
ENVIRONMENTAL PROTECTION DURING MINING ACTIVITIES

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ABSTRACT

It may be stated that ore mining and ore processing have a highly detrimental environmental effect. Mineral resources appear in all the environmental categories that should be protected. The global demand for energy raw materials, metallic and non-metallic ore etc. is still significant, regardless of the more or less regional depressions that occur in mining industry. Therefore, within the framework of the mining process it is necessary to provide the best available environmental protection or to find and implement highly developed, environmentally sound mining technologies.

Key words: ore mining, environmental effects, environmental protection

At this moment the world mining industry is defined by the following factors:

- comparatively lower quality of mineral resources and increased mining depths,
- highly mechanized processes for ore mining and processing,
- high deposit recovery ratio,
- large investments in safety at work and environmental protection etc.

Assuming that the exhaustion of natural resources, the devastation and the pollution of the environment represent major environmental risks it may be stated that mining industry is a human activity that seriously endangers the environment in all of the three environmental categories. Such adverse impacts are more or less intense, but they are obvious and should be defined separately for each mining unit, region or country.

Mining as one of the oldest human activities led to a massive exhaustion of numerous ore deposits of all types. Over the long history of mining there had been certain periods during which profit making was the primary, if not the only criterion. In such circumstances the ore deposits have not been rationally exploited and certain amounts of mineral resources were permanently wasted and destroyed, while a considerable portion of useful components remained lost at waste and tailing dumps.

The development of ore dressing and processing technologies indicates that in the course of current mining operations it is necessary to protect certain deposits or their parts even if they do not have an economic value, at the moment. Namely, the future generations will have to exploit these reserves even if, for the present, that does not seem justified. Consequently, mining technologies should among other requirements comply with the increasing demands for the protection of natural resources.

Devastation represents one of the most visible consequences of mining activities. Apart from large opencast coal and metallic ore mines there are also several thousand of small opencast mines of non-metallic ore. On the other hand, in underground mining besides the environmental destruction that occurs at the mine faces, there is also a large number of drifts and drives. Their length is considered to be greater than the length of the equator. The disposal of waste also represents a form of environmental degradation and destruction, which is a specific problem, especially for the countries with developed opencast mining.

Environmental pollution is frequently emphasized as one of the basic hazards posed to all living species including mankind. Mining industry falls into the category of polluters with a moderate environmental impact. However, there are the so-called environmental hot spots initiated by large accidents (for example, the break-through of tailing dumps). In general, it may be stated that mining operations and ore dressing cause land, water and air pollution. The intensity of pollution depends on numerous factors but basically the methods selected for ore mining and dressing are among the most influential factors.

In spite of the global tendency that implies the relocation of mining operations from developed European countries to less developed parts of the world and countries in transition, the mining industry will still continue to exist in Europe for a long time. It is to be expected that the changes will occur within the organization, by increasing the recovery ratio, by implementing enhanced technologies etc. It should be borne in mind that mineral resources represent a strategic asset for every country and that they have value only if they are accessible.

The basic environmental protection methods in respect to mining activities imply: taking measures of protection within the existing ore mining and dressing technologies, searching for new technologies that involve minimum environmental risks, implementing techniques for mitigating or remediation of adverse impacts and finally developing awareness and education programs for engineers and professionals engaged in mining-related environmental protection.

Environmental protection within existing ore mining and dressing technologies represents a highly complex and responsible task that depends on numerous factors among which the most significant ones are:

- type of ore,
- ore mining and dressing technologies,
- environmental category within which the mining activity is carried out,
- capacity of the equipment intended for monitoring of adverse environmental impacts,
- level of training of the personnel involved,
- control, legal and regulatory framework etc.

The type of ore that is being mined may have either direct or indirect influence on the environment. The composition or the properties of certain types of ore may provoke particular changes in the environment (oxidation of coal, radiation of the uranium ore, emission of noxious gases etc.). However, the indirect influence is far more pronounced and its effect shows in applied mining technologies within ore dressing. One of the major

points of issue is the influence of applied technologies regarding ore excavation, conveyance, disposal and dressing. In other words, the mining industry due to its specific properties is not usually apt to change frequently the methods used to obtain the useful materials since the natural factors play a predominant role here. For this reason, it represents an obligation to pay full attention to environmental protection in the course of the entire process, from the exploration phase to the closure of mining operations.

Different categories of the environment also play an important role in determining the environmental impact of mining. Namely, ore mining takes place in national parks, in well-preserved areas, in partially degraded areas but also in urbane areas (Bor, Katowice etc.). Therefore, it is crucial to arrange constant monitoring of the impacts that mining systems have on the environment. For that purpose it is necessary to provide adequate equipment and trained personnel at all levels. A reliable environmental protection should be sustained by corresponding legal and regulatory framework and supported by an accordingly secure external and internal control systems.

State-of-the-art technologies with a high level of environmental protection represent the main target in the countries with developed mining industry. The questions that frequently arise mainly concern the very nature and the targets of these state-of-the-art ore mining and dressing technologies. Generally, it is considered that new technologies are successful if they are able to provide, among other things, an enhanced recovery ratio and improved economic effects. However, environmental protection should be added to this list since that is one of the major imperatives of the modern world.

In modern mining numerous new technologies are implemented searching for new ore mining and dressing methods, which imply a high level of environmental protection. The most significant ones are:

- opencast mining technologies with minimum degradation of the surface in the course of excavation and disposal of earthwork,
- underground mining technologies, which reduce or completely impede terrain subsidence,
- ore dressing technologies with minimum release of noxious matter or discharge of polluted water,
- technologies for the exploration, production, refining and transportation of oil and gas with minimum risk of accident occurrence,
- processing and previous treatment of technogenous raw material as products of ore deposit mining,
- technologies for external ore conveyance assuming minimum land, water and air pollution risks.

The results achieved in conquering and implementing new technologies into mining processes give support to assertions claiming that ore mining and dressing may be carried out with considerably reduced environmental risks.

Mitigating or remediation of the effects produced by mining activities represents a permanent commitment for all the agents engaged in mining industry. Namely, it is not possible to mitigate or avoid the exhaustion of ore deposits but on the other hand, the remediation of devastated and polluted environment is not only possible but also imperative.

The remediation of adverse effects is possible even in the course of the mining process or immediately after the completion of the basic mining activities. The following methods are the most frequently used to mitigate the adverse effects of mining:

- back-filling of excavated spaces,

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- reclamation of degraded land,
 - revival of damaged areas in the surroundings,
 - disassembling and removal of constructions left after mining activities or their adaptation for new purposes etc.

In many countries the remediation of effects provoked by mining activities represents a legally-binding commitment. However, the remediation results depend upon many other factors, among which some are not factors of technical nature. In spite of all the efforts made in this field some subjects still fail to comply with these requirements and the consequences of such behavior may be measured in tens of thousands of dollars only in Europe.

The remediation of adverse effects must be taken into account even during the designing stage and when particular mining methods are selected for each concrete case. Due to high reclamation costs it is sometimes necessary to opt for underground mining methods even in conditions in which surface mining was traditionally applied (construction stone). The remediation of abandoned mining sites and facilities is a special problem since they, even abandoned, represent potential environmental hazard for a long time.

The education of the personnel employed in mining industry is very important and it must be integrated into all levels of the organization in compliance with the type of job performed. In general, the employees may be classified into the following groups:

- a) employees in charge of environmental protection and
- b) employees engaged in operations that endanger the environment.

The complexity of environmental protection and the consequences that might result from the irresponsible behavior of some subjects involved in mining activities impose the need for education and training of workers and professionals. Education should become a permanent process and should be integrated at all levels. Apart from the basic knowledge introduced at the level of elementary schools, vocational and professional education should be provided through:

- vocational schools introducing compulsory courses,
- universities at the level of full-time studies introducing major, compulsory and elective courses,
- postgraduate schools that would include specialist's, M.A. and Ph.D. studies,
- permanently creating innovative solutions, organizing vocational seminars, regular lectures and other forms of education and training within enterprises,
- popularization of environmental protection and know-how, publishing of popular leaflets, manuals etc.

The education level of the personnel engaged in all the technological phases, particularly of the officers responsible for environmental management and organization, may be a good criterion to evaluate the success of environmental protection as a whole. Since mining engineers and technicians are the ones to determine and conduct the mining and dressing processes they assume the greatest responsibility.

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