

METHODS OF REDUCING THE IMPACT OF THE PREPARATION ACTIVITY OF THE USEFUL MINERAL SUBSTANCES

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Abstract. The concerns regarding the environment protection, in the mining industry, must be applied in all the stages and during all the exploitation period- the preparation of the useful mineral substances. In order to elaborate an adequate policy in this field it is necessary first, to know the existence and the importance of the issue that these sites represent, and then as a first step, to know them as completely as possible and within a total transparency. This knowledge must be based on an inventory and a systematic research of the potentially degraded sites with the establishment of some priorities regarding the needs for remedy. The treatment each site must be made function of its impact on the environment, of the degree of risk and desired use.

As a method and base of implementation of some technical methods of reducing the impact of the mining activities on the ecologic factor, on the health of the population, on the social- economic factor, it is absolutely necessary to have a legal package in this field. Also, in the construction period- operation, it is necessary to choose the most performing ecological technology option and at the closure of the activity of preparation of the ore, it is necessary to adopt the remedy methods of the affected area which will take into consideration the particularities of each type of technology used in the flotation process, technology that is determined by the type of the useful mineral substance that is prepared.

The mining industry and the environment

The mining industry – the extractive industry as well as the useful mineral substances preparation industry represent an important sector of the economy, being a source of raw materials and combustible for the other branches of the economy.

The exploitation and the processing of the mineral resources were developed as the evolution of mankind; we must mention that through the conservation instinct itself to procure the necessary food in order to exist and to protect against the living

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beings, the primitive human being had in the first place to build in this purpose tools and weapons. Together with wood and bones, the stone was one of the basic raw materials, due to its hardness and its possibility to be processed. The prehistoric human being noticed that some stones can be shaped by simply striking it. This led to the exclusive use of these rocks, such as: the flint (quartz), the jasper, the obsidian, and quartzite. In this way we got to the research of the rock natural deposits and its extraction from the primary or secondary deposits existing in certain regions. Thus, the mining activity of the prehistoric human being begins.

When the human being has passed from the nomad life to the sedentary one, he used the rock for the buildings constructions, and the clay for pottery, the bricks and even the cultural objects.

It seems that the gold, gathered from the alluvial deposits of the rivers, was the first metal that was known and used by the primitive human being, and the copper was the first metal to be melted.

In all the placements where the exploitation and the preparation of the mineral resources are made, there will appear problems related to the environment, which are felt through the degradation of the natural fields, the water and air pollution, a negative impact on the terrestrial and aquatic ecosystems, of the population health, as well as impacts of a socio-economic nature.

The degradation and pollution of the mining sites can be the result of other activities that are connected to the mining industry: from transportation, combustible deposits, installation of electric transformers, mechanic workshops, as well as through organic waste resulted from social groups or from the annex household.

In this sense, in 1999, in a row of efforts initiated by the mining companies with the purpose to change the perception of the public on the destructive effects of the mining industry and to better understand the way to remedy these effects and to prepare the sector for the World Summit for Sustainable Development which was to be held in Johannesburg, nine of the biggest mining companies in the world have launched the Global Initiative for Mining. A contract has been signed with the International Institute for Environment and Development (IIED), with the support of the World Business Council for Sustainable Development (WBCSD), in order to prepare a study of the activity area. This study recommended the project and the area of activity of the MMDD, an independent research and consultancy process of two years, launched in 2000 and which had as purpose to explain which is the best method through which the mining sector can contribute to the evolution to sustainable pattern for the economic development.

The concerns for the environment protection, in the mining industry, must be applied in all the stages and during the whole period of exploitation- preparation of useful mineral substances.

The procedures for the economic extraction of the minerals from the primary ore vary function of the mineral types, but which have a common number of steps in the process and which have to be taken: Ore Extraction- the Crush- the Splinter- The concentrated extraction- Sterile deposit in the pond.

One of the major problems of the mining industry is to deposit the waste that come from the extraction activity as well as from the mineral preparation. The impact of this mining waste consists of chemical pollution of the surface and underground waters, the contamination of the soil with ions and heavy metals, the occupation of wide surfaces of agriculture fields and/or forest fields, the destruction of the natural ecosystems, the modification of the water course, the risk of earth sliding, the destruction of the landscape, the air pollution, etc. Amongst the deposits of mining waste a special attention is given to the decantation ponds of the mining sterile come from the preparation of the ores, due to the major effects that were produced, as a consequence of the numerous technical accidents, on the component elements of the environment factors.

For the elaboration of an adequate policy in this field it is first necessary to know the existence and the importance of the issue that these sites represent, and then, as a first step to get a more complete knowledge of them and in a total transparency context. This knowledge must be based upon an inventory and a systematic research of the potentially degraded sites and establishing some priorities regarding the needs to remedy them. The Treatment of each site must be made function of its impact on the environment, of the degree of risk and the desired use.

1. Legal context

As a method and basis of implementation of some technical methods of reducing the impact of the mining activities on the ecologic factor, on the health of the population, on the socio-economic factor, it is imperative to have a legal package in this field.

Two decades before 1989, the mining sector in Romania was an industry that was in great development, which offered jobs and which stimulated the economic activity in many regions of the country. The inheritance of the socialist period has weighed a great deal for the mining development in Romania. Before 1989, the mining industry was also an industry the received significant subventions and which registered losses.

In April 2004 the Government has approved the *Strategy for the Mining Industry* (SIM) for 2004-2010, which had the purpose to consolidate the reform of the mining industry, in order to respect the rules for the adhesion of Romania to the European Union (EU). This stipulates that all the subventions for the mines where

the extraction of metals and minerals was made should be eliminated until 2007 and those for the extraction mines of the coal until 2010.

The Strategy for the Mining Industry (SIM) was approved in the Government Decision 615 in April 2004 in the context of an assistance project supplied by the World Bank to the Romanian Government for the restructure of its mining sector. The process has been managed by the Ministry of Economy and Finance. The strategy is the result of a process that included the consultancy and participation of all the interested sectors from the inside and outside of the mining areas, non-governmental organizations and governmental institutions (Strategy for the Mining Sector, 2004.)

SIM is based on four main principles, each of these being divided in other few objectives, as shown below:

- a) The Facilitation of the commercial approach of the mining industry;
- b) The reduction of the direct implication of the government and the attraction of the private capital in the mining sector;
- c) The development of the mining activities concerning the environment standards through:
 - The inventory of the inherited environment affected by the mining activities;
 - The evaluation of the damage caused by the mining and declaring the responsibilities for the state mining societies and for the private concessionaires
 - The elaboration of instructions for the protection of the environment, which should include the European standards for the mining industry for the promotion of the mining with a responsibility towards the environment
 - The improvement of the institutional and regulation context in order to ensure an adequate monitoring of the responsibilities of the concession holders.
- d) the attenuation of the social impacts caused by the closure of the inefficient mines from the economic point of view and the restoration of the local economy.

The standards series ISO 14000 was developed by the International Organization of Standardization with the purpose to establish the primary requests for the Environment Management Systems as an indicator of the convenient practice of an ecological management.

It is well known the fact that “an effective control of the pollution cannot be made exclusively on the technological solutions, but this must be approached based on an environment management system, integrated in the general management of the company” (Rojanschi,2002).

During the 90s there was a large international consensus regarding the fundamental principles of the environment management in the mining sector, this being transposed in a series of international guides. The fundamental principles that are at the basis of a good environment management and protection have been largely expressed as guides for the mining sector and for the environment protection, within an International Round Table on the Theme of Mining and Environment, organized in Berlin, in 1991. Known as “The Principles from Berlin”, these have been included in the first edition of the Environment Guide of the United Nations for the Mining Exploitations, being a component part of the second edition of the GUIDES of the United Nations, in 1998.

The **Directive 2006/21/CE** of the European Parliament and of the Council from March 15 2006 regarding the management of the waste in the extractive industry is transposed into the Romanian legislation through the Government Decision no 856/2008; this stipulates, among others, the need to reduce to the lowest level possible the cyanide concentration in the decantation ponds, because of their toxic and damaging effects, using the best techniques. In the same time, the article 13, point 6, establishes the maximum limits of the cyanide concentration allowed in the decantation ponds and their gradual reduction until 2018. The Government Decision 856/2008 “establishes the legal context regarding the directing lines, the measures and the procedures for the prevention or reduction as much as possible of any negative effects on the environment, especially on the water, air, fauna, flora, and the landscape, as well as of any risks on the population health, resulted as a consequence of the waste management in the extractive industries.”

Government Emergency Ordinance no. 195/2005 regarding the environment protection approved by the Law no. 265/2006, modified by the OUG 114/2007, modified by the OUG 164/2008. Taking into consideration the principles and strategic elements that lay at the basis of this legislation, among which: “The principle of preventive action”, “the principle of retaining the polluters at source”, “the main polluter pays”, “the sustainable use of the resources”, etc. some of the implementation methods are: (art.4):

- “ the integrated prevention and control of the pollution by using the best techniques available for the activities that have a significant impact on the environment ;
- the evaluation of the impact on the environment in the initial stage of the projects with significant impact on the environment;
- the creation of a national integrated monitoring system of the environment quality;

- the rehabilitation of the areas affected by pollution.”

Also, in the Section 3, concerning the obligations of the private and legal entities, there are stipulated the responsibilities of the operators who develop their activities of prospecting, exploring or exploiting the natural resources to remedy the areas that have been affected, as a consequence of these activities, the soil, the subsoil, the terrestrial ecosystems.

There are also regulations regarding the obligations of the economic operators regarding the : procedure of regulation on the environment line, the regime of dangerous substances and preparations, the regime of the waste, the regime of the bio-diversity, the protection of waters and aquatic eco systems, the protection of the atmosphere.

The Evaluation of the Impact on the Environment by the economic operators is extremely important, through specialized institutes, so that the potential impacts of a project from its initiation could be identified, being able to establish in this way the prevention measures- their limits or the finding of alternative solutions.

The European/international legal system regarding the EIM and the public participation is based on some directives and conventions that have already been transposed and in present they are in course of implementation in Romania. These are:

- The Directive 97/11/EC regarding the evaluation of the impact on the environment of some public and private projects
- The Directive 90/313/EEC regarding the free access to the environment information
- The Convention from Aarhus regarding the free access to information, the public participation to decision making and the access to justice in matters of environment

The Mines law 85/2003 stipulates norms for the regime of the mineral resources, the concession system, the rights and obligations of the concessionaries, the agreements and procedures for the mining activities, requests concerning the environment, and it defines the institutional structure responsible for the administration of the mining sector. This covers all the operations related to prospecting, exploring, developing, exploiting, processing, concentrating, commercialization of the mining products, the closure of the mines and the rehabilitation of the environment.

In the Law of Mines, there is specified the development of the mining activities regarding the environment standards through:

- The Inventory of the inherited environment affected by the mining activities
- The evaluation of the damage produced by the mining on the environment and declaring the responsibilities of the state mining societies and the private concessionaires
- The elaboration of the instructions for the environment protection, which should include European standards for the mining industry for the promotion of mining with the environment responsibility
- The elaboration of the instructions for the closure of the mines in order to ensure that the mines are closed based on the social responsibility and concerning the environment
- The improvement of the institutional context and regulation for ensuring the adequate monitoring of the responsibilities of the concession holders.

The Evaluation of the Environmental Risk. The environmental risk represents, such as it is defined by the Standard AS/ NZS 4360: 2001, the possibility of happening of an event that will induce an impact on certain objectives. That is why it is very important that in the mining activity, a permanent “aggressor” of the environmental factors as well as of the human community, where the risk can be generated by the natural factors (for example falls that exceed the normal level) but also by the human factor (the incorrect surveillance of the installations that have a polluting potential, not taking the measures for the correct use of some “clean” technologies, etc.) to have implemented the ecological risk management, this identifying all the possible results after deploying an activity. The probability of each catastrophe I estimated and its magnitude.

Through a common order of the ministry of waters and environment protection and of the ministry of health – The Order no 161/2003- the methodology for the rapid evaluation of the environmental risk and human health was approved.

Although the management of the environment risk is a component part of the Group of the Systems of Environment Management, I consider that it is necessary to mention it separately, taking into account the major problems that the mankind are confronted to – the climate changes, the disasters that have a bigger and bigger proportions – having repercussions on the environment and population. Let us not forget the one of the events that were largely commented upon at an international level, that is the accident from January 2000, when, due to abundant rain, a quantity of approximately 100000 mc of material from the decantation pond from Bozanta, which was in the property of SC AURUL SA Baia Mare, was versed in the river Lapus and contaminated with cyanide its water, the hydrographic network situated downstream – the rivers Somes, Tisa and the Danube stream- as well as the aquifer quartered in the Lapus alluviums.

In the county of Suceava, the situation of the decantation pond Tarnisoara, which served the Plant of Complex ore preparation Tarnita, which in the past 10 years had each year a damage with high risk for the environment and population, culminating with the events in 2006, 2007 and 2008 when there was the danger, following some torrential rain, to destabilize and move the mass of sterile in the water flows downstream. Taking into account the fact that the deposit had a volume of approximately 8 mil cm of factory sterile, its content of heavy metals and cyanides, the consequences for the water flow- the brook Brateasa, as well as for the households from downstream, at about 0.9 km, in the village of Ostra, can be easily imagined.

The methods for reducing the impact after the closure of the activity of the useful mineral substances preparation plants, are generally specified in the legislation package regarding the norms and regulations concerning the extractive activities and those of closure and ecologic reconstruction of the mines, such as:

- Handbook of closing the mines, approved by the Order 273/2001 of the Ministry of Industry and Resources, which regulates the way of deployment of the whole activity through the technical procedures established in the 14 annexes;
- Guide of elaborating the environment monitoring program after the approval of the Plan for the closure of the activity of the mine, promoted through the order of the MEC no 1525/2007.
- Handbook of procedures for the environment and the implementation of a new environment management system in the mining sector, promoted by the Order MEC no 1526/2007.

We have to mention also that there is a special annex to the closure manual regarding the manner of handing over / taking over of the decantation ponds.

2. Technical methods for reducing the impact of the activity of preparation of the usefull mineral substances

▫ The activity of preparation of the useful mineral substances is a complex activity through the nature of the technological processes that it supposes, of the reactive used in the flotation process, some of them being integrated in the category of dangerous chemical substances, of the big volume of water used- resulting also a great quantity of used waters- , of the volume of polluting waste; all these lead to the idea that the effect produced on the environment and the population during their functioning but especially when some accidents or damage happen is extraordinary, in a negative way, that is why a great attention must be paid in the construction-operation stage as well as in the closure- post closure phase.

In the construction-operation stage, it is necessary to choose the most ecologically performing technological option, taking into consideration also the

“Reference Document on the Best Available Techniques in the Industry of non-ferrous metals”, issued in December 2001, document that reflects information related to the article 16, align 2 Directive 1996/61/CE on the prevention and integrated reduction of the Environment Pollution (Directive IPPC.) A “clean technology” represents the optimum, efficient method for a reduced impact, as far as the preparation technologies as well as the deposit of the sterile technologies, as well as a reduction of the works for the closure – ecological rehabilitation of the mining site.

In the spirit of the things mentioned above, the unit for preparation of the poly metallic ore Manaila, which is being open in the industrial enclosure in the commune of Iacobeni which belongs to SC MINBUCOVINA SA, has foreseen performing processing technologies, using some reactive with a reduced degree of toxicity, reducing the volume of sterile factory material by filtering it, resulting in a mud filtered with a humidity of 6.63 % which are going to be deposited in the tub prepared (impermeable) of an old career, The Oita career, in the commune of Ciocanesti.

▫ At the closure of the activity of preparation of the useful mineral substances, it is necessary to adopt remedy methods of the affected area which would take into account the particularities of each type of technology used in the process of flotation, technology which is determined by the type of the mineral substance which is prepared: complex ore, sulphur, salt, barytine, manganese.

If for the air and vegetation, once the flotation stops its activity, the main sources of pollution are closed (the emissions of powder in suspension resulted from the unloading, siloing and breaking operation of the ore, emissions of powder and gas from the operations of calcinations, micronisation, gathering of the barytine concentrate, emissions of volatile organic compounds from the fuels and the operations of decantation of the fuels at the filling of the means of transport and carrier equipments, gas emissions resulted from the combustion of the gas resulted from the steam-generating station), leaving the powder emissions in suspension entailed by the wind from the dams of the decantation ponds and the gas emissions (sulphur oxides, hydrogen sulphide) resulted from the oxidation of the metal sulphides, from the sterile of the decantation pond and the concentrates deposited temporary, for water (either on the surface, either underground)- a way to propagate the polluters and soil- the area of accumulation of the polluters, there are special methods needed for the decontamination and remedy. Although the method of self purification of the aquatic ecosystems, we have to take into consideration the nature of the polluters that come from the preparation units of the useful mineral substances that affect their quality. We are dealing with conservatory substances, such as the ions from the heavy metals, the mineral salts which are practically spread into the environment by waters, its self purification being an

apparent process. We find the polluters in the river beds, in the aquatic vegetation, in the animals that are fed with this vegetation – phenomenon which is more visible as the debit of the receiving water flow of the noxes is smaller, which does not facilitate a good dilution of the polluters.

The method of de-pollution of the unpurified waters is that of passing them through a purifying station, using various technologies function of the nature of the polluters. However, after closing the activity of the mining plant, this is an expensive solution and not always efficient, given the high volume of water which should be purified. That is why it the elimination is important, or where this is not possible (as the situation of the decantation ponds of the plant sterile which constitutes a source- through the acid draining of the rocks, the entailing of the sterile material in the water flows by the pluvial waters, etc. – by used waters for all the life duration of the deposit), the limitation of the pollution sources by applying some efficient methods of de- pollution.

The soil, “product of life and regenerator of it ” (Papacostea, 1976) needs a special attention given the special impact that the great volume of plant waste has, having a great content of water which entails the toxic substances, destroy the natural biology of the soil, as well as the concentrate deposits, the losses of sterile at its transportation to the deposits, the great surface of terrain used by the decantation ponds- without having taken measures for the conservation of the soil for its reuse at the closure of the activity; practically we deal with an modification of the soil, in the SNRCS, 1980, being named as the anthropic proto soils, in SRTS 2003 as entiatrosoils.

The methods of de- pollution of the contaminated soils, function of the nature and size of the polluter, can be applied “in situ” or “ex situ”.

Among the methods of de-pollution of the soil, there are:

- methods of isolation and confining the contaminated soils, which blocks the movements of the polluters;

- the thermic methods- the thermic desorbtion, the vitrification or burning of the contaminated soils, for example of those impregnated with petrol products; in the mining perimeter of Calimani there are still petrol waste deposited, at the base of the old crude oil tanks, waste which, in the summer of 2007, through liquefaction, have versed on the field that is near the fuel deposit. The impregnated soil is to be burnt;

- physical methods of de-pollution of the soils- washing, the solvent extraction, the flotation;

- chemical methods of de pollution of the soils: oxidation methods, reducing chemical processes, chemical dichloride,

- biological methods of de-pollution of the soils- the natural metabolic processes of the living bodies such as bacteria, fungi, superior plants, in order to

destroy the pollutants or to transform them in less toxic forms: methods of biologic treatment of the soils in bulk, the biologic treatment of the soils in bioreactors;

- methods of de pollution of the soils through stabilization and solidification- these methods do not destroy the pollutants but they transform them in another physical state where they become stable from a chemical point of view and are fixed in a solid matrix and they are not available for the transmission ways and for the receptors (Oros V., Damian Gh., 2000).

A separate method which has not been experimented in Romania but to a reduce scale, is that of the fito-remedy- the use of herbs, of the forest vegetation for the decontamination of the soil. In the county of Suceava, ICAS Câmpulung Moldovenesc has experienced this method in the period 1993-2003 by planting – in the area of the old fuel deposit, in Pinu: service tree, larice, juniper, spruce fir, pinus cembra. At the base, in every experimental block, there was put: forest humus, forest humus with dolomite, either they were planted in pits with nude roots. In 2002 there was registered the biggest rate of growth for the larice and juniper, planted in pits with forest humus.

Conclusions

The limitation of the impact that the activity of preparation the useful mineral substances has must be a legislative priority and not an option of the mining operator, interested in the economic profitability of the activity, as a performing “clean” technology, although it is generally more expensive, has consequences with a lower degree of pollution in the operational period, with an obvious gain for the quality of the environment and population health as well as a lower cost of the remedy activity of the mining site, at the closure of the activity.

The methods for the ecological rehabilitation must not become in their turn pollution factors- and I refer to the particular situation of the mining sites having a closed activity in the county of Suceava, practically abandoned, with structures in an advanced degree of degradation which implies, at taking over by the constructor of these perimeters for the remedy works to be made, the realization of new utility network, new types of waste produced on the place, building site organization.

The decommissioning and rehabilitation of these mining sites is necessary to be made following a code of environment procedures which has at the basis:

- the identification of the problems, the management of waste, the stability of the location, the management of the water, the prevention of erosion, replanting and the management of soils, visual resources and alternative uses of the site;

- the elaboration of a management plan which would cover all the identified problems.

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