, parteneri, autorităţi şi instituţii publice), cât şi din perspectiva mediului intern între resursele umane ale entităţii.

Comunicarea productiv-economică minieră internă ajută la realizarea circulaţiei optime a informaţiei în interiorul firmei, operaţionalizarea funcţiilor manageriale, monitorizarea, evaluarea şi motivarea angajaţilor, respectiv la dezvoltarea şi păstrarea competitivităţii.

Comunicarea productiv-economică minieră este un proces care din unghiul ştiinţei comunicării dispune de patru componente fundamentale: un *emiţător*, un *canal*, *informaţie* şi un *receptor* *(J.J. Van Cuileburg, O. Scholten, G.W. Noomen).* [7]

Pentru a-şi atinge obiectivele, managerul trebuie să participe la definirea obiectivelor, să transmită informaţiile către personal, să cunoască şi să înţeleagă obiectivele individuale ale angajaţilor, să creeze un mediu propice compatibilităţii dintre obiectivele organizaţionale şi cele personale.

Personalul angajat trebuie să cunoască misiunea şi obiectivele firmei productiv-economică minieră, să înţeleagă şi să accepte rolul lui în atingerea obiectivelor, să îşi apropie aceste obiective pentru a putea participa proactiv la îndeplinirea lor, să identifice calea de armonizare a obiectivelor firmei cu cele personale.

În practica firmelor productiv-economice miniere se întâlnesc forme specifice de comunicare managerială pentru fiecare etapă a evoluţiei productiv-economice.

Managerii dezvolta şi promovează politicile firmei productiv-economice miniere bazate pe sisteme de comunicare ce permit ajustarea structurii şi a procesului organizaţional.

Comunicarea managerială este o formă a comunicării interumane, un instrument al conducerii care pune în circulaţie informaţii despre rezultatul deciziilor productiv-economice miniere.

În corpul organizaţional al firmei productiv-economice miniere se întâlnesc reţele şi canale de comunicaţii ce au configuraţii specifice.

Sub-sistemul comunicaţional reprezintă ansamblul de date şi informaţii ce circulă pe canale de comunicare formale sau neformale, prin circuite şi fluxuri informaţionale în cadrul unei firme productiv-economice miniere. [7]

Reţelele de comunicare productiv-economice miniere pot fi: a) centralizate (informaţia avansează spre centru) şi b) descentralizate (schimbul de informaţii nu are o matrice).

Comunicarea internă productiv-economică minieră este: a) bipolară; b) în reţea (în formă de stea sau centrate; de Y; de cerc; multiple).

Într-o firmă, comunicarea internă productiv-economică minieră este influenţată de factori, precum: structura organizaţională, tipul de comunicare realizat, barierele comunicaţionale, importanţa comunicării informale, relaţia şef - subordonat şi climatul comunicării.

În sens larg, comunicarea productiv-economică minieră reprezintă procesul de transmitere de informaţii, idei, opinii, păreri fie de la un individ la altul, fie de la un grup la altul.

Există comunicare atunci când o sursă influenţează stările unui sistem, receptorul alegând dintre semnale pe acelea care conectează sursa cu receptorul.

Elementele structurale caracteristice ale procesului de comunicare productiv-economică minieră sunt [7]:

– existenţa a cel puţin doi parteneri (emiţător şi receptor);

– capacitatea de a emite şi recepta semnale;

– existenţa unui canal de transmitere a mesajului.

Într-o firmă comunicarea productiv-economică minieră reprezintă o componentă esenţială, în egală măsură o stare de spirit şi instrument operaţional în organizare şi conducere.

Prin conţinutul mesajelor, în procesul de comunicare se urmăreşte realizarea anumitor scopuri şi transmiterea diferitelor semnificaţii.

Un proces de comunicare productiv-economică minieră are o triplă dimensiune: *a)* comunicarea exteriorizată (acţiunile verbale şi nonverbale vizibile), *b)* meta-comunicarea (ceea ce se înţelege dincolo de cuvinte) şi *c)* intra-comunicarea (la nivelul sinelui).

Procesul de comunicare productiv-economică minieră are un caracter dinamic şi se derulează într-un context, în interdependenţă. [7]

Procesul de comunicare productiv-economică minieră are un caracter ireversibil (odată transmis un mesaj, el nu mai poate fi oprit).

Un prim criteriu luat în clasificarea formelor comunicării îl constituie modalitatea sau tehnica de transmitere a mesajului.

Există: a) comunicarea directă (mesajul este transmis uzitându-se mijloace primare – cuvânt, gest, mimică) şi b) comunicarea indirectă (se folosesc tehnici secundare –scriere, tipăritură, semnale transmise prin unde hertziene, cabluri, sisteme grafice ş.a.) *(I. Drăgan, 1991)*. [7]

Se identifică următoarele forme ale comunicării:

– intrapersonală (sau comunicarea cu sinele)

– interpersonală (sau comunicare de grup);

– de masă (pentru publicul larg).

După modul de realizare a procesului de comunicare se identifică:

– ascendentă (de la nivelurile inferioare către cele superioare);

– descendentă (realizează de la nivelurile superioare către cele inferioare);

– orizontală (între indivizi aflaţi pe poziţii ierarhice similare).

Într-o firmă comunicarea productiv-economică minieră reprezintă o componentă esenţială, în egală măsură o stare de spirit şi instrument operaţional în organizare şi conducere.

Elementele componente ale procesului de comunicare productiv-economică minieră sunt [7]:

– *feed-back-ul* (este un mesaj prin care emitentul primeşte un răspuns de la destinatar);

– *canalele de comunicare* (sunt căile urmate de mesaje);

– *mediul comunicării* (există mediu oral şi scris).

Barierele sunt perturbaţiile ce pot interveni în procesul de comunicare productiv-economică minieră.

Se întâlnesc bariere de limbaj, de mediu, datorate poziţiei emiţătorului şi receptorului, de concepţie.

Într-o firmă, barierele de mediu sunt cele mai cunoscute, fiind reprezentate de climatul de muncă necorespunzător şi folosirea de infrastructură informaţionala necorespunzătoare.

După modalitatea de transmitere a mesajului, comunicarea productiv-economică minieră este a) directă şi b) indirectă.

După modul în care managerii şi angajaţii participă la comunicare, aceasta poate fi: a) intrapersonală (comunicarea cu sinele); b) interpersonală (de grup); c) de masă (pentru publicul larg).

După modul de realizare a relaţionării comunicarea productiv-economică minieră în firmă este: a) ascendentă b) descendentă şi c) orizontală. [7]

Prin comunicarea productiv-economică minieră se înfăţişează performanţele, sensul, semnificaţia şi conotaţia legăturilor în cadrul firmei pentru formalizarea stabilităţii unor comportamente individuale sau de grup.

Scopul comunicării manageriale productiv-economice miniere este de a derula informări corecte, eficiente şi eficace, în concordanţă cu obiectivele manageriale şi organizaţionale stabilite.

Comunicarea productiv-economică minieră ocupă un loc fundamental în procesul de management, evoluţia acesteia fiind de la comunicarea autoritară, prescriptivă către cea relaţională, democratică.

Relaţia dintre participanţii la control reprezintă un alt aspect al funcţiei de control-evaluare ce se realizează prin comunicare productiv-economică minieră.

În exercitarea controlului sunt implicate trei persoane: a) decidentul; b) controlorul; c) controlatul.

Comunicarea scrisă productiv-economică minieră cuprinde rapoarte, memorii, scrisori, note şi alte documente bazate pe cuvântul scris. Are un grad ridicat de exactitate în raport cu comunicarea verbală, având avantajul păstrării facile a informaţiilor.

3. Concluzii

Prin comunicarea productiv-economică minieră se înfăţişează performanţele, sensul, semnificaţia şi conotaţia legăturilor în cadrul firmei pentru formalizarea stabilităţii unor comportamente individuale sau de grup.

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Comunicarea productiv-economică minieră ocupă un loc fundamental în procesul de management, evoluţia acesteia fiind de la comunicarea autoritară, prescriptivă către cea relaţională, democratică.

Într-o firmă, comunicarea internă productiv-economică minieră este influenţată de factori, precum: structura organizaţională, tipul de comunicare realizat, barierele comunicaţionale, importanţa comunicării informale, relaţia şef - subordonat şi climatul comunicării.

În sens larg, comunicarea productiv-economică minieră reprezintă procesul de transmitere de informaţii, idei, opinii, păreri fie de la un individ la altul, fie de la un grup la altul.

Există comunicare atunci când o sursă influenţează stările unui sistem, receptorul alegând dintre semnale pe acelea care conectează sursa cu receptorul.

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RISCURILE NON-INDUSTRIALE ÎN CADRUL NOII ECONOMII A RESURSELOR NATURALE/

NON-INDUSTRIAL RISK IN THE NEW ECONOMY OF NATURAL RESOURCES

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ABSTRACT

În noua economie ciclurile de afaceri, structura informaţiilor şi tehnologiilor de comunicare, precum şi productivităţile, - asociate cu globalizarea -, vor fi afectate în privinţa formelor, conţinuturilor şi timpului de operaţionalizare. Efectele reţelistice şi externalităţile devin multifactori principali de influenţă a productivităţii şi creşterii. Elementele conceptuale relatate mai sus conduc la propunerea de redifinire -, în sensul convenţional al înţelegerii la timpul prezent -, a globalizării, noii economii şi a protecţiei sociale pentru asigurarea cadrului de identificare a riscurilor societale. În contextul prezent, se identifică şi sunt cunoscute riscurile societăţii/economiei industriale. Se avansează propunerea de a se trece la analize situaţionale previzioniste, pentru identificarea şi sistematizarea riscurilor societăţii/ economiei non-industriale.

KEYWORDS

multifactori principali de influenţă, globalizare, riscurile societăţii/ economiei non-industriale, noua economie, resurse naturale.

1. Riscurile societăţii/ economiei non-industriale

Întrucât noua economie este dominată operaţional de piaţă, cei ce se află pe arealul concurenţial al acesteia, în mod individual devin responsabili pentru asigurarea veniturilor oamenilor, inclusiv pentru protecţia sau asigurarea bunăstării lor. [16]

Se consideră că statul ar trebui să devină „ultimul intervenţionist” în acest proces asiguratoriu, în măsura în care pentru diferite momente sau segmente de timp nu se îndeplinesc parametrii minimi de protecţie socială.

În prezent (2015), filosofia comportamentală generală, faţă de sărăcie de exemplu, se manifestă prin „ajutor şi solidaritate mutuală”, când sunt vizibile tangenţele cu evenimentele convenţional neacceptabile/nefavorabile, în măsura în care non-contribuitorii se regăsesc în inerţia socială, pseudo-asiguratorie pentru bunăstare. [16]

Democraţia politică ar trebui să fie însoţită de *responsabilitate socială* şi, în egală măsură, de *justiţie socială*.

Statul manifestă rol non-invaziv în esenţa asiguratorie socială, întrucât se constată tendinţa sa de intervenţie indirectă, prin sprijinul pieţelor şi a celor ce produc/furnizează utilităţi pentru supravieţuire pe aliniamentul activ contribuitor de protecţie socială.

Această tendinţă de „distanţare” survine din mulţimea diferenţiată de politici guvernamentale ce au rolul de punere în practică a managementului public, aferent riscurilor sociale.

În fapt, rolul statului în protecţia socială este frecvent dictat de *condiţionalităţile politice*.

Noile tehnologii, globalizarea, dereglementările şi competiţia de pe piaţă arată apariţia de noi incertitudini şi riscuri, asociate noii economii, cu reflexii în privinţa securităţii sociale [16].

Rezultă că în teoria şi practica protecţiei sociale, cu atât mai mult pentru situaţia manifestării noii economii, *nu se întâlneşte un model universal* în domeniu.

Este probabilă instituirea ideii de *„asigurare socială universală*”, care să soluţioneze dobândirea unui minim de securitate socială pentru fiecare membru al colectivităţii umane.

O astfel de abordare, datorită insuficienţei generale şi a rarităţii resurselor, presupune consens în privinţa redistribuirii lor, aspect relativ improbabil de soluţionat.

De aceea, se constată frecvent manifestarea *sistemului mixt* de protecţie socială. De exemplu, în SUA, sistemul de protecţie socială se remarcă prin deservirea grupurilor sociale „de margine”, aflate la „limitele” subzistenţei. „Statul european incipient” (aferent UE), manifestă „comportament universalist”, cu asumări de responsabilităţi pentru o largă gamă de probleme sociale, în timp ce statul scandinav aspiră la inducerea egalităţii *pentru standarde înalte* (nu pentru standarde limită, minime). [16]

În toate situaţiile, manifestarea statală în privinţa protecţiei sociale *este şi trebuie să fie continuă.*

Presiunea competiţiei în noua economie se ridică la rang de cerinţă naturală. Este posibil ca statul să nu mai aibă potenţialul, pârghiile, instrumentele, metodele, tehnicile şi resursele pentru asigurarea protecţiei sociale. Mai degrabă, rolul său ar putea fi de „administrator delegat” al problematicii şi soluţiilor de securitate socială generală. [16]

Informaţiile şi tehnologiile de comunicare (ITC), împreună cu economia bazată pe cunoaştere (E↔BC) generează paradigma tehnico-economică a noii economii {δTE(NE)} [16]:

$$\{\delta\ TE(NE)\} = (ITC) * (E \leftrightarrow BC) \qquad (1)$$

Situaţia paradigmatică enunţată, oferă oportunităţi pentru crearea/apariţia unei *noi clase de elite, profesionalizate în cunoaştere*, care poate favoriza instituirea de „noi tipuri de pieţe libere” în societatea post-industrială, caracterizate prin: *1)* dereglementare, *2)* privatizare, *3)* descentralizare şi *4)* globalizare.

În aprecierea noastr[această evoluţie conduce la apariţia *riscului de diferenţiere*, inclusiv în sfera protecţiei sociale. [16]

Este necesară formalizarea unei *ideologii pentru protecţie socială*, având în vedere riscul manifestării erodării sociale a diferitelor categorii de cetăţeni, prin neasimilarea instantanee a cunoaşterii echipotenţiale.

Ca atare, vor avea loc, în continuare şi în noua economie acţiuni de prioritizare, de ierarhizare şi direcţionare/redirecţionare a resurselor cu scop social, în contextul în care competiţia generală *foarte accentuată/ înaltă* vizează, în primul rând, costurile, inclusiv cele sociale.

Grupurile minoritare vulnerabile vor fi o realitate şi în noua economie, întrucât digitalizarea societăţii produce divizări, prin diferenţieri date de nivelul de educaţie al fiecărei persoane.

Dacă în economia prezentă (2015) se „acumulează/ stochează resurse”, în noua economie se va „acumula/depozita cunoaştere”. [16]

Între actuala şi noua economie este previzibilă apariţia de divergenţe, urmare a diferenţelor existente deja între capitalul uman obişnuit (convenţional, din prezent) şi capitalul intelectual, care va fi predominant.

Neîndoielnic, în noua economie ciclurile de afaceri, structura informaţiilor şi tehnologiilor de comunicare, precum şi productivităţile, - asociate cu globalizarea -, vor fi afectate în privinţa formelor, conţinuturilor şi timpului de operaţionalizare.

Efectele reţelistice şi externalităţile devin *multifactori principali de influenţă* a productivităţii şi creşterii.

Elementele conceptuale relatate mai sus conduc la propunerea de redifinire -, în sensul convenţional al înţelegerii la timpul prezent -, a globalizării, noii economii şi a protecţiei sociale pentru asigurarea cadrului de identificare a riscurilor societale.

În contextul prezent, se identifică şi sunt cunoscute riscurile societăţii/economiei industriale.

Se avansează propunerea de a se trece la *analize situaţionale previzioniste*, pentru identificarea şi sistematizarea *riscurilor societăţii/economiei non-industriale.* [16]

Economia bazată pe cunoaştere *(Knowledge Based Economy-KBE)* este caracterizată prin volatilitatea manifestării, însă, prin similitudine cu economia industrială/post-industrială se dovedeşte a avea „ferestre economice structurale", prin care să se întrevadă, să se înţeleagă şi să se interpreteze consecinţele transformărilor radicale/radicalizante în producţie/reproducţie şi distribuţie/consum. [16]

Incertitudinea manufacturării, sesizată în economia obişnuită, este similarizată cu *incertitudinea cunoaşterii/recunoaşterii.*

Riscurile aferente incertitudinilor, şi într-un caz şi în altul trebuie controlate şi minimizate, iar pentru sfera socială, în noua economie, din perspectivă asiguratorie este necesar efort ştiinţific şi politic.

Actualmente, în mediul economic strategic este adjudecată concepţia apariţiei/formalizării noii economii prin varianta sa atotcuprinzătoare, cunoscută sub denumirea de „*economie bazată pe cunoaştere*". Sub marcajul strategic, vizionar mulţumitor ca alternativă a acestei concepţii, se înregistrează „o linişte conceptuală" în privinţa riscurilor şi a protecţiei sociale ce acaparează transformarea în sine. [16]

De exemplu, „actuala economie" este însoţită de un nivel/volum al „sărăciei", care afectează părţi din colectivităţile umane.

Dimensiunea economico-socială actuală, cuantificabilă cu ajutorul indicatorilor statistici convenţionali, trebuie extrapolată şi virtual cuantificată cu dimensiunea economico-socială viitoare, aferentă noii economii, pentru care problema „sărăciei" nu este focalizată analitic şi evolutiv cu grad suficient de reprezentativitate [16].

Într-o astfel de situaţie poate să se menţină o anume „*iresponsabilitate/lipsă de responsabilitate organizată*", atâta timp cât instituţiile şi factorii politici acceptă statutul ce confirmă confruntarea cvasi-continuă cu riscurile, recunoscute ca realităţi imuabile, intangibile şi definitiv/obiectiv date.

În fapt, ar fi utilă „*procesarea incertitudinii*", respectiv a riscurilor, iar prin schimbări cu dinamism mai accentuat să se identifice *arealul riscurilor sistemice*, asupra cărora să se acţioneze cu raţionalitate. [16]

O variantă metodică pentru facilitarea abordării rezolvării problematicii sociale, respectiv controlului şi dinamicii riscurilor în noua economie poate surveni din propunerea de „*instituţionalizare a reţelelor sociale*".

Securitatea socială şi bunăstarea pot deveni „bunuri/servicii" mai publice, pentru sustenabilizare colectivă.

O sistematizare originală, exemplificativă pentru economia României, în perspectiva următoarelor 3-4 decenii de evoluţie productivă/consum sub incidenţa noii economii, se referă la sistemele de: *a)* securitate socială, *b)* beneficiu social universal, *c)* structuri private de beneficii sociale.

În noua economie nu este vorba de instaurarea egalitarismului social, însă adecvarea subzistenţei se impune din raţiuni fundamentale etice, legate de existenţa şi manifestarea condiţiei umane concurenţiale. [16]

Politicile sociale transnaţionale, evoluând către cele globale, sunt caracterizate de dificultăţi ridicate în privinţa formulării lor ca operaţionalitate, conţinut şi sustenabilitate, în raport cu politicele în domeniu, deja funcţionale în planurile locale, naţionale.

2. Tendinţe pentru identificarea riscurilor economice [16]

Firmele se află sub incidenţa *riscului* care trebuie stăpânit managerial spre a proteja viziunile referitoare la avansul operaţional fezabil în mediul economic ambiant.

Metrica performanţei poate fi cunoscută sau aplicată, folosind în mod „pro-activ" *ciclurile posibile de tendinţe*.

Obţinând informaţii cu privire la creştere/descreştere este posibil să se formuleze modalităţi de reacţie (reactive) la fiecare ciclu, marcând situaţional fiecare fază, care este înţeleasă şi raportată contextual spre folisinţă decizimală.

Se apreciază că toate etapele şi fazele de afaceri conţin *riscuri operaţionale*.

De exemplu, realizarea corectă a eficienţei, deficitul de securitate în telecomunicarea economică (pe internet), amploarea deciziilor strategice, soluţiile tehnice posibile ca variante proiectate ş.a. se înscriu în rândul riscurilor operaţionale moderne.

Acestora li se adaugă riscurile deschise de tip „soft" *(soft fact risk)* care se regăsesc în imaginea firmei, brand, reputaţie, consecvenţă şi constanţă operaţională ş.a.

În cadrul unei firme sau a unui grup de firme este posibilă sistematizarea tipurilor de evenimente care conţin riscuri operaţionale .

Riscul în concepţia tradiţională nu a fost perceput întotdeauna în *relaţie permanentă cu entitatea productiv-economică,* ci doar ca element de influenţă în sine ceea ce determină caracterizarea sa subiectivă în procesul de apariţie şi combatere (reducere sau eliminare).

În perioada modernă se observă preocupări pentru identificarea de noi metode de *cuantificare permanentă a riscurilor,* respectiv pentru creşterea obiectivităţii în procesul de măsurare a acestoraşi evitarea camuflării lor. [16]

Riscul a devenit parametru/factor în sistemul de management general economic, fiind considerat „indicator cheie pentru performanţă".

În procesul competitiv entităţile productiv-economice sunt caracterizate de abilitatea şi capacitatea lor de a alege (însuşi) obiective care să suporte riscurile.

Vizualizarea contextului manifestării a riscurilor se bazează pe [16]:

1) corelarea evenimentelor firmei;

2) predicţii bazate pe extrapolare din elementele aferente unor evenimente trecute;

3) măsurarea indicatorilor cheie aferenţi performanţei, şi

4) abordarea „excepţiilor" în privinţa regulilor urmate de firmă în dezvoltarea sa.

În acest cadru, indicatorii impuşi (obiectivele finale) se află sub incidenţa manifestării riscurilor, respectiv a controlului/monitorizării lor [16].

În sistemele productiv-economice se formalizează lanţul logic al acţiunilor, vizând dezvoltarea entităţii (organizaţiei) sau mediului economic, fiind enumerate activităţile aferente.

Pe această bază se identifică excepţiile, pentru care se enumeră riscurile, posibilităţile de apariţie şi impactul acestora.

Întotdeauna se folosesc elementele de mediu ambiant existente şi cunoscute, care devin referenţiale pentru reunirea acţiunilor, activităţilor şi a riscurilor în mulţimi distincte, ce se supun analizei şi procesărilor pentru optimizări.

În practică se întâlneşte combinarea riscurilor manageriale, respectiv a managementului riscurilor cu performanţele operaţionale ale activităţilor.

Pe acest fond se pot derula operaţionalizările productiv-economice bazate pe niveluri impuse de performanţă.

Obiectivele firmelor, riscurile, procesul de control şi căutarea aliniamentelor de normalitate pentru avans convenţional productiv-economic spre eficienţă se regăsesc în ciclurile închise de tendinţe.

În prezenţa riscului entităţile productiv-economice au operaţionalizate conceptualitatea acţională în trei zone după cum urmează [16]:

1) zona A - *Reducerea şi prevenţia riscului.* În acest caz riscul sesizat este mare, iar hazardul mai redus. Incertitudinea este ridicată însă se poate acţiona preventiv asupra acesteia;

2) zona B – *Obţinerea performanţelor operaţionale.* În acest cadru riscul începe să scadă şi în mod corespunzător hazardul înregistrează scădere.

3) zona C – *Iniţiative strategice*. Entităţile productiv-economice beneficiază în această zonă de strategii sau iniţiative strategice, care sunt caracterizate de riscuri foarte reduse (chiar nule), însă hazardul aferent conţinutului acestora este ridicat.

Se concluzionează că, în fapt ciclurile de tendinţe pot oferi imagini şi date de interes practic pentru dezvoltarea entităţilor productiv-economice luând în considerare mărimea riscurilor, a incertitudinilor şi hazardului, spre a cantona evoluţiile pe arealul de oportunităţi contravenţional dorite/impuse.

3. Prevenirea riscului şi diminuarea efectelor apariţiei sale [16]

Direcţiile importante pentru opţiunile decidenţilor în a preveni riscul în entităţile economice au expresii în obiectivele strategice, din rândul cărora se enumeră:

a) Reducerea cheltuielilor. Este examinată situaţia costului unitar şi a rezultatului din exploatare, urmare a creşterii cantităţii fabricate, respectiv a reducerii cantităţii fabricate, cu anumite niveluri procentuale (5%; 10%; 15%,….).

Se constată că modificarea volumului fizic al producţiei obţinute antrenează modificări în sens invers a costului unitar, întrucât suma cheltuielilor fixe va fi absorbită de un număr mai mare sau mai mic de produse.

Influenţa se resimte la nivelul rezultatului din exploatare.

Creşterea costului unitar determină reducerea rezultatului, iar reducerea costului unitar antrenează creşterea profitului.

Realitatea economică este sensibil diferită de suma influenţelor date de ipotezele teoretice din ştiinţa economică.

În economia reală evaluarea cât mai corectă a riscului este legală de evoluţia cheltuielilor variabile, considerate *indicator de efort*.

Cifra de afaceri este un *indicator de efort*. Atât cheltuielile variabile cât şi cifra de afaceri nu au caracter liniar.

Se impune determinarea cifrei de afaceri optime, aceasta fiind înregistrată când costul marginal (C_m) este egal cu venitul marginal (V_m) [16]:

$$C_m = V_m \longrightarrow \textit{profit max} \qquad (2)$$

Punctele critice rezultă tocmai din variaţiile neliniare ale costurilor şi vânzărilor.

b) Creşterea cifrei de afaceri. Cifra de afaceri este influenţată de: 1) cantitatea vândută şi 2) preţul de vânzare.

Creşterea cifrei de afaceri se obţine prin creşterea factorilor *cantitativi,* cât şi a celor *calitativi*.

Principalii factori cantitativi se referă la folosirea de tehnici moderne de marketing, ocuparea de noi pieţe, dezvoltarea desfacerii ş.a..

Factorii calitativi se referă la ridicarea nivelului calitativ al produselor finite, preţ de vânzare care corelează condiţiile interne cu cele externe, promovarea de noi produse ş.a.

Strategiile de prevenire a riscului în economie, în esenţă încorporează obiectivele strategice.

Managerii au astfel la dispoziţie posibilităţi acţionale pentru a preveni şi diminua riscul operaţional din exploatarecu ajutorul strategiilor.

Întreprinderile care înregistrează niveluri ridicate ale cheltuielilor fixe necesită modelări ale propriilor strategii, întrucât devin *mai riscante* şi *mai puţin flexibile* la modificările mediului economic.

Riscul în noua economie, într-o altă ordine de idei, îşi poate avea originea în maniera în care se iau deciziile, respectiv în natura politică a procesului de decizie care determină (formalizează) o politică economică în termeni economici convenţional impuşi/ programaţi/ ceruţi. [16]

Într-un astfel de context, se dovedeşte utilă identificarea arealelor de minimizare a riscurilor în noua economie.

4. Concluzii

Considerăm că, în noua economie urmează să se modifice mecanismele politice cunoscute de luare a deciziilor colective economice.

Astfel, *democraţia economică directă*, [16] în forma sa perfectă, în context clasic semnifică votul direct al unui corp electoral economic asupra unei politici economice, care să contracareze riscurile.

Este posibil să se manifeste următoarele reguli de vot (alegere):

- regula *sincerităţii*;
- regula *agendei* (care conţine materiale la care se manifestă expresiile de interes economic majoritar);
- regula *adaptării la circumstanţe*;
- regula *pronunţării pe baza informaţiei transmise*, care este purtătoare de semnificaţii, legalitate şi conţinut de interes.

În noua economie, preferinţele - ca satisfacere -, se vor baza preponderant pe ultima regulă (respectiv pe pronunţarea derivată din informaţia transmisă).

În *democraţia economică reprezentativă* distribuţia de politici economice ocazionează creşterea intuiţiei pentru alegerea convenţională adecvată.

Este posibil ca în noua economie să se manifeste procesul decizional operaţionalizat sub forţa *grupurilor de presiune* din reţelele de clusterizare.

Modelele de influenţă devin instrumente de mediere *multi-principială* a deciziilor economice.

De aceea pronunţarea pe baza informaţiei transmise, operată de către grupurile economice contributive din reţelele clusterizate oferă diferite corelaţii între riscuri şi profituri în noua economie dominată de fluxuri informaţionale tehnologice cu pante maximizate.

Panta fluxului informaţional tehnologic este cu atât mai mare cu cât riscurile sunt mai mari, iar profiturile mai reduse.

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METODE SI SURSE SUSTENABILE DE FINANTARE STRATEGICA A REFACERII TERENURILOR MINIERE DIN BAZINUL CARBONIFER AL OLTENIEI

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ABSTRACT

În articol se arată necesitatea proceselor de restructurare a activităţilor de exploatare a lignitului care a fost determinată de cerințe ale reducerii costurilor prin creşterea eficienţei tehnico-economice în activitatea de exploatare minieră; derularea operaţiunilor miniere prin luarea măsurilor stringente de protejare a mediului înconjurător. La acestea se adaugă situații contextuale/ conjuncturale precum: reducerea cererii de energie electrică şi termică la nivel naţional şi implicit reducerea consumului de combustibili solizi; necesitatea asigurării competitivităţii energetice în centralele termoelectrice pe bază de cărbune cu alte surse purtătoare de energie. Strategia de finanțare pe termen lung adoptată de complexele energetice din zonă este de a asigura continuarea procesului de funcționare a unităţilor fezabile, viabile, eficiente economic, așa încât preţul cărbunelui energetic produs să fie competitiv cu preţul combustibililor alternativi existenţi pe piaţă.

KEYWORDS

strategia de finanțare, activităţi de exploatare a lignitului, terenuri miniere, protejarea mediului înconjurător

1. Introducere

Combustibilii fosili solizi sunt o sursă primară semnificativă de energie în structura energetică a României, reprezentând o pondere de 39-42%.

Producţia de cărbune energetic a SNL Oltenia SA Tg-Jiu asigură necesarul pentru producerea a 36-40% energie electrică şi termică.

Dinamica producţiei de lignit obținută de Societatea națională a Lignitului Oltenia din Tg-Jiu este influențată de măsurile de retehnologizare şi restructurare parcurse şi de strategia de tranziţie pe piaţa energetică din România.

Se înregistrează variaţii continue ale cererii de cărbune energetic ceea ce presupune și impune elaborareade programe și modele de finanțare flexibile a activităților de extracție.

Întreprinderile miniere de exploatare a lignitului din bazinul carbonifer al Olteniei sunt amplasate pe un areal/aliniament desfăşurat pe cca 120 km, din Valea Dunării până în Valea Bistriţei-Vâlcea (*Figura.1.*). [5]

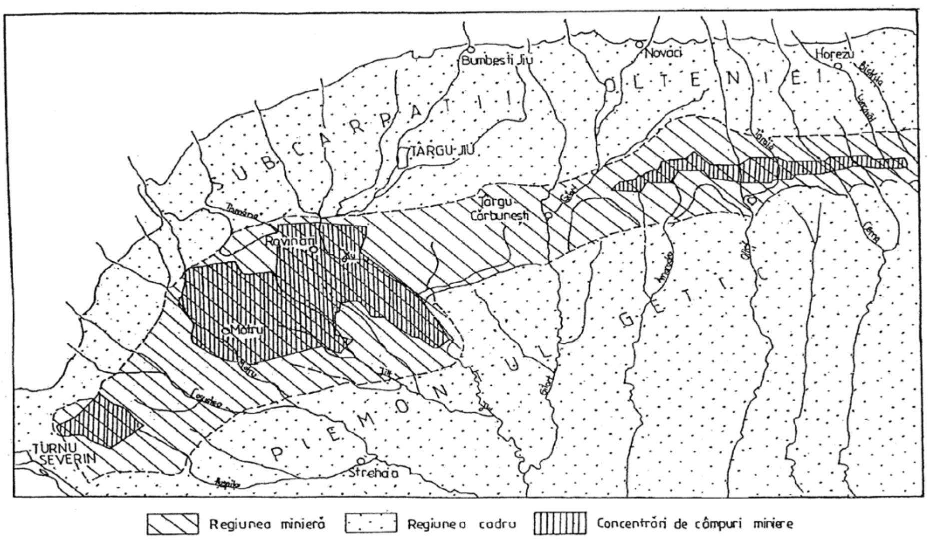

Figura.1. Perimetrele miniere carbonifere principale în zona Olteniei

Geologia zonei evidențiază faptul că zăcămintele de lignit din bazinul carbonifer al Olteniei aparţin perioadelor Neogen şi Cuaternar, respectiv sistemului geomorfologic Getic-Piemont.

Zona depresionară locală îndeplineşte funcţia de bazin de sedimentare.

Stratele sunt în număr de 21 și au distribuție neuniformă.

Tectonica stratelor este variabilă şi sunt situate la adâncimi reduse de exploatare, la cca. 50-150 m în raport cu suprafața. Situaţiile hidrogeologice sunt diferite, existând condiţii pentru exploatarea la zi cât şi în subteran.

Lignitul este un cărbune inferior, fiind combustibil preponderent pentru ardere în teermocentrale pentru producerea energiei electrice şi termice şi în mai redusă măsură pentru consumul casnic.

Caracteristicile combustibilului de tip lignit sunt: putere calorifică cuprinsă între 1650-1950 kcal/kg, conţinutul de sulf încadrându-se în intervalul 1%-1,5%, umiditate W_t=42% şi cenuşă 36,5%. [6].

Din perspectivă analitică economico-financiară obsevăm că, în fapt, cu cât poziția de extracţie a lignitului este mai apropiată de locul de producere a energiei electrice şi termice, cu atât preţul de cost al acestui combustibil este mai redus.

Baza materială este reprezentată din rezervele de lignit cantonate în perimetrele miniere concesionate, de cca. 178 milioane tone lignit energetic, din care 4 milioane tone rezerve dovedite și 174 milioane tone rezerve probabile.

Capacitatea de producţie este de 18 milioane tone/an lignit energetic, din care 96% în exploatări la zi şi 4% în exploatări subterane.

Activitatea de extracţie a lignitului se realizează pe o suprafaţă de cca. 100 km2 prin 9 exploatări miniere la zi.

În acest caz se folosesc tehnologii de extracţie în flux continuu cu excavatoare cu rotor, transportoare cu bandă de mare capacitate şi maşini de haldat.

Sunt în funcțiune și 3 exploatări miniere subterane în care extracţia lignitului se realizează cu abataje cu front lung echipate cu complexe mecanizate.

Activitatea de exploatare a lignitului în zonă se desfăşoară pe teritoriul a 3 judeţe: Gorj, Mehedinţi şi Vâlcea, în 12 perimetre miniere grupate în 5 unităţi de producţie, baze de aprovizionare tehnico-materială, transport şi prestări servicii, o unitate de valorificare a activelor şi un centru de recuperare şi perfecţionare a forţei de muncă.

Strategia de dezvoltare a activităţii miniere în zonă s-a bazat în primul rând pe reorganizarea unităţilor și pe de modernizarea mijloacelor de producţie, respectiv perfecţionarea continuă a forţei de muncă.

2. Elemente ale strategiei de finanțare în Bazinul Carbonifer al Olteniei

O constatare generală referitoare la conţinutul strategiei de finanțare este aceea că problematica de mediu/de refacere a mediului este acută în zonă.

Necesitatea proceselor de restructurare a activităţilor de exploatare a lignitului a fost determinată de cerințe ale reducerii costurilor prin:

- creşterea eficienţei tehnico-economice în activitatea de exploatare minieră;
- derularea operaţiunilor miniere prin luarea măsurilor stringente de protejare a mediului înconjurător.

La acestea se adaugă situații contextuale/ conjuncturale precum :

- reducerea cererii de energie electrică şi termică la nivel naţional şi implicit reducerea consumului de combustibili solizi;
- necesitatea asigurării competitivităţii energetice în centralele termoelectrice pe bază de cărbune cu alte surse purtătoare de energie;

Strategia de finanțare pe termen lung adoptată de complexele energetice din zonă este de a asigura continuarea procesului de funcționare a unităţilor fezabile, viabile, eficiente economic, așa încât preţul cărbunelui energetic produs să fie competitiv cu preţul combustibililor alternativi existenţi pe piaţă.

Bilanţul contabil anual şi contul de profit şi pierderi se supun spre aprobare Ministerului Finanţelor şi se publică în Monitorul Oficial al României, Partea a IV-a.

Strategia de finanțare trebuie să țină seama de faptul că untităţile productiv-economice din zona minieră Oltenia au, în principal, următorul obiect complex de activitate [5]: gestionarea şi protecţia zăcămintelor de lignit din perimetrele încredinţate spre exploatare; extracţia prin subteran şi cariere a cărbunelui, prepararea şi comercializarea lignitului din zăcămintele şi câmpurile miniere aferente entităţilor componentelor; executarea de lucrări miniere de deschidere şi pregătire în subteran şi descoperită în cariere; executarea de lucrări de cercetare geologică şi tehnologică pentru extinderea perimetrelor în exploatare şi pentru creşterea gradului de cunoaştere a celor existente; menţinerea şi dezvoltarea capacităţilor existente de producţie, precum şi deschiderea de noi câmpuri miniere; elaborarea de studii, proiecte şi documentaţii proprii în vederea îmbunătăţirii activităţii tehnologice; lucrări privind întreţinerea, repararea, confecţionarea pieselor de schimb şi utilajelor proprii necesare obiectului de activitate; construcţii-montaje miniere în subteran şi la suprafaţă; acţiuni de import-export şi de cooperare economică internaţională; servicii informatice proprii; perfecţionarea personalului pentru activitatea proprie, îmbunătăţită, performantă.

În conformitate cu contractele încheiate pentru producţia programată, complexele energetice determină anual volumul de venituri de realizat, cheltuielile totale de efectuat şi cota de impozit pe profit datorată bugetului de stat, conform legii

Întreprinderile din zona extractivă minieră al Olteniei întocmesc anual bilanţuri contabile şi conturile de profit şi pierderi după modelele stabilite de Ministerul Finanţelor, aspect realizat și în concordanță cu asumările din strategia de finanțare.

Se constată că veniturile cuprind şi subvenţiile pe produse, precum şi cheltuielile, și se stabilesc prin bugetul de venituri şi cheltuieli pentru fiecare exerciţiu financiar.

Bugetul de venituri şi cheltuieli se aprobă de Guvern cu avizul Ministerului Finanţelor şi al Ministerului Economiei.

Analizele evidențiază faptul că din veniturile realizate, în zonă se acoperă cheltuielile evidenţiate în costuri, precum şi cheltuielile şi plăţile prevăzute a fi suportate direct din venituri, potrivit legii.

Totodată, din veniturile realizate după acoperirea cheltuielilor se constituie fondul de rezervă şi fondul de dezvoltare, precum şi fondurile necesare pentru pregătirea, perfecţionarea şi recalificarea personalului angajat, pentru cointeresarea prin premiere a acestuia, plăteşte impozitele, taxele, cotele de asigurări şi securitate socială şi celelalte vărsăminte prevăzute de lege.

Preţurile de livrare la produsele, lucrările şi serviciile executate de societăţile miniere se stabilesc în condiţiile legii.

Preţurile şi tarifele la bunurile şi serviciile de interes public care fac obiectul propriu-zis al activităţii, pentru care concurenţa este exclusă sau substanţial restrânsă datorită existenţei unui monopol, sunt supuse controlului instituit de Guvern.

Strategia și modelul de finanțare evidențiază, deasemenea că Societăţile pot beneficia, după caz, de subvenţii care se aprobă prin Legea bugetului de stat.

Subvenţiile pot fi utilizate numai potrivit scopurilor pentru care au fost acordate. Programul de livrări avut în vedere la fundamentarea subvenţiilor constituie limita maximă de determinare a alocaţiilor respective.

Se remarcă faptul că, în prezent SNL Oltenia Târgu-Jiu nu beneficiază de subvenţii.

În cazul în care în cursul exerciţiului financiar veniturile nu sunt suficiente pentru acoperirea cheltuielilor, în contextul strategic financiar amintit, pe baza calculelor de fundamentare, se determină volumul creditelor necesare activităţii de producţie în valoare de cel mult 20% din veniturile brute realizate în anul precedent.

Pentru acoperirea eventualelor deficite, contractarea de credite peste nivelul stabilit se înfăptuiește cu sprijinul şi aprobarea Ministerului Finanţelor.

Unitățile miniere din zonă hotărăsc cu privire la investiţiile ce urmează a fi realizate, în limita competenţelor ce le sunt acordate, stabilesc nivelul surselor proprii de finanţare şi determină volumul creditelor bancare pentru obiectivele de dezvoltare.

În cazul investiţiilor finanţate integral sau parţial de la bugetul de stat, entităţile în cauză au obligaţia ca în executarea bugetului de venituri şi cheltuieli să se încadreze în alocaţiile bugetare aprobate.

Raportat la cererea prognozată prin Strategia Energetică a României, în perioada 2007-2020 rezultă un deficit din producţia internă de cca. 1,3 milioane tone/an lignit începând cu anul 2008, diferenţă care creşte progresiv, ajungând la 3,1 milioane tone în anul 2012, în condiţiile în care această cerere se menţine la nivelul prognozat.

Scăderea cererii de cărbune impune reducerea inclusiv a capacităţii de producţie, care corelată cu potenţialul economic al perimetrelor concesionate și presupune măsuri organizatorice şi tehnologice pentru redimensionarea activităţii extractive.

Reducerea activităţii de exploatare şi analiza personalului angrenat în exploatări implică măsuri adecvate pentru dimensionarea costurilor de exploatare şi sociale.

Exploatarea lignitului are o influenţă semnificativă asupra mediului, aspect pentru care în programul de investiţii sunt prevăzute cheltuieli pentru refacerea mediului prin lucrări de redare în circuitul economic a suprafeţelor afectate în conformitate cu legislaţia în vigoare.

Ponderea acestor lucrări în programul de investiţii este de aproximativ 4% din valoarea totală.

Din rândul măsurilor specifice de finanțare, cu valențe de înscriere în metodele si sursele sustenabile de finantare strategică a refacerii terenurilor miniere din Bazinul Carbonifer al Olteniei se reţin:

- redarea în circuitul economic prin predarea de către comunitatea locală a unor suprafeţe de 30-354 ha/an;

- surse financiare pentru elaborarea documentaţiilor de mediu;

- susținere financiară pentru reducerea emisiilor de particule în suspensie sau sedimentabile pentru încadrarea în condiţiile de mediu impuse de legislaţia europeană în domeniul protecţiei aerului;

- sprijin financiar pentru îmbunătăţirea indicatorilor de calitate ai apelor evacuate, prevăzuţi în autorizaţiile de funcţionare;

- sume din buget pentru protecţia terenurilor împotriva poluărilor accidentale, asigurarea stabilităţii acestora;

- surse financiare pentru monitorizarea factorilor de mediu, apă, aer, zgomot în vederea încadrării în condiţiile impuse de legislaţia europeană în aceste domenii;

Aceste opţiuni /măsuri strategice financiare pot asigura transpunerea în practică a măsurilor de protecţie a mediului în zonele critice ale instalaţiilor şi utilajelor precum și protejarea împotriva agenţilor poluanţi a zonelor limitrofe activităţii miniere.

3. Aspecte concluzive

• Raportat la cererea prognozată prin Strategia Energetică a României, în intervalul 2007-2020 se identifică un deficit din producţia internă de 1,3 milioane tone lignit ceea ce impune adaptarea starategică și tactică la noua situație a formulelor de finanțare.

• Considerăm că infrastructura geo-minieră zonală reprezintă factor de fundamentare strategică afiecărui scenariu de finanțare a domeniului industrial-extractiv în sistemul productiv-economic zonal.

• Ca atare, afectările de mediu, în particular cele asupra terenurilor miniere, nu pot fi eliminate prin alternativa abandonării activităţii miniere, ceea ce impune redirecționarea conceptuală a finanțării strategice în zonă.

• În acest cadru sunt necesare variante de eficientizare economică şi de imprimare a tendinţelor şi perspectivelor financiare favorabile în activitatea de exploatare, în strânsă legătură, cu refacerea terenurilor miniere.

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SUFICIENȚA RESURSELOR ȘI MODELUL DE OPERAȚIONALIZARE A EXPLOATĂRII ȘI VALORIFICĂRII LOR SUSTENABILE

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ABSTRACT

În articol sunt redate aspecte privind valorile modelistice ale resurselor minerale sub restricții de suficienţă economică a mediului. Se precizează că, în fapt, condiţiile suficienţei valorificării substanțelor minerale utile sunt absolute şi relative, însă acestea nu induc neapărat limitarea cantitativă şi calitativă a resurselor. Se observă că progresul tehnic, tehnologic şi noua cunoaştere în noua economie bazată pe cunoaștere extind categoriile de resurse, prin introducerea de noi tipuri şi sortimente de rezerve în circuitele de producţie şi reproducţie. Se ajunge la concluzia că suficienţa efectivă a resurselor minerale determină căutarea de variante, alternative și soluţii pentru asigurarea sortimentelor cerute de consum, din punct de vedere cantitativ şi calitativ.

KEYWORDS

suficienţa resurselor, suficienţa economică a mediului, model de suficiență, exploatare, valorificare, sustenabilitate.

1. Introducere

Concepția referitoare la suficienţei resurselor minerale este caracterizată de relativitate aplicativă, operaţională deoarece aceasta este legată de costuri.

Resursele minerale se întâlnesc cvasi-complet în volum fizic finit, care variază de la zăcământ la zăcământ.

Se constată că starea de exploatare şi valorificare totală a resurselor minerale complet finite nu se înregistreazî ideal, însă diferite tipuri de resurse ating epuizarea.

Recurgerea la folosirea resurselor minerale se face prin decizii echilibrate sau dezechilibrate, respectiv prin alocări simetrice sau asimetrice de perimetre pentru exploatare, în baza datelor referitoare la suficienţa volumului şi calităţii substanțelor utile.

Se întâlnește suficienţa fundamentală, de bază, iar în unele cazuri procesul de alocare, distribuire a exploatării este strict controlat, impus administrativ.

De multe ori, vizând perspectiva, eficienţa și productivitatea, problemele de mediu se regăsesc în plan secundar.

În mediul economic descentralizat, bazat pe competiţie şi competitivitate, suficienţa resurselor minerale este caracterizată de alocări la exploatare prin căutare, în funcţie de auto-suficienţa zonală a economiilor din areale regionale.

În esenţă, capitalul aferent exploatării şi valorificării resurselor minerale circulă şi se amplasează aplicativ doar pe zone/zăcăminte cu eficienţă.

Condiţiile suficienţei valorificării substanțelor minerale utile sunt absolute şi relative, însă acestea nu induc neapărat limitarea cantitativă şi calitativă a resurselor.

Se observă că progresul tehnic, tehnologic şi noua cunoaştere în noua economie bazată pe cunoaștere extind categoriile de resurse, prin introducerea de noi tipuri şi sortimente de rezerve în circuitele de producţie şi reproducţie.

2. Un model al suficienţei resurselor minerale

Suficienţa efectivă a resurselor minerale determină căutarea de variante, alternative și soluţii pentru asigurarea sortimentelor cerute de consum, din punct de vedere cantitativ şi calitativ.

Un model preluat din [7] exprimă faptul că într-un sistem de valori se manifestă *cerinţe economice* (de producţie) şi *cerinţe comerciale* (de piaţă) (Figura.1).

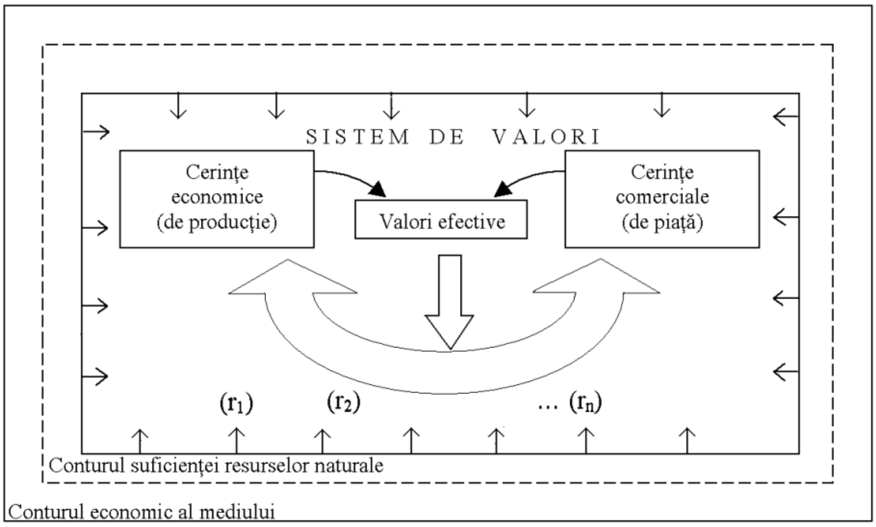

Figure 1: Figura: 1. Valori modelistice ale resurselor minerale sub restricții de suficienţă economică a mediului

r1, r2, ...,rn = restricţii ale sistemului de valori

Datele efective ale modelului arată alocările influenţate de restricţii tehnice, tehnologice, de eficienţă, ş.a (r_1, r_2, ..., r_n).

Ținând seama de existenţa complet finită, fizic absolută a resurselor minerale, în raport cu elementele considerate resurse, luând ăn calcule suprafața de distribuire a acestora, costul de exploatare şi preţul de vânzare, suficienţa optimă (S_{optim}) [7] se poate exprima prin modelul următor:

$$\left.\begin{cases} \mathscr{M}(E_r) = \{E_r^i\} \\ S \in D \\ (C \le P \\ V_f\,[\mathscr{M}(E_r^i)] \ne +\infty \end{cases}\right\} \longrightarrow S_{optim} \qquad (1)$$

Se observă că dacă cvasi-totatlitatea elementelor considerate resurse complet finite în volum fizic absolut este ridicată cantitativ costul final de exploatare-valorificare poate fi, de regulă, mai redus decât preţul posibil de practicat la valorificare.

Suficienţa resurselor minerale rezultă din realitatea fizică geologică şi ecosistemică fiid, așadar, *caracterizată de relativitate operaţională*.

Ca atare, este utilă elaborarea conceptuală a modelului suficienţei resurselor minerale, întrucât poate fi examinat raportul dintre costul total de exploatare-valorificare şi mărimea resurselor complet-finite în zăcământ.

Se pot întâlni și variantele de suficienţa maximă, respectiv de suficienţa minimă asimilată cu insuficienţ, raportate însă la preţurile şi costurile din procesele de producţie şi reproducţie, care antrenează resursele minerale în transformări materiale și energetice.

Resursele minerale supuse exploatării şi valorificării au efectele fizice cele mai semnificative asupra mediului. Suficienţa lor, arată că, prin exploatare, consum conduc la insuficienţă, influenţând calitatea mediului înconjurător.

De aceea, este importantă solutionarea: 1) cerinţelor fizice de resurse mineralet intrate sub procesul optimizării și 2) cerinţelor restrictive faţă de afectările ce se produc asupra mediului pe măsura exploatării şi valorificării acestora.

Totodată, trebuie avută în vedere *capacitatea mediului*, pentru a fi reactiv la exploatarea categoriilor de resurse menţionate.

Resursele naturale sigure, absolute sunt din ce în ce mai rare și inevitabil are loc reducerea naturală cantitativă a celor existente în zăcăminte convenționale.

În concordanţă cu tendinţa de mai sus, se simte nevoia practicării unui management specific tipurilor de resurse şi transformări.

Se observă și tendința ca resursele ne-regenerabile să intre sub incidenţa reducerii volumului şi intensităţii de exploatare.

În principal, tendinţa de reducere a volumului de resurse ne-regenerabile se bazează: 1) pe folosirea eficientă a acestora, respectiv; 2) pe accentuarea reciclării lor.

În privinţa managementului resurselor naturale, în literatură şi în conţinutul cercetărilor în domeniu [7] se constată manifestarea formalizărilor de tip *1)* diferit, *2)* diversificat, *3)* neconvergent şi *4)* tangente tendinţelor practice pe termen scurt şi mediu.

3. Concluzii

Predicţia suficienţei asigurării cu resurse minerale nu este întotdeauna complet fundamentată, în cazul resurselor neregenerabile.

Cu toate că se asistă la decuplarea cantitativă a consumului de materiale (care rămâne constant sau în scădere), în raport cu cvasi-continua creşterea economică se poate concluziona că în sfera impacturilor asupra mediului curbele de afectare sunt în creştere.

Totuşi, între curbele de impact şi curba creşterii economice se înregistrează decuplări sau decalaje.

Scenariile practice pe plan mondial în domeniul resurselor naturale arată, că în medie este posibilă creşterea eficienţei economice a folosirii energiei cu cel puţin 1% pe an.

Continuă degradarea, respectiv scăderea bio-productivităţii solurilor, iar afectarea sănătăţii umane nu înregistrează scăderile scontate de impact.

Asigurarea securităţii resurselor în contextul suficienţei lor induce cerinţa consolidării ciclurilor naturale în care sunt înglobate resursele naturale.

Toate aserțiunile de mai sus, este necesar să se regăsească articulate şi interconectate în management, respectiv în strategiile manageriale din domeniu.

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EVALUAREA RISCURILOR DE ACCIDENTARE ȘI ÎMBOLNĂVIRE PROFESIONALĂ

Vîgă Dragoș-Vasile

1 Consideratii generale

Exista o mare diversitate de metode de evaluare a riscurilor profesionale. Ansamblul metodelor se caracterizeaza prin varietate, atat din punct de vedere al abordarii generale, cat si al domeniului de aplicabilitate. Conform definitiei , riscul reprezinta combinatia dintre probabilitatea de producere a unui eveniment nedorit si gravitatea consecintelor rezultate.

riscul poate fi definit simplu ca dauna probabila, avand asadar doua dimensiuni:

probabilitatea, prin care se prognozeaza producerea in viitor a evenimentului;

dauna, care de regula poate fi indicata in functie de contextul producerii evenimentului respectiv.

Perceptia riscului ca un element subiectiv este o problema fundamentalain stabilirea riscului acceptabil.

In principiu exista doua posibilitati de evaluare a nivelului de risc/ securitatea munciiintr-un sistem:

evaluarea postaccident/ boala profesionala(a posteriorii); se bazeaza pe analiza accidentelor de muncasi a bolilor profesionaleproduse intr-un sistem de munca, intr-o anumita perioada de timp, criteriile de evaluare folosite sunt ratele de morbiditate prin accident de munca sau boala profesionala, respectiv indicii de frecventa si de gravitate:

evaluarea preaccident/ boala profesionala (a priorii) se bazeaza pe analiza riscurilor, inainte de a se materializa in accidente sau boli profesionale, criteriile de evaluare se bazeaza pe estimarea calitativa a riscului.

1.1 Categorii de metode

Pentru a raspunde obiectivului acestui capitol, nu se pot aplica criteriile clasice de clasificare a metodelor de analiza a riscurilor, care corespund:

- metodelor inductive, bazate pe observarea cauzelor si a consecintelor (HAZOP, APR, AMDEC si arborele de evenimente;
- metodelor deductive, care constau din a porni de la consecinte spre cauzele primare ale acestora, de exemplu prin stabilirea pentru un eveniment final a evenimentelor care il genereaza(arborele defectarilor).

In scopul descrierii tipurilor de metode se vor utiliza urmatoarele patru criterii de baaza:

- metode care permit o abordare calitativa;
- metode care permit o abordare cantitativa;
- metode deterministe;
- metode probabilistice.

Aplicand criteriile deterministe si probabilistice se pot evidentia urmatoarele trei clase de metode de analiza a riscurilor:

- exclusiv deterministe – se bazeaza pe luarea in considerare a echipamentelor concomitent cu evaluarea consecintelor, exprimate prin efecte asupra oamenilor;

- exclusiv probabilistice, se bazeaza pe estimarea probabilitatii sau a frecventei de aparitie a unei situatii periculoase sau pe materializarea consecintelor unui accident potential. Metodele probabilistice se focalizeaza pe probabilitatea de defectare a echipamentelor sau a elementelor componente ale acestora;
- combinate, in acest caz campul de actiune permite efectuareaunei analize globale a amplasamentului industrial, respectiv a sistemului de munca.

2 Prezentarea unei metode pentru evaluarea riscurilor de accidentare si imbolnavire profesionala (metoda elaborata de I.N.C.D.P.M. Bucuresti)

2.1 Relaţia risc – securitate

În terminologia de specialitate, securitatea omului în procesul de muncă este considerată ca acea stare a sistemului de muncă în care este exclusă posibilitatea de accidentare şi îmbolnăvire profesională.

În limbajul uzual, securitatea este definită ca faptul de a fi la adăpost de orice pericol, iar riscul – posibilitatea de a ajunge într-o primejdie, pericol potenţial[1].

Dacă luăm în considerare sensurile uzuale ale acestor termeni, se poate defini securitatea ca starea sistemului de muncă în care riscul de accidentare şi îmbolnăvire este zero.

Prin urmare, securitatea şi riscul sunt două noţiuni abstracte, contrare, care se exclud reciproc.

În realitate, datorită trăsăturilor oricărui sistem de muncă, nu se pot atinge asemenea stări cu caracter de absolut. Nu există sistem în care să fie exclus complet pericolul potenţial de accidentare sau îmbolnăvire; apare întotdeauna un risc „rezidual", fie şi numai datorită imprevizibilităţii acţiunii omului. Dacă nu se fac intervenţii corectoare pe parcurs, acest risc rezidual creşte, pe măsură ce elementele sistemului de muncă se degradează prin „îmbătrânire".

În consecinţă, sistemele pot fi caracterizate prin „niveluri de securitate", respectiv „niveluri de risc", ca indicatori cantitativi ai stărilor de securitate, respectiv de risc. Definind securitatea ca o funcţie de risc y = f(x), unde $y = \frac{1}{x}$, se poate afirma că un sistem va fi cu atât mai sigur, cu cât nivelul de risc va fi mai mic şi reciproc. Astfel, dacă riscul este zero, din relaţia dintre cele două variabile rezultă că securitatea tinde către infinit, iar dacă riscul tinde către infinit, securitatea tinde către zero (figura nr.6):

$$y = \frac{1}{0} \rightarrow +\infty; \quad y = \frac{1}{+\infty} \rightarrow 0.$$

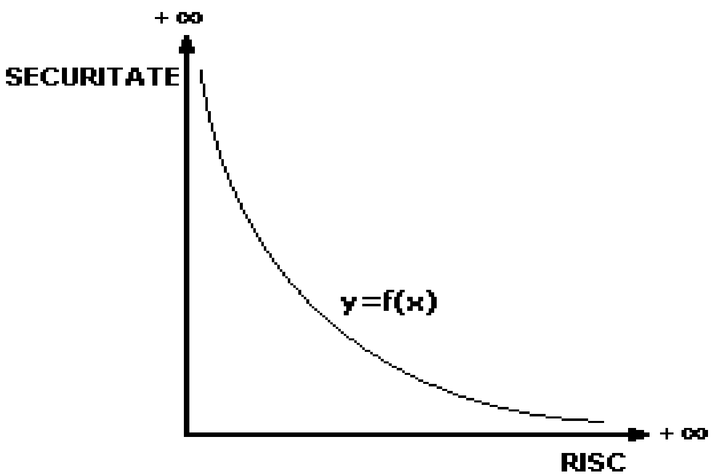

Fig. nr.6 Relaţia risc – securitate

În acest context, în practică trebuie admise o limită de risc minim, respectiv un nivel al riscului diferit de zero, dar suficient de mic pentru a se considera că sistemul este sigur, ca şi o limită de risc maxim, care să fie echivalentă cu un nivel atât de scăzut de securitate, încât să nu mai fie permisă funcţionarea sistemului.

2.2 Noţiunea de risc acceptabil

Riscul a fost definit în literatura de specialitate în domeniul securităţii muncii prin probabilitatea cu care, într-un proces de muncă, intervine un accident sau o îmbolnăvire profesională, cu o anumită frecvenţă şi gravitate a consecinţelor.

Într-adevăr, dacă admitem un anumit risc, putem să-l reprezentăm, în funcţie de gravitatea şi probabilitatea de producere a consecinţelor, prin suprafaţa unui dreptunghi F_1, dezvoltat pe verticală; rezultă că aceeaşi suprafaţă poate fi exprimată şi printr-un pătrat F_2 sau printr-un dreptunghi F_3 extins pe orizontală (figura nr.7).

În toate cele trei cazuri riscul este la fel de mare. În consecinţă, putem atribui unor cupluri gravitate – probabilitate diferite, acelaşi nivel de risc.

Dacă unim cele trei dreptunghiuri printr-o linie trasată prin vârfurile care nu sunt pe axele de coordonate, obţinem o curbă cu alură de hiperbolă, care descrie legătura dintre cele două variabile: gravitate – probabilitate. Pentru reprezentarea riscului funcţie de gravitate şi probabilitate, standardul CEN-812/85 defineşte o astfel de curbă drept „curbă de acceptabilitate a riscului" (figura nr.8).

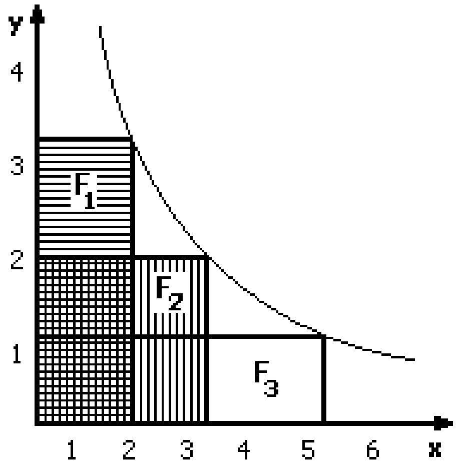

Fig. nr.7 Reprezentarea grafică a echivalenţei riscurilor caracterizate prin cupluri diferite de gravitate – probabilitate

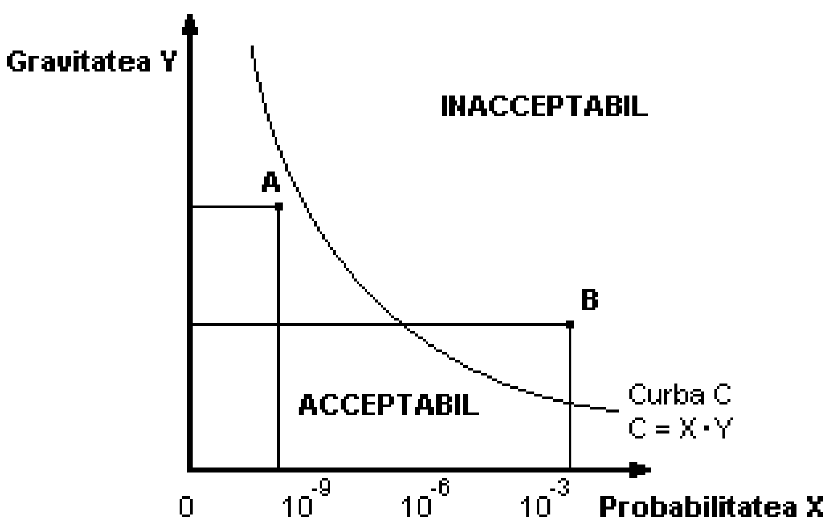

Fig. nr.8 Curba de acceptabilitate a riscului

Această curbă permite diferenţierea între riscul acceptabil şi cel inacceptabil. Astfel, riscul de producere a unui eveniment A, cu consecinţe grave, dar frecvenţă foarte mică, situat sub curba de acceptabilitate, este considerat acceptabil, iar riscul evenimentului B, cu consecinţe mai puţin grave, dar cu o probabilitate mai mare de apariţie, ale cărui coordonate se situează deasupra curbei, este inacceptabil.

De exemplu, în cazul unei centrale atomice se iau astfel de măsuri încât riscul unui eveniment nuclear – fie el riscul evenimentului A – este caracterizat printr-o gravitate extremă a consecinţelor, dar de o probabilitate de producere extrem de mică. Din cauza frecvenţei foarte reduse de apariţie, activitatea este considerată sigură şi riscul acceptat de societate.

În schimb, dacă pentru riscul evenimentului B luăm ca exemplu accidentul rutier din activitatea unui conducător auto, deşi acest tip de eveniment provoacă consecinţe mai puţin grave decât un accident nuclear, probabilitatea de producere este atât de mare (frecvenţă foarte ridicată), încât locul de muncă al şoferului este considerat nesigur (risc inacceptabil).

Orice studiu de securitate are drept obiectiv stabilirea riscurilor acceptabile. O asemenea tratare a riscului ridică două probleme:

- cum se stabilesc coordonatele riscului: cuplul gravitate – probabilitate;
- ce coordonate ale riscului se vor alege pentru a delimita zonele de acceptabilitate de cele de inacceptabilitate.

Pentru a le rezolva, premisa de la care s-a pornit în elaborarea metodei de evaluare a fost relaţia risc – factor de risc.

2.3 Determinarea coordonatelor riscului

Existenţa riscului într-un sistem de muncă este datorată prezenţei factorilor de risc de accidentare şi îmbolnăvire profesională. Prin urmare, elementele cu ajutorul cărora poate fi caracterizat riscul, deci pot fi determinate coordonatele sale, sunt de fapt probabilitatea cu care acţiunea unui factor de risc poate conduce la accident şi gravitatea consecinţei acţiunii factorului de risc asupra victimei.

În consecintă, pentru evaluarea riscului, respectiv a securităţii, este necesară parcurgerea următoarelor etape:

- identificarea factorilor de risc din sistemul analizat;
- stabilirea consecinţelor acţiunii asupra victimei, ceea ce înseamnă determinarea gravităţii lor;
- stabilirea probabilităţii de acţiune a lor asupra executantului;
- atribuirea nivelurilor de risc funcţie de gravitatea şi probabilitatea consecinţelor acţiunii factorilor de risc.

Modelul teoretic al genezei accidentelor de muncă şi bolilor profesionale elaborat în cadrul I.N.C.D.P.M. Bucureşti, abordând sistematic cauzalitatea acestor evenimente, permite elaborarea unui instrument pragmatic pentru identificarea tuturor factorilor de risc dintr-un sistem.

În condiţiile unui sistem de muncă real, aflat în funcţiune, nu există suficiente resurse (de timp, financiare, tehnice etc.) pentru ca să se poată interveni simultan asupra tuturor factorilor de risc de accidentare şi îmbolnăvire profesională. Chiar dacă ar exista, criteriul eficienţei (atât în sensul restrâns, al eficienţei economice, cât şi al celei sociale) interzice o astfel de acţiune. Din acest motiv, nici în cadrul analizelor de securitate nu se justifică luarea lor integral în considerare. Din multitudinea factorilor de risc a căror înlănţuire se finalizează potenţial cu un accident sau o îmbolnăvire, factorii care pot reprezenta cauze finale, directe, sunt cei a căror eliminare garantează imposibilitatea producerii evenimentului, deci devine obligatorie orientarea studiului asupra acestora.

Diferenţierea riscurilor în raport cu gravitatea consecinţei este uşor de realizat. Indiferent de factorul de risc şi de evenimentul pe care-l poate genera, consecinţele asupra executantului pot fi grupate după categoriile definite prin lege: incapacitate temporară de muncă, invaliditate şi deces. Mai mult, pentru fiecare factor de risc se poate afirma cu certitudine care este consecinţa sa maximă posibilă. De exemplu, consecinţa maximă posibilă a electrocutării va fi întotdeauna decesul, în timp ce consecinţa maximă a depăşirii nivelului normat de zgomot va fi surditatea profesională – invaliditate. Cunoscând tipurile de leziuni şi vătămări, ca şi localizarea potenţială a acestora, în cazul accidentelor şi bolilor profesionale, aşa cum sunt ele precizate de criteriile medicale de diagnostic clinic, funcţional şi de evaluare a capacităţii de muncă elaborate de Ministerul Sănătăţii şi Ministerul Muncii şi Solidarităţii Sociale , se poate aprecia pentru fiecare factor de risc în parte la ce leziune va conduce in extremis, ce organ va fi afectat şi, în final, ce tip de consecinţă va produce: incapacitate, invaliditate sau deces. La rândul lor, aceste consecinţe se pot diferenţia în mai multe clase de gravitate. De exemplu, invaliditatea poate fi de gradul I, II sau III, iar incapacitatea: mai mică de 3 zile (limita minimă stabilită prin lege pentru definirea accidentului de muncă), între 3 – 45 zile şi între 45 – 180 zile. Ca şi în cazul probabilităţii de producere a accidentelor sau îmbolnăvirilor, putem stabili şi pentru gravitatea consecinţelor mai multe clase, după cum urmează:

- **clasa 1:** consecinţe neglijabile (incapacitate de muncă mai mică de 3 zile);
- **clasa 2:** consecinţe mici (incapacitate cuprinsă între 3 – 45 zile, care necesită tratament medical);
- **clasa 3:** consecinţe medii (incapacitate 45 – 180 zile, tratament medical şi spitalizare);
- **clasa 4:** consecinţe mari (invaliditate gradul III):
- **clasa 5:** consecinţe grave (invaliditate gradul II);
- **clasa 6:** consecinţe foarte grave (invaliditate gradul I);
- **clasa 7:** consecinţe maxime (deces).

Referitor la frecvenţă, este cunoscut că accidentul sau boala sunt evenimente aleatorii. Prin urmare, factorii de risc se vor diferenţia între ei prin faptul că fiecare conduce cu o altă probabilitate la producerea unui accident sau a unei îmbolnăviri. De exemplu, probabilitatea de producere a unui accident datorită mişcării periculoase a organelor în mişcare ale unei foreze este diferită faţă de cea a producerii, la acelaşi loc de muncă, a unui accident datorită trăsnetului. De asemenea, acelaşi factor va putea fi caracterizat printr-o altă frecvenţă de acţiune asupra executantului, în diverse momente ale funcţionării unui sistem de muncă sau în sisteme analoge, în funcţie de natura şi de starea elementului generator. Astfel, probabilitatea de electrocutare prin atingere directă la manevrarea unui aparat acţionat electric este mai mare dacă acesta este vechi şi are uzată izolarea de protecţie a conductorilor, decât dacă aparatul este nou.

Din punct de vedere al operativităţii, nu se poate lucra însă cu probabilităţi determinate strict pentru fiecare factor de risc. În unele cazuri, ele nici nu pot fi calculate, cum se întâmplă cu factorii proprii executantului.

Probabilitatea de a acţiona într-o anumită manieră generatoare de accident nu poate fi decât aproximată. În alte situaţii, calculul necesitat de determinarea riguroasă a probabilităţii de producere a consecinţei este atât de elaborios, încât ar fi mai costisitor şi mai îndelungat decât aplicarea efectivă a măsurilor de prevenire. De aceea ar fi mai indicat să se stabilească probabilităţile, de regulă, prin apreciere şi să se grupeze pe intervale. Este mai uşor şi mai eficient pentru scopul urmărit să se aproximeze că un anumit accident este probabil să fie generat de acţiunea unui factor de risc cu o frecvenţă mai mică de o dată la 100 de ore. Diferenţa faţă de nişte valori riguroase de 1 la 85 ore sau 1 la 79 ore este nesemnificativă, evenimentul putând fi caracterizat în toate trei cazurile ca fiind foarte frecvent.

Din acest motiv, dacă utilizăm intervalele precizate în CEI 812/1985, obţinem 5 grupe de evenimente, pe care le putem ordona astfel:

- extrem de rare: $P < 10^{-7}/h$;
- foarte rare: $10^{-7} < P < 10^{-5}/h$;
- rare: $10^{-5} < P < 10^{-4}/h$;
- puţin frecvente: $10^{-4} < P < 10^{-3}/h$;
- frecvente: $10^{-3} < P < 10^{-2}/h$;
- foarte frecvente: $P > 10^{-2}/h$.

Vom atribui acum fiecărei grupe o clasă de probabilitate, de la 1 la 6, aşa încât vom spune că evenimentul E_1, a cărui frecvenţă probabilă de producere este de $P_1 < 10^{-7}/h$, este de clasa 1 de probabilitate, iar evenimentul E_6, cu frecvenţa $P_6 > 10^{-2}/h$, este de clasa a 6-a de probabilitate. Obţinem o scală de cotare a probabilităţii.

Având la dispoziţie aceste două scale – de cotare a probabilităţii şi a gravităţii consecinţelor acţiunii factorilor de risc – putem să asociem fiecărui factor de risc dintr-un sistem un cuplu de elemente caracteristice, gravitate – probabilitate, pentru fiecare cuplu stabilindu-se un nivel de risc.

Pentru atribuirea nivelurilor de risc, respectiv de securitate s-a utilizat curba de acceptabilitate a riscului.

Mai întâi, deoarece gravitatea este un element mai important din punct de vedere al finalităţii protecţiei muncii, s-a admis ipoteza că are o incidenţă mult mai mare asupra nivelului de risc decât frecvenţa. În consecinţă, corespunzător celor 7 clase de gravitate s-au stabilit 7 niveluri de risc, în ordine crescătoare, respectiv 7 niveluri de securitate, dată fiind relaţia invers proporţională între cele două stări (risc – securitate):

– N_1 – nivel minim de risc → – S_7 – nivel maxim de securitate;
– N_2 – nivel foarte mic de risc → – S_6 – nivel foarte mare de securitate;
– N_3 – nivel mic de risc → – S_5 – nivel mare de securitate;
– N_4 – nivel mediu de risc → – S_4 – nivel mediu de securitate;
– N_5 – nivel mare de risc → – S_3 – nivel mic de securitate;
– N_6 – nivel foarte mare de risc→ – S_2 – nivel foarte mic de securitate;
– N_7 – nivel maxim de risc → – S_1 – nivel minim de securitate.

Dacă luăm în considerare toate combinaţiile posibile ale variabilelor specificate, câte două, obţinem o matrice $M_{g,p}$ cu 7 linii – g, care vor reprezenta clasele de gravitate, şi 6 coloane – p – clasele de probabilitate:

$$M_{g,p} = \left\| \begin{matrix} (1,1) & (1,2) & (1,3) & (1,4) & (1,5) & (1,6) \\ (2,1) & (2,2) & (2,3) & (2,4) & (2,5) & (2,6) \\ (3,1) & (3,2) & (3,3) & (3,4) & (3,5) & (3,6) \\ (4,1) & (4,2) & (4,3) & (4,4) & (4,5) & (4,6) \\ (5,1) & (5,2) & (5,3) & (5,4) & (5,5) & (5,6) \\ (6,1) & (6,2) & (6,3) & (6,4) & (6,5) & (6,6) \\ (7,1) & (7,2) & (7,3) & (7,4) & (7,5) & (7,6) \end{matrix} \right\|$$

Reprezentînd grafic (figura nr.9) matricea în cadrul unui sistem de coordonate rectangulare obţinem un dreptunghi a cărui bază (abscisa) o constituie mulţimea claselor de probabilitate, înălţimea (ordonata) – clasele de gravitate, iar suprafaţa sa: mulţimea nivelurilor de risc posibile:

$$\sum_{R=1}^{7} N_R$$

De asemenea, cu ajutorul fiecăruia dintre cupluri descriem un dreptunghi care considerăm că figurează un risc; fiecărei microsuprafeţe îi vom atribui un nivel de risc, astfel încât prin reuniune să obţinem:

$$\sum_{R=1}^{7} N_R$$

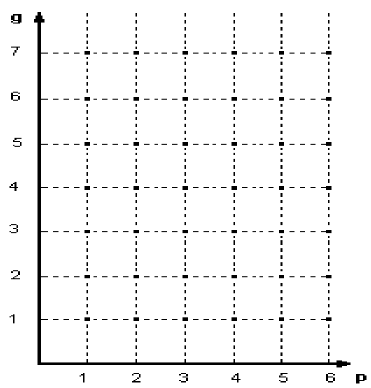

Fig. nr.9 Reprezentarea grafică a matricei cuplurilor de variabile gravitate – probabilitate (mulţimea nivelurilor de risc): *g* – clasă de gravitate; *p* – clasă de probabilitate

Observaţie:

Din considerente practice, la construirea graficului s-au acceptat următoarele convenţii:

- *atât pe axa Og, cât şi pe axa Op, clasele corespunzătoare au fost figurate prin segmente egale, deşi diferenţele între gravităţile evenimentelor de la o clasă la alta, cât şi intervalele de timp în cazul claselor de probabilitate, pe baza cărora s-au determinat, nu sunt egale;*
- *pentru intervalele care reprezintă clasele de gravitate s-au folosit segmente cu lungime mai mare decât pentru cele care delimitează clasele de frecvenţă ($1^{1/2}$ - 1), tocmai datorită premisei că gravitatea are o pondere mult mai mare în dimensiunea riscului.*

Prin suprapunerea succesivă, în anumite condiţii, a curbei de acceptabilitate a riscului asupra reprezentării obţinute a mulţimii nivelurilor de risc s-a stabilit încadrarea cuplurilor pe niveluri de risc, aşa cum se explicitează în continuare.

Menţinând logica reprezentării prin segmente egale a claselor, rezultă că şi curbele care delimitează nivelurile de risc trebuie să fie echidistante. În consecinţă, împărţim diagonala mare a dreptunghiului care semnifică suma mulţimilor nivelurilor de risc în 7 segmente egale, prin care se vor trasa curbele.

Nivelul 1 – nivel minim de risc acceptabil

Limita din dreapta a primului segment este unul dintre punctele prin care se va trasa curba nivelului 1. Luăm acum în considerare toate cuplurile în care gravitatea intră cu valoarea 1 (linia 1 a matricei $M_{g,p}$).

Într-adevăr, toţi factorii de risc a căror consecinţă posibilă este incapacitate de muncă mai mică de 3 zile pot fi consideraţi ca fiind de nivel minim de risc acceptabil, evenimentele produse neconstituind subiect al prevenirii (nu sunt accidente de muncă; de regulă, sunt tratate ca incidente şi eliminarea lor face obiectul acţiunii de mărire a confortului în muncă, nu a securităţii). Cuplul limită este cel în care gravitatea are valoarea 1 şi probabilitatea valoarea 6.

Trasăm prin cele două puncte astfel stabilite o curbă având alura curbei de acceptabilitate stabilită prin CEN-815/85 (figura nr. 10).

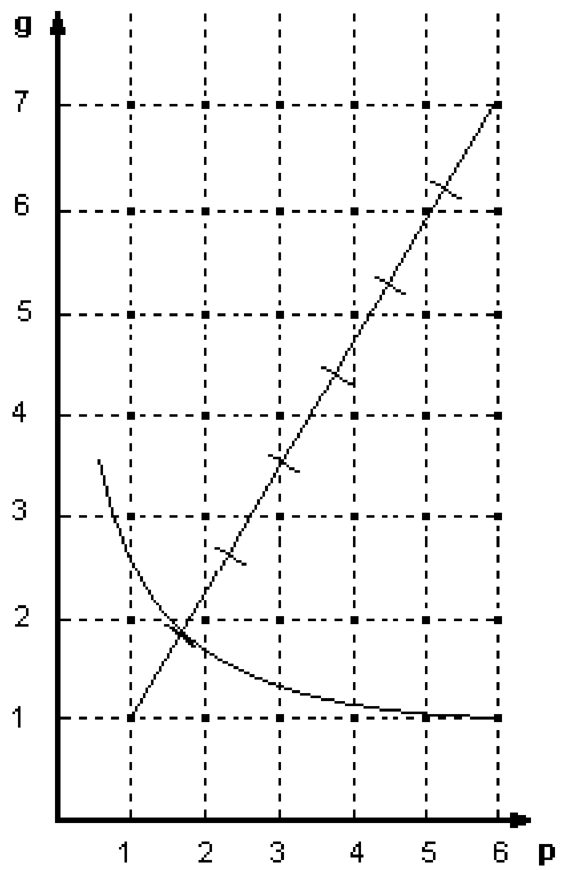

Fig. nr. 10 Trasarea curbelor nivelurilor de risc.
Stabilirea punctelor prin care se trasează curbele de nivel;
curba de nivel 1 (risc minim acceptabil

Suprafaţa care este delimitată de laturile dreptunghiului şi de curba trasată va reprezenta grafic nivelul 1 de risc. Toţi factorii de risc ce pot fi caracterizaţi prin cupluri ale căror coordonate generează puncte situate în interiorul suprafeţei astfel delimitate sau pe curbă vor fi consideraţi de nivel 1 de risc, respectiv 7 de securitate.

Din reprezentarea grafică, rezultă că din matricea $M_{g,p}$, nivelului 1 de risc îi corespunde submatricea:

$$M_{1,p}^{6} = \|(1,1) \quad (1,2) \quad (1,3) \quad (1,4) \quad (1,5) \quad (1,6)\|$$ şi elementul (2,1).

Nivelul 2 – 7

Trasăm curbele pentru nivelurile 2 - 6 paralel la curba de nivel de risc minim acceptabil prin punctele care delimitează segmentele stabilite pe diagonala dreptunghiului mulţimii nivelurilor de risc (figura nr. 11).

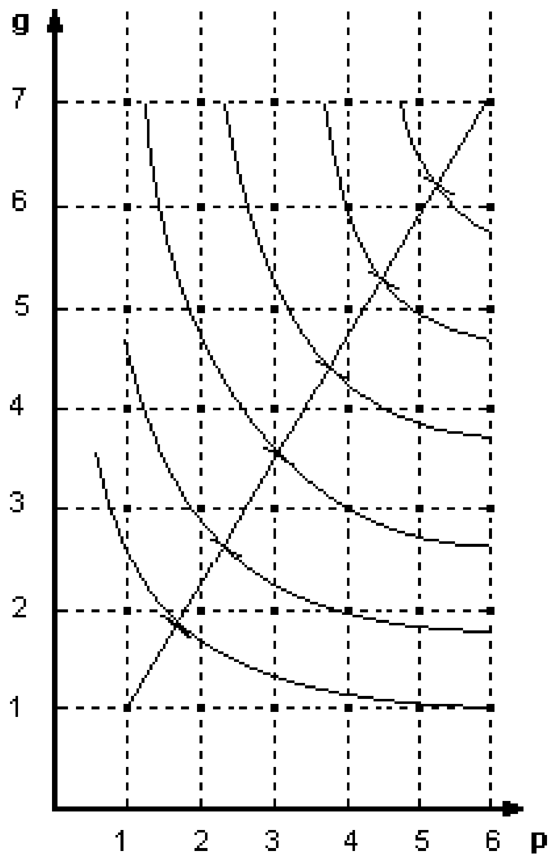

Fig. nr. 11 Trasarea curbelor nivelurilor de risc.
Trasarea curbelor pentru nivelurile 2 – 7;
nivel de risc maxim acceptabil şi critic.
Nivelul de risc 1 – cuplurile g-p: (1,1) (1,2) (1,3) (1,4) (1,5) (1,6) (2,1);
Nivelul de risc 2 – cuplurile g-p: (2,2) (2,3) (2,4) (3,1) (3,2) (4,1);
Nivelul de risc 3 – cuplurile g-p: (2,5) (2,6) (3,3) (3,4) (4,2) (5,1) (6,1) (7,1);
Nivelul de risc 4 – cuplurile g-p: (3,5) (3,6) (4,3) (4,4) (5,2) (5,3) (6,2) (7,2);
Nivelul de risc 5 – cuplurile g-p: (4,5) (4,6) (5,4) (5,5) (6,3) (7,3);
Nivelul de risc 6 – cuplurile g-p: (5,6) (6,4) (6,5) (7,4);
Nivelul de risc 7 – cuplurile g-p: (6,6) (7,5) (7,6).

Ca şi mai sus, secţiunea delimitată de curba nivelului 1 şi de curba imediat superioară va reprezenta grafic nivelul 2; tuturor factorilor de risc pentru care cuplurile gravitate – probabilitate generează puncte situate în interiorul acestei suprafeţe sau pe limita sa superioară li se alocă nivelul 2 de risc.

Similar se atribuie nivelurile 3, 4, ..., 6.

Suprafaţei delimitate de curba nivelului 6 şi de cele două laturi superioare ale dreptunghiului i se alocă nivelul 7.

Interpretând reprezentarea din figura, rezultă că fiecărui nivel de risc îi corespunde cel puţin o submatrice din matricea $M_{g,p}$:

- nivelul 2: $\begin{cases} \underset{p=2}{\overset{4}{M_{2,p}}} = \left\| (2,2) \quad (2,3) \quad (2,4) \right\| \\ \underset{p=1}{\overset{2}{M_{3,p}}} = \left\| (3,1) \quad (3,2) \right\| \end{cases}$ şi elementul (4,1);

- nivelul 3: $\begin{cases} \underset{p=5}{\overset{6}{M_{2,p}}} = \left\| (2,5) \quad (2,6) \right\| \\ \underset{p=3}{\overset{4}{M_{3,p}}} = \left\| (3,3) \quad (3,4) \right\| \\ \underset{g=6}{\overset{7}{M_{g,1}}} = \left\| \begin{matrix} (5,1) \\ (6,1) \\ (7,1) \end{matrix} \right\| \end{cases}$ şi elementul (4,2);

- nivelul 4: $\begin{cases} \underset{p=5}{\overset{6}{M_{3,p}}} = \left\| (3,5)\ (3,6) \right\| \\ \underset{p=3}{\overset{4}{M_{4,p}}} = \left\| (4,3)\ (4,4) \right\| \\ \underset{g=2}{\overset{3}{M_{5,g}}} = \left\| (5,2)\ (5,3) \right\| \\ \underset{g=6}{\overset{7}{M_{g,2}}} = \left\| \begin{matrix} (6,2) \\ (7,2) \end{matrix} \right\| \end{cases}$;

- nivelul 5: $\begin{cases} \underset{p=5}{\overset{6}{M_{4,p}}} = \left\| (4,5) \quad (4,6) \right\| \\ \underset{p=4}{\overset{5}{M_{5,p}}} = \left\| (5,4) \quad (5,5) \right\| \\ \underset{g=6}{\overset{7}{M_{g,3}}} = \left\| \begin{matrix} (6,3) \\ (7,3) \end{matrix} \right\| \end{cases}$;

- nivelul 6: $\underset{p=4}{\overset{5}{M_{6,p}}} = \left\| (6,4) \quad (6,5) \right\|$ şi elementele (5,6), (7,4);

- nivelul 7: elementul (6,6) şi submatricea: $\underset{p=5}{\overset{6}{M_{7,p}}} = \left\| (7,5) \quad (7,6) \right\|$.

Din relaţia risc – securitate definită se deduce imediat că nivelul 7 de risc reprezintă un nivel critic, la care securitatea sistemului este minimă. Dincolo de această limită, securitatea tinde către zero, deci desfăşurarea procesului de muncă nu mai poate avea loc, deoarece ea ar fi echivalentă cu producerea accidentului sau îmbolnăvirii. Despre factorii de risc caracterizaţi prin cuplurile (6,6), (7,5), (7,6) se poate afirma că ei vor conduce rapid şi cu certitudine la producerea evenimentului extrem – decesul (pericol iminent).

Reglementările normative din majoritatea ţărilor nu permit însă atingerea stadiului critic. Pentru aceasta, în general, se stabilesc pentru fiecare factor de risc fie limite maxime sub formă de valori, în cazul factorilor a căror formă de manifestare poate fi caracterizată prin elemente măsurabile, fie interdicţii – factorii la care măsurătorile nu sunt posibile. Normele respective corespund unui nivel de risc maxim acceptabil, care diferă de la o ţară la alta, în funcţie de condiţiile economice şi sociale.

Autorii metodei elaborate în cadrul I.N.C.D.P.M. Bucureşti consideră că pentru ţara noastră ar fi indicat ca nivelul de risc maxim acceptabil să corespundă nivelului 3,5. Aceasta ar însemna în primul rând ca autorizarea de funcţionare a agenţilor economici din punct de vedere al protecţiei muncii să se acorde numai dacă evaluarea riscurilor la locurile de muncă confirmă nedepăşirea acestui nivel.

Plecând de la premisele teoretice prezentate anterior, a fost elaborată metoda de evaluare a riscurilor de accidentare şi îmbolnăvire profesională la locurile de muncă, metodă care va fi prezentată în continuare.

Un avantaj al metodei elaborate în cadrul I.N.C.D.P.M. Bucureşti îl constituie faptul că aplicarea ei nu este limitată de condiţia existenţei fizice a sistemului de evaluat. Ea poate fi utilizată în toate etapele legate de viaţa unui sistem de muncă sau a unui element al acestuia: concepţia şi proiectarea, realizarea fizică, constituirea şi intrarea în funcţiune, desfăşurarea procesului de muncă.

Deoarece formele concrete de manifestare a factorilor de risc, chiar şi pentru un sistem relativ simplu, sunt multiple, procedura de lucru în cadrul acestei metode este relativ laborioasă. Aplicarea ei şi gestionarea riscurilor la locurile de muncă pe baza rezultatelor obţinute necesită personal specializat şi tehnică de calcul.

3 Realizarea unui program de calcul pentru evaluarea riscurilor profesionale generale

Tehnica de calcul poate servi la modelarea unor diversitati de probleme, printre care raspund si necesitati de evaluare a riscurilor profesionale in timp real. Pentru fisele de evaluare a nivelului de securitate si respectiv a nivelului de risc rezidual, se doreste elaborarea unui program a carui principala functie este de a efectua automat operatiile de calcul (calcularea nivelului de securitate si respectiv a nivelului de risc rezidual) si de a furniza o serie de rapoarte cu rezultatele evaluarii si de documente de sinteza.

Programul de evaluare se realizeaza in Excel, iar pentru preluarea rationala a continutului fiselor este necesara realizarea unor baze de date relationale. Realizarea legaturilor intre bazele de date se face prin atribuirea de coduri numerice pentru fiecare fisa, capitol, subcapitol, indicator si raport. Stabilirea acestor legaturi se realizeaza automat prin codul programului cu ajutorul unei comenzi.

Utilizatorul introduce datele in meniul principal al aplicatiei (datele de identificare ale sistemului analizat, sectia, tipul de activitate, data evaluarii), date legate de coordonatorul evaluarii, categoriile de personal participante la procesul de munca si numarul acestora, alte date specific sistemului. Printr-o simpla comanda se deschid pe rand fisele de evaluare a nivelului de securitate pentru domeniile fiecarei componente umane(executants, respectiv sarcina de munca) a sistemului de munca.

Dupa ce se parcurg toate fisele de evaluare a nivelului de securitate in cadrul programului, sunt prezentate rezultatele analizei nivelului de securitate indus de executant, de componenta sarcinii de munca care vizeaza reducerea gravitatii consecintelor si respectiv a componentei care vizeaza reducerea probabilitatii de producere. Tot aici se afiseaza si coeficientul de corectie determinat de nivelul global de securitate. Pasul urmator este trecerea la fisele de evaluare a riscurilor profesionale. Si in acest caz utilizatorul programului de calcul are sarcina de a aprecia conformitatea sistemului fata de cerintele fiecarui indicator (cerinta esentiala de securitate). Scala de cotare este cuprinsa intre 0 si 5.in mod automat programul va afisa probabilitatea de producere (functie invers proportionala cu nivelul de securitate).

In mod automat programul va calcula gravitatea corectata si respectiv probabilitatea corectata pentru fiecare categorie de participant la procesul de munca. Tot in mod automat programul transpune pe grila de apreciere a riscului rezidual un punct (pentru fiecare participant la procesul de munca) determinat de valoarea gravitatii corectate si respectiv a probabilitatii corectate.

Pe baza datelor primare introduce in fisele de evaluare a nivelului de securitate si respective a nivelului de risc, programul elaboreaza si o serie de rapoarte analitice si sintetice a nivelului de risc prezentat de sistemul analizat.
In final programul prezinta rapoarte de sinteza privind nivelul global de securitate si nivelul global al riscului rezidual.

4 CONCLUZII

Aplicarea practică a metodei de evaluare a riscurilor în sistemul de muncă este suficient de laborioasă, ca număr de informaţii care trebuie luate în considerare în cazul urmăririi mai multor locuri de muncă, pentru a justifica folosirea tehnicilor moderne de prelucrare autonată a datelor.
Utilizarea calculatorului este posibilă datorită anumitor caracteristici ale metodei, respectiv:

- procedura de lucru etapizată;
- existenţa unui algoritm de calcul al nivelului de risc;
- tipul de legături dintre variabilele luate în considerare la determinarea nivelului de risc.

Tehnica automată de calcul poate fi aplicată atât la evaluarea propriu-zisă a riscurilor, cât şi la gestiunea computerizată a acestora în cadrul unităţii.
În timpul evaluării propriu-zise utilizarea computerului este recomandabilă în două modalităţi:

- constituirea unor bănci de date privind:
  - durata de viaţă a echipamentelor tehnice;
  - timpul de funcţionare;
  - numărul de persoane expuse;
  - timpul de expunere;
  - statistica accidentelor de muncă şi bolilor profesionale produse şi utilizarea lor pentru a determina cu mai mare acurateţe clasele de probabilitate;
- calculul automat al nivelurilor de risc parţiale şi al nivelului de risc global pe loc de muncă, sector de activitate, întreprindere.

Gestiunea computerizată a riscurilor presupune realizarea unor bănci de date complete şi actualizabile permanent, cuprinzând datele din fişele de risc şi de măsuri pentru toate locurile de muncă evaluate din unitate.
În acest mod, în fiecare moment se poate cunoaşte şi corecta conform ultimei evaluări situaţia exactă a riscurilor existente, a dimensiunii acestora (nivelurile de risc), a măsurilor care trebuie luate, a celor care s-au luat, a răspunderilor şi competenţelor pentru respectivele măsuri.

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ELEMENTS of ARTIFICIAL INTELLIGENCE in MINING EQUIPMENT STUDY

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ABSTRACT

Mining production systems used in both underground and open pit mining consist of serially connected elements (winning, hauling, main conveying equipment, transfer devices and stock pile/bunker feeding equipment). The whole production system is characterized by the throughput, which depends on the functioning state of each element and it is also strongly influenced by randomness and variability of the involved processes. In order to correctly simulate and model such systems, probabilistic methods and Artificial Intelligence approaches are used - involving unit operations and equipment as well as the system as a whole - such as Neural Networks, Fuzzy Systems, Monte Carlo simulation and the Load Strength Interference method. The obtained results are convergent with real data and offer the opportunity for further developments of the wider application of mentioned methods in the study of mining production systems. The actual approach in mining equipment design is focused on split design of different parts, such as mechanical, electrical, hydraulic and steering subsystems. The lesson learnt from the mechatronics philosophy of design, can provide guidelines of innovative design of any mining equipment, including open pit mining equipment, which consist in many multi-domain subsystems, making the design difficult and amended by over considering some aspects in relation with other ones. The paper deals with theoretical and conceptual aspects derived from this idea, trying to synthesize of the main ideas converging towards the application of the results of the engineering design based on Mechatronics philosophy, illustrating both the aspects of connected domains which can be translated in the sphere of mining equipment, and achievements which are currently working tools in the leading mining equipment companies.

1 INTRODUCTION

The continuous mining production systems consist mainly in a string of equipment starting with winning equipment (shearer loader, in case of underground longwall mining or bucket wheel excavator in case of open pit mining), hauling equipment (armored face conveyor in longwall mining or the on-board belt conveyor in case of excavators), main conveying equipment (belt conveyor in both cases), transfer devices, stock pile or bunker feeding equipment [1].

This system of mainly serially connected elements is characterized by the throughput (overall amount of bulk coal respectively overburden rock), which is dependent on the functioning state of each involved equipment, and is affected also by the process inherent variability due to the randomness of the cutting properties of the rock.

In order to model and simulate such production systems, some probabilistic methods are applied arising from the artificial intelligence approach, involving unit operations and equipment, as the overall system as a whole, namely the Monte Carlo simulation, and for unit operations and equipment the neural network, fuzzy systems, and the Load Strength Interference methods.

The constructive complexity, variety and the operating environment aggressiveness lead to a sinuous and conjectural evolution of the equipment for mineral industry, the implementation of new techniques and technology achievements vas performed with a large delay in comparison to other industrial fields.

On the other hand, a systemic methodology for design, development and manufacturing of this equipment is not yet realized. However, the mining equipment experienced in the past two decades, due to the general evolution of the technology, a degree of sophistication and a complexity without precedent. The new achievements in the field of Information technology, of sensors, actuators and other elements determined an advance of steering and monitoring systems overcoming the technological level of the mechanical and driving systems.

2 PERFORMANCE OPTIMIZATION MODEL FOR WINNING MACHINE USING NEURAL NETWORKS

Operational parameters of winning machines are strongly influenced by the random variations of strength and energetic characteristics of coal, respectively the specific resistance to cutting and specific energetic consumption at breaking.

Due to the variation of these parameters, rate of feed, torque of the drum axle and the advancement force vary randomly around an average value, which can be suddenly modified by rapid change, for example when crossing a hard rock intrusion.

Using special transducers and processing equipment, it is possible to record the instantaneous values of torque, of the hauling (advancement) force and of the rate of feed.

Based on the above mentioned parameters, it is useful and possible to derive the values of the specific cutting resistance, (A) and of the specific energy consumption, (E_s) in order to forecast, for other conditions, expected values of the feed rate, (v_a), which influence the cutting capacity, of the torque on the axle, (M_t), which is limited by the power of the engine and of the advancement force, (F_a), which is also limited by the power of the hauling system.

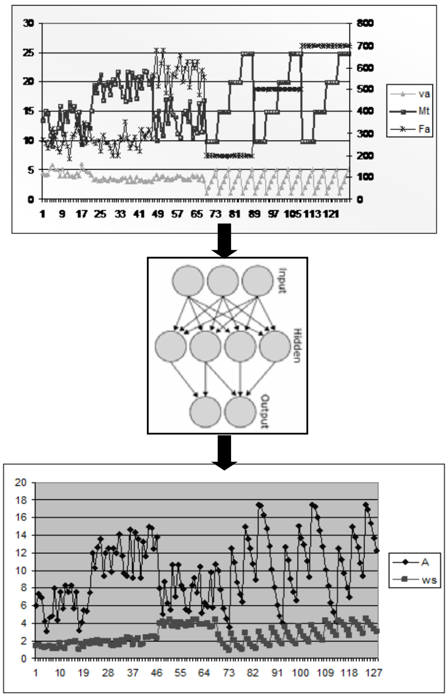


Figure 1: Inputs and outputs of the neural network

Starting from simultaneously recorded values of the above mentioned, using a perceptron neural network (Fig.1.), the values F_a, M_t and v_a have been used, regarded as inputs for instructing the network, with the calculated values of E_s and A, using dependency relations known in the technical literature.

According to the resulting structure of the neural network, the values for M_t, F_a and v_a have been determined for discrete values of E_s and A. According to these values the dependencies between the mentioned parameters have been mapped out, as in fig. 2.

In the mentioned diagram, the hauling force F_a has been considered as an independent parameter. It could be possible to embed such a processing unit in the control loop of a shearer loader, in order to adaptively optimize the feed rate and/or the energy consumption.

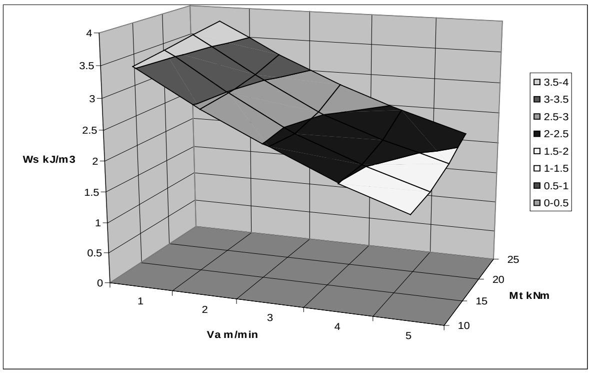


Figure 2: Dependency of E_s (M_t, v_a) for ***F_a = 700 kN***

3 LONGWALL SUPPORT EFFECTIVENESS ASSESSMENT USING FUZZY SETS

The adaptation of powered roof support, from constructive and functional point of view to the variation and specificity of geologic mining conditions, is a very actual and important research subject.

In past decades, the coal extraction technology evolved dramatically. However, the problem of the interdependence between geo/mining conditions and constructive and functional features of powered support represents a challenge which faces the specialists with huge problems to be solved and engineering sciences offer new tools for an interdisciplinary approach in this work, in order to provide to manufacturers, designers and users scientifically founded solutions.

It is difficult to obtain closed form solutions from deterministic models, historical statistical data presents a large variability, so deriving support-surrounding rocks system's behavior is very difficult to be described using classical approaches.

In the present section we try to use FUZZY modeling to obtain some qualitative results.

The support characteristics are not fix (crisp) values, they belongs to a value range. The parameters describing geo mining conditions also are difficult to be quantified, their approximation being expressed by non digital attributes.

Hence, the decision to select a shield in order to test its compliance to given working conditions and technological factors can be made using FUZZY rules.

Starting from the idea presented in [6], we have delivered an IT system based on FUZZY logic using the FUZZY module of MATLAB, using the idea of ground response curves.

This system allows the establishment of the main parameters, the resistance and the stiffness and also setting pressure for an appropriate selection of the shield.

In Fig. 13, the ground response curves for supports with the four combination of the stiffness and yield load, with roofs of different stability are depicted.

The curves 1 to 4 in Fig. 3 represent the dependence between the roof convergence and the support load, for decreasing roof stabilities.

The shape of curves are determined by the empiric observation stating that at constant support load the convergence increases, when stability decreases and to maintain a given allowable convergence the support load must be higher.

The slope lines continued by horizontal lines represents the support's loading characteristic, as

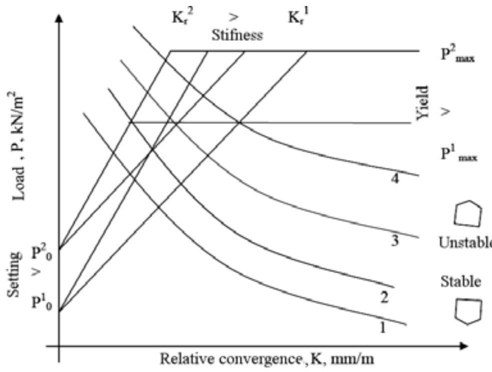


Figure 3: Ground response curves conceptual model

the stiffness is greater, as the line is more vertical.

The elevation of the horizontal segment represents the value of the yield load of the support. The setting load is represented by the start point of slope line on the vertical axis.

The intersection between the support characteristic line and the roof characteristic curve gives the functioning point of the support-roof system at the equilibrium. The target for a proper support of the roof is to maintain this point on the inclined line segment, for this reason the external control parameters are the setting load, the yield load and the stiffness of the support shield.

The main finding of previous research is the fact that the characteristic curve of the roof is changing in time during a working cycle, and the combination of the above mentioned parameters of the support must be selected in such a way, that the convergence be maintained under an imposed limit and the stability preserved during the entire cycle.

The roof stability, described by [7] is another metric which can be used as output for the devised FUZZY model. For illustration, this concept of stability in ground response curves is presented in the Fig. 4.

In this approach, the curves represent the load-convergence dependence of the whole support-roof system. Different curves represent the system's behavior in different operating stages of the face.

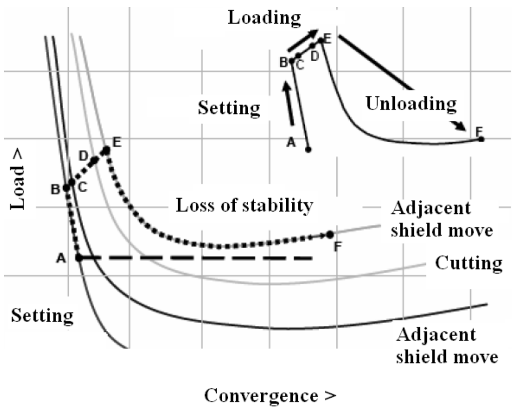
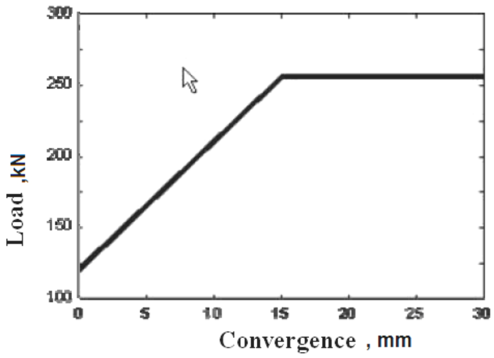


Figure 4: Ground response curves conceptual model according to [7].

Between these three input parameters, i.e. the setting pressure (resistance), the yield pressure (resistance) and stiffness and the output parameters, i.e. stability and convergence, the field observations and the above common sense findings allow to derive inferences for FUZZY rules.

Based on the above considerations, we developed two FUZZY models. The FUZZY models has been developed using MATLAB's FUZZY toolbox



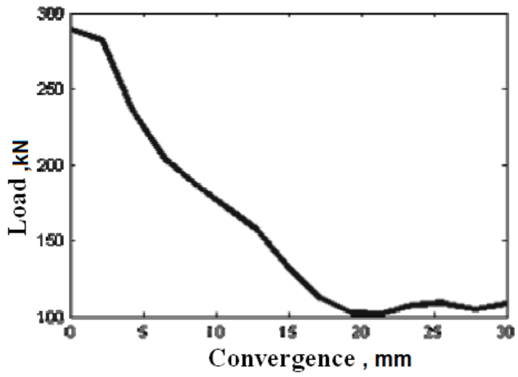


Figure 5 Load-convergence curve of the support Figure 6 Load-convergence curve of the roof

In the first model developed, we used inference rules for deriving the support load-convergence curve respectively the roof load-convergence curve. The output graphs are presented in Figs. 5 and 6.

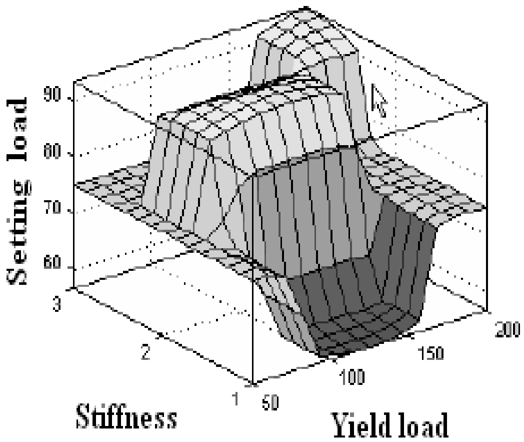


Figure 7 Setting load as a function of stiffness and yield load

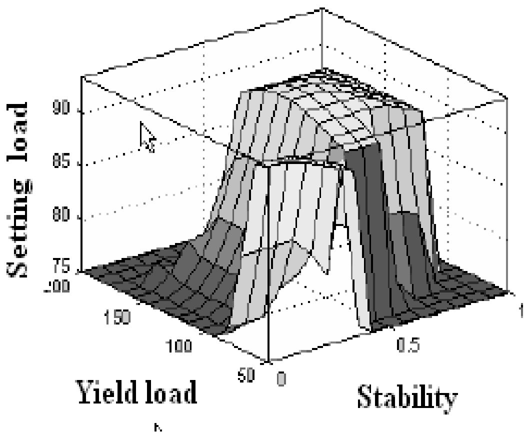


Figure 8 Setting load as a function of stability andyield load

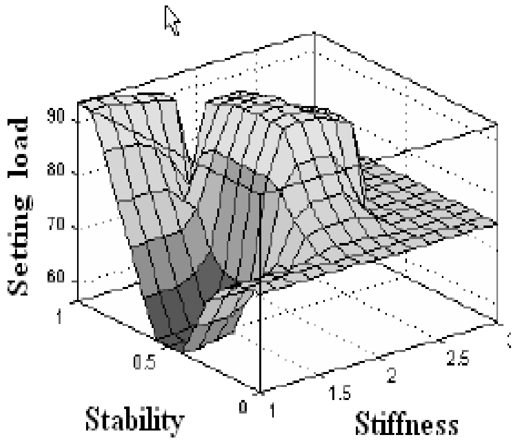


Figure 9 Setting load as a function of stability and stiffness

In the second model, more sophisticated, we used stiffness, stability, yield and setting load as input variables and convergence as output variable.

We obtained the spatial graphs presented in Figs. 7-9.

Interpreting the results starting from these spatial graphs may offer some practical rules about prior selection of supports, using statements from historical data and simple factual reasoning. It is possible to adjust and refine the model, comparing field data with those obtained from the model, with crisp values if applicable.

We can use the defuzzyfication module of the model as an interactive tool to simulate different situations by modifying some input parameters and derive crisp values for outputs, as in Fig. 10.

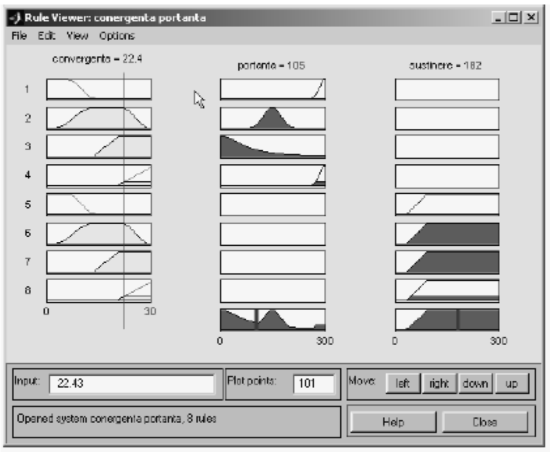


Figure 10 .Defuzzification module as an interactive tool

4 CONCLUSION

In order to find out new methods for the quick assessment of large production systems used in coal mining, we presented and tested by real world examples two alternative–complementary methods of reliability analysis, namely the Monte Carlo simulation and the Load Strength Interference methods.

The application of neural nets to derive the dependencies between the working parameters of a shearer-loader and the cuttability metrics of the rock has been also treated .

The use of FUZZY sets to describe the operation of the roof support, starting from a qualitative conceptual model of ground response curves is presented.

The results obtained are convergent and offer the opportunity for further developments of their application.

Mechatronics – the new emerging border science is able to offer new availability and performance to mining equipment, influencing also the thinking of designers. The steering, control, monitoring and regulation systems are not only „added", they are embedded parts of the entire system. The equipment is designed and conceived as a whole in which the mechanical, hydraulic, electrical and IT systems are integrated elements, and not separate functional blocks.

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DEFORMAREA TERENULUI SUB INFLUENTA EXPLOATARII SUBTERANE DIN MINELE DIN VALEA JIULUI

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ABSTRACT

In aceasta lucrare se analizeaza efectele negative asupta echilibrului ecologic si se examineaza tehnicile de prevenire ,refacere si protectie , care pot si trebuie luate in raport cu legislatia in vigoare . Sunt analizate si diferite moduri de comportament al terenului de la suprafata sub influenta exploatarii subterane si sunt prezentate diferite procedee de reducere a impoactului negative asupra terenurilor si constructiilor.

KEYWORDS

Keyword1, Keyword2, Keyword …

1. INTRODUCERE

Mineritul produce multiple si variate efecte negative asupra mediului, cum ar fii :

– degradarea terenului, prin deplasări pe verticală şi orizontală ale suprafeţei şi alunecarea haldelor şi iazurilor de decantare, cu provocarea unor grave accidente;

– modificări ale reliefului, manifestate prin degradarea peisajului şi strămutări ale gospodăriilor şi obiectivelor industriale din zonele de exploatare;

– influenţe negative asupra atmosferei, florei şi faunei din zonă;

– poluarea chimică a solului, care poate afecta pentru mulţi ani proprietăţile fertile ale acestuia;

– zgomote, vibraţii şi radiaţii răspândite în mediul înconjurător, cu o puternică acţiune nefavorabilă.

– impurificarea apelor curgătoare de la suprafaţă şi a apelor freatice;

– distrugerea stabilitatii rocilor inconjuratoare , provocate in urma extragerii unui volum de substante minerale utile dintr-un zacamant;

2. INFLUENTA ACTIVITATILOR DE EXPLOATARE SUBTERANA

Majoritatea zăcămintelor existente în subsolul din Valea Jiului , datorită formei, dimensiunilor şi mai ales adâncimii mari la care se găsesc în scoarţa terestră, se exploatează prin lucrări miniere subterane, aplicând diferite metode şi tehnologii de lucru.

Când abatajele depăşesc dimensiunile critice din punct de vedere al stabilităţii rocilor înconjurătoare şi nu s-au luat măsuri adecvate de susţinere şi de lichidare a golurilor formate, se produce surparea rocilor acoperitoare, ceea ce dă naştere unui complex de fenomene, cunoscute sub denumirea de efecte de subsidenţă, care se pot extinde pe toată grosimea rocilor acoperitoare, până la suprafaţă.

Trebuie făcută distincţie între efectele dinamice care se produc pe timpul exploatării şi efectele care se manifestă un timp îndelungat după încetarea exploatării, adică atunci când s-au atins noile condiţii de echilibru ale formaţiilor de roci acoperitoare.

În primul caz, afectarea structurilor de la suprafaţă (autostrăzi, căi ferate, poduri, construcţii industriale şi civile etc.) este cauzată de deformaţiile de mare anvergură, atât orizontale cât şi verticale ale suprafeţei terenului.

Structurile mai sus-amintite sunt supuse eforturilor de tracţiunesau de compresiune care, după caz, pot să le producă stricăciuni.

În anumite situaţii se pot lua măsuri de prevenire a inconvenientelor, cum ar fi, de exemplu, cazul exploatării stratelor apropiate de cărbune, unde se poate aplica exploatarea armonică,

ce urmăreşte compensarea efectelor de la suprafaţă date de exploatarea diferitelor strate din suită.

Dar, în orice caz, chiar la echilibrul de lungă durată, subsidenţa de la suprafaţă poate avea o incidenţă negativă asupra mediului înconjurător şi, ca urmare, programarea lucrărilor miniere trebuie să ţină seama de aceste posibilităţi.

În Valea Jiului au avut loc fenomene de subsidenţă la multe exploatări subterane, atât din domeniul exploatării zăcămintelor de cărbuni cât şi din domeniul exploatării zăcămintelor

de minereuri.

Terenurile fracturate şi afectate de exploatarea subterană cuprind, la nivelul bazinului Petroşani, peste 20 ha şi acestea nu mai pot fi utilizate pentru construcţii sau activităţi agricole, întrucât prin prăbuşirea suprafeţei s-a realizat o coborâre a nivelului hidrostatic al pânzei freatice, apărând şi fenomenul de deşertizare prin dispariţia florei şi faunei locului.

Terenurile fracturate şi instabile au afectat aproape 70 de gospodării individuale ţărăneşti, iar în anumite cazuri, au necesitat evacuarea şi demolarea unor blocuri de locuit în oraşul

Petrila, sau chiar demolarea unui întreg microcartier de case particulare, din oraşul Lupeni.

2. ANALIZA IMPACTULUI PRODUS ASUPRA TERENULUI DE LA SUPRAFAŢĂ ÎN URMA EXPLOATĂRII SUBTERANE A UNOR ZĂCĂMINTE DIN VALEA JIULUI

Cazul stratelor groase de huilă cu înclinare medie şi mare. Bazinul Petroşani este constituit dintr-un fundament cristalin şi depozite sedimentare molasice de cuvertură, atribuite Cretacicului superior, Paleogenului şi Neogenului.

Acest zăcământ este puternic tectonizat şi conţine 20-22 de strate de cărbune superior, cu extindere, grosime şi calitate variabile, în funcţie de zonă. Principalele strate explotabile sunt nr.3 şi nr.5. Stratul 3, cu o pondere de 48% din totalul rezervelor, prezintă grosimi şi înclinări variabile, de la câţiva metri la peste 40-50 m. Stratul 5 reprezintă 12%, cu înclinări variabile şi grosimi de 1,5-5,5 m. Rocile sedimentare înconjurătoare sunt argile, marne, şisturi şi gresii, cu rezistenţe la compresiune foarte diferite, cuprinse între 2 MPa şi peste 30 MPa. Exploatarea stratelor de cărbune are la bază procedeul de dirijare a presiunii prin surparea rocilor înconjurătoare (şi, ocazional, cu rambleerea spaţiului exploatat), iar în ultimul timp, şi pe cel cu surparea cărbunelui şi a rocilor înconjurătoare.

Ortelecan M., în lucrarea [Studiul deplasării suprafeţei sub influenţa exploatării subterane a zăcămintelor din Valea Jiului, zona estică, Teză de doctorat, Petroşani, 1997.], se ocupă de studiul deformaţiei terenului sub influenţa exploatării stratelor 3 şi 5, în zonele cu înclinare medie şi mare, prin organizarea a numeroase staţii de observaţie în perimetrele din estul bazinului (Dâlja, Livezeni, Petrila, Lonea). În urma analizei datelor obţinute din măsurători topografice şi fotogrammetrice s-au tras următoarele concluzii: albiile şi fenomenele de scufundare s-au dezvoltat asimetric (fig. 11); deplasările verticale maxime au fost de ordinul zecilor de metri– 16,4 m în cazul exploatării stratului 3 – Lonea, prin surparea rocilor înconjurătoare (fig. 12), şi mult mai mici, de cca. 1,823 m, în cazul exploatării cu rambleere a str.3 – Petrila; deformaţiile specifice înregistrate (de +77,88 mm/m şi –51,85 mm/m) au produs la suprafaţa terenului fisuri, rupturi şi chiar surpări, iar clădirilor situate în zonele de influenţă, fisuri şi crăpături;

Scufundarea maximă este direct proporţională cu grosimea zăcământului, factorul de scufundare şi cu dimensiunea zonei exploatate, iar parametrii de scufundare sunt influenţaţi de adâncimea de exploatare, unghiul de înclinare a stratului şi de dinamica exploatării.

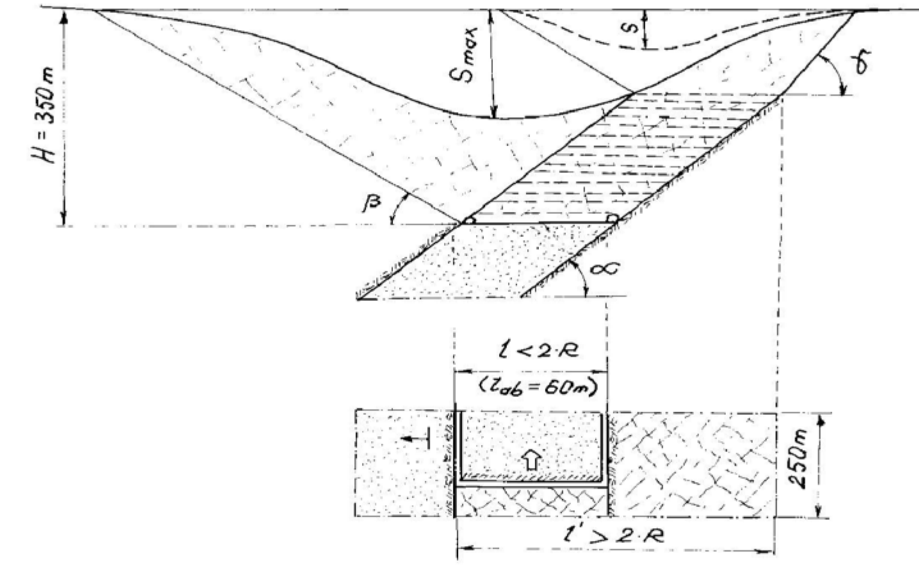

Figura 11: Aria exploatată şi zonele de influenţă a exploatării în cazul stratelor groase cu înclinare mare extrase în felii orizontale .

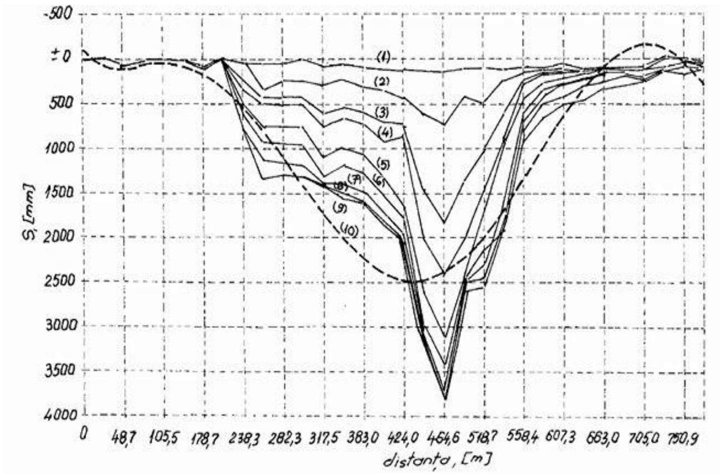

Figura 12: Reprezentarea în timp a profilelor scufundărilor (profil transversal stratul 3–Dâlja)[1] (1) – X.75;(2)-V.76;(3)-IV.77; (4) – X.77;(5)- IV.78; (6)- X.78; (7)- IV.79; (8)- X.79; (9)- IV.80; (10)- curbă de regresie polinimială

4. METODE DE REDUCERE A DEFORMAŢIILOR TERENULUI DE LA SUPRAFAŢĂ

Pilierii de siguranţă. Cea mai sigură metodă de protecţie a terenului de la suprafaţă (cu obiectivele amplasate pe acesta) şi a lucrărilor miniere subterane este lăsarea în zona acestora a unor porţiuni de zăcământ neextrase, astfel încât să le situeze în afara ariei de influenţă a exploatării, numite pilieri de siguranţă.

Criteriul cel mai frecvent utilizat în proiectarea pilierilor de siguranţă este criteriul unghiului critic, bazat pe relaţia dintre unghiul de înclinare a pilierului β şi deformaţia specifică admisibilă εa, reprezentat în tabelul 4 pentru patru categorii de obiective .

Dacă deformaţia este mai mare de 12 mm/m, clădirile devin practic neutilizabile, deoarece acestea au suferit căderi de pereţi şi alte distrugeri importante.

Metoda grafică de trasare a pilierilor de siguranţă are la bază unghiurile de scufundare obţinute prin măsurători topografice, la nivelul albiilor de scufundare din fiecare bazin minier, şi sunt specifice doar acestora. De asemenea, în jurul construcţiilor de la suprafaţă se lasă o porţiune de teren, numită bermă sau marjă de siguranţă. Această bermă de siguranţă are valoarea în funcţie de gradul de importanţă al clădirii şi se ia de 10-15 m pentru prima categorie de protecţie a clădirilor, de 5-10 m pentru cele din a doua şi de 5 m pentru cele din a treia şi a patra categorie .

Tabelul 4 : Criteriu privind proiectarea pilierilor de siguranţă

Categoria	Deformații admisibile, ε_a, mm/m	Unghi pilier, β, grade	Caracterizarea distrugerii	Obiectivul
I	0,01–1,5	54	Fisuri invizibile	Puțuri, obiective industriale (instalații de preparare, oțelării, uzine electrice etc.), șosele, căi ferate, baraje, poduri, spitale, râuri și lacuri.
II	1,5 – 3,0	58	Fracturi vizibile, de 2-5 mm	Găuri de foraj, depozite, conducte de petrol, blocuri cu peste două nivele, stații de transformare, linii de înaltă tensiune, instalații pentru irigații, structuri industriale și pentru agricultură.
III	3,0 – 6,0	62	Fracturi deschise, de 10-20 mm	Drumuri și căi ferate secundare, bungalouri, lucrări subterane, aeroporturi.
IV	6,0–12,0	66	Fracturi deschise, de > 10-20 mm	Clădiri temporare, terenuri agricole și forestiere.

Rambleerea compactă. Datele obţinute dintr-un număr mare de observaţii au arătat faptul că scufundarea maximă a terenului de la suprafaţă este strâns legată de grosimea zăcământului şi de metoda de dirijare a presiunii. Scufundarea maximă este de aproximativ 60-80% din grosimea extrasă a zăcământului, atunci când este folosită dirijarea presiunii miniere prin surparea integrală a rocilor din acoperiş. Pentru rambleerea compactă, cum ar fi cea hidraulică cu nisip, scufundarea maximă este de doar 6-10% din grosimea extrasă a stratului. Extinderea rambleerii compacte depinde de procedeul tehnologic de rambleere aplicat şi de tipul de material folosit la umplere . În urma observaţiilor efectuate, Whittaker a ajuns la concluzia că pentru dirijarea presiunii cu stive şi surparea rocilor din acoperiş, scufundarea maximă poate atinge 90% din înălţimea extrasă a stratului, adică pentru rapoarte w/h egale cu 1,4 sau mai mari (unde: w reprezintă lăţimea zonei exploatate, iar h, adâncimea medie de situare a zăcământului). De asemenea, pentru cazul rambleerii pneumatice, scufundarea maximă este în jur de 45%, iar pentru cea hidraulică, de aproximativ 15-20%. Experienţa utilizării rambleerii arată că pentru a avea o reducere semnificativă a scufundării suprafeţei, raportul w/h trebuie să fie mai mare decât 0,6.

Exploatarea parţială. Exploatarea parţială sau cu pilieri abandonaţi este folosită cu succes în minele de cărbuni şi de minereuri şi în vederea reducerii deformării terenului de la suprafaţă. În acest caz, gradul de recuperare a zăcământului variază între 50 şi 60%. Dacă exploatarea parţială este combinată cu rambleerea hidraulică, scufundarea maximă posibilă este de 2% din grosimea extrasă a stratului, iar dacă este combinată cu surparea rocilor înconjurătoare, scufundarea maximă este în jur de 3-10%. Exploatarea parţială este utilizată, în special, atunci când la suprafaţă sunt situate anumite obiective importante [26, 4].

Exploatarea în felii. Exploatarea în felii este specifică stratelor groase. În acest caz se consideră că extragerea următoarei felii trebuie să se realizeze după un timp suficient de lung pentru ca deformarea terenului să se stabilizeze sau să se reducă la un nivel acceptabil [8]. Exploatarea simultană a feliilor, cu un decalaj bine stabilit între abataje, poate conduce la reducerea influenţei asupra terenului de la suprafaţă, efect specific abatajelor armonice [26].

Exploatarea la intervale de timp. Este importantă în cazul exploatării parţiale. După exploatarea unei porţiuni de zăcământ este necesar ca scufundarea să înceteze sau să se diminueze; porţiunile de zăcământ rămase sunt exploatate ulterior, astfel încât mişcarea totală a terenului se reamorsează la anumite intervale de timp. Aceasta este o metodă foarte eficientă de protecţie a clădirilor situate la suprafaţă. Această metodă şi cea în felii sunt cele mai bune metode de reducere a cumulării diferitelor efecte generate de influenţa excavaţii miniere subterane.

Exploatarea armonică. Este una dintre cele mai eficiente metode de protecţie a obiectivelor situate la suprafaţă împotriva efectelor distructive ale exploatării subterane. Metoda este practicabilă atunci când sunt exploatate simultan mai multe strate apropiate. Ideea este de a conduce exploatarea în aşa fel încât deformaţiile de tracţiune, din zona de influenţă a unui abataj, să se suprapună peste cele de compresiune ale altui abataj. Acestea echilibrându-se, efectul distructiv al suprafeţei se reduce la minimum . Metoda abatajelor armonice a primit o largă aplicabilitate la exploatarea pachetelor de strate din pilierii de siguranţă ai puţurilor sau a unor construcţii situate la suprafaţă. Exploatarea se concentrează fie pe un strat fie, în cazul mai multor strate, prin atacarea concomitentă a acestora, însă cu extragerea decalată a abatajelor.

Decalajul dintre fronturile de abataj, de pe stratele apropiate, trebuie să ţină seama de faptul că deformaţiile, a căror mărime depăşeşte limitele admisibile, trebuie să fie compensate de deformaţiile de semn contrar, ce iau naştere în masivul de roci înconjurătoare. Compunerea tensiunilor de semn contrar se poate obţine şi în urma exploatării a două câmpuri de abataj adiacente, respectiv situate pe acelaşi strat şi exploatate cu decalaj. Decalajul dintre cele două fronturi trebuie să fie astfel ales încât tensiunile de tracţiune dezvoltate în masivul de roci din acoperiş să le compenseze pe cele de compresiune .

Creşterea vitezei de exploatare. Mărind viteza de exploatare se creează condiţii favorabile pentru protejarea suprafeţei, în timpul perioadei de exploatare. În mod normal, reducerea relativă a deformaţiei suprafeţei, prin creşterea vitezei de exploatare, va fi mare pentru roci mai dure sau o adâncime de exploatare redusă şi efectul va fi redus pentru roci mai moi şi o adâncime de extracţie importantă . Deci,timpul este un factor principal în degradarea rocilor supuse unei anumite stări de tensiuni. Astfel că, deformaţia maximă la tracţiune εt, care urmăreşte un front în exploatare, este în general mai redusă decât deformaţia finală de tracţiune εmax şi, cu cât exploatarea este mai rapidă, cu atât deformaţiile εt sunt mai reduse. Mai mult decât atât, deformaţiile maxime de compresiune, ce însoţesc frontul, sunt întotdeauna mai mici decât deformaţiile corespunzătoare de tracţiune.

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