CONSIDERATIONS REGARGING THE USING AND PROCESSING THE WASTE FROM MINING INDUSTRY ACCORDING TO THE SUSTAINABLE DEVELOPMENT

Dumitru FODOR[1,2], Ionut PREDOIU[2], Ioan Calin VEDINAȘ[2]

[1]Full Member of the Academy of Technical Sciences in Romania
[2]University of Petrosani

Mining activities of extraction and exploitation of minerals have paved the way for civilization, progress and prosperity for many countries, including Romania.

Over time the mining industry has provided the world with huge amount of useful minerals and contributed to technical and economic progress of mankind. *There is nothing wrong if we say that mining has created the material basis of civilization.*

Extraction and processing of solid mineral raw materials in Romania are known from ancient times, and the variety and importance of mineral resources have determined that mining be a permanent occupation and well organized for over 2000 years in this part of Europe and the world.

In Romania, the mining industry known until the last decade of the twentieth century continued to grow and increase when entered in a time of transformation and adaptation to transition of an economy market.

Useful mineral deposits in Romania are numerous and show a great diversity of varieties represented by: mineral fuels all types of precious metal ores, ferrous and non-ferrous metal ores, rare and radioactive metal mineral, rocks of all origins, etc.

In terms of geography, deposits are spread across the country, the mineral is found in mountainous areas, while coal and non-metallic substances in the hills and depressions.

In the 9th decade of the twentieth century, when production of mining industry reached its peak more than 150 million tons annually only to fossil fuels and metal ores, there were 278 mines and coal pits in operation, 70 plants and equipment for preparation of the metallic minerals, from which 30 in metal ore sector, 34 in non-metallic sector and 6 in coal sector, spread in 41 basins located in the territory of 23 counties. At that time the mining sector was a way of life for about 10% of the population and covering approximately 17,500 hectares of land.

Deposits features in Romania are generally heavy and very heavy, as exemplified by: complicated tectonic, small reserves, layers and thin veins, useful content reduced depth of mining, difficult hydrological conditions etc. In such fields have not been able to organize and develop only small-scale mining, but with a strong influence noticeable and easy on the environment.

The development of the mining industry in Romania, especially in the second half of the twentieth century, led to concentration of numerous staff for mining, strong labor centers located near deposits of useful minerals, such as for example: Uricani, Rovinari, Motru, Berbeşti-Alunu, Moldova Nouă, Abrud, Baia - Borşa, Bălan, Brad etc.

Mining industry with its branches and activity sectors aims to achieve minerals from the ore and preparation for recovery through various preparation techniques.

Parallel to obtain useful mineral substances from crude ore minerals in the mining industry is inevitably to produce a series of solid, liquid and gaseous waste.

Solid waste, mainly represented by waste rock from underground workings and coal pit stripping requires large areas of land for storage. These lands are thus removed permanently for a long time, or current use for agriculture and forestry.

Liquid waste most representative of the mining industry is mine water and waste water from the preparation plants that can pollute all environmental factors.

Gaseous waste represented by residues powders, gases and vapors which come from all sectors of the mining industry. Under the action of air currents, the gaseous pollutants are transported over long distances of hundreds and even thousands of miles and affect all environmental factors.

In table 1 is shown an inventory of mining waste after their state of aggregation and by place of origin.

Table 1. **Classification of mining waste by place of origin**

Aggregation state	Origin		
	Branch of mining exploitation	**Branch of mining preparation**	**Branch of metal exploitation**
Solid	- sterile from mine and coal pit stripping; - carbonaceous shale extracted with coal; - poor ore or unprocessed by extraction date.	- gangue of processed minerals; - processing ore slurry, discharged as slurry; - shale and coal slurry.	- residues from pyrometallurgical operations; - the melting and refining residues from metallurgy of Pb and Zn; - distillation residues (Zn metallurgy); - waste frying (pyrites); - waste from coal power plants: molten slag, fly ash.
Liquid	Mining waters: - from coal mines; - from ore mines; Coal pit waters: - from dewatering; - from rain.	Water from processing of useful mineral substances: coal, metal ore, radioactive ore.	- water from coal; - leaching solutions used in hydrometallurgy; - wastewater from steel and metallurgical processes; - wastewater from power plants (hydraulic transport of slag and ash)
Gas	- Air poluted with mine gases (Grizuu, CO_2, CO, NO_x, SH_2, etc.); - air poluted by explosives, undergroud fires (CO, CO_2) with water vapor and solid particles (dust).	- poluted air by dust from coal and ore (SiO_2, etc.); - poluted air by vapors from flotation reactives, cyanide etc with strong smell; - poluted air with radioactive powder from preparation of radioactve ore.	- polluted air like smoke and gases from steel and metallurgical furnaces (SO_2) and dust; - air pollution from power plants (SO_2), ash etc.); - air loaded with volatile products from coke ovens; - foul air from gas electro aluminum electrolysis (fluoride + aerosols); - air with Hg vapor from mercury ore roasting; - air polluted with smoke and gases resulting from burning dumps.

Mining activities as a whole do not fall indefinitely for sustainable development, but the sequence and manner of the categories of work necessary to accomplish can be routed so that the environment, the economy and the local community as a whole to achieve quality standards net above the beginning and mining development.

Sustainable development is how to keep in present and future, a high quality of life for society, ensuring the maintenance of ecological processes on which life with continued use of natural resources we need rationally and efficiently.

For sustainable development means to extract the most useful of all components of raw ores and other sectors using waste rock from the ore extracted once with useful components.

In this context one of the issues that concern us and which fall within the theme of our conference is to use as fully and in the most efficient way of mining waste.

In our concerns we stopped more on solid waste given the sheer amount of such residues existing in our country.

In the 41 mining basins of Romania, there is an inventory for 750 dumps of different sizes from mines and coal pits which have over 2.500 million m^3 of sterile.

We also have over 70 ponds with 500 million m^3 of sterile from the preparation plants from all over the country.

USING THE MINING WASTE

The objective in recovery action of solid mining waste is in their treatment by physical, chemical and biological own mining techniques in order to recover metals, obtaining energy from waste coal or achieving industrial products used in other fields.

Processing of these residues and getting recoverable by-products is a significant problem and even pressure from large volumes of tailings and waste accumulated over time.

It is highlighted that these materials contain often, some of the useful minerals which have been processed resulting from this the residues; like any industrial operation is never perfect. Residues may also contain other constituents, when processing tailings interest not economically or they do not know their extraction technology.

Using it in various purposes, as further processing of mining waste in order to capitalize on the constituents of which still contain residues requires records stored both in terms of quantity, and in terms of content. Without these elements, it must be determined when it comes to use and process a mining waste deposit.

So solid mining waste resources can be considered a resource because it can be extracted by processing at relatively low cost, a number of useful components, or may be used in construction materials and others can be used as fertilizer. From the materials dumped in waste dumps or ponds can be extracted several useful components such as feldspar, heavy metals, noble metals, etc.

Processing examples of old landfill sites from mining or preparation plants, are numerous. In this case dumps and tailings dams are true ore reserves of useful mineral substances resulting from their processing.

In various countries with developed mining is always considered solid residues, both the mining sector and metallurgical sector, the potential metal resources being very important.

In Romania there are large amounts of waste material derived from mines, coal pits and processing plants that are useful components. This happens due to the adoption, at that time, the processing of outdated technologies, inadequate technologies and the failure to comply strictly technological discipline.

As example, the dumps from the old iron mines - Teliuc, Ghelar and Ocna de Fier from Banat, or from some gold mines - Săcărâmb, Barza, Zlatna, Baia de Arieş etc, were procesed as ore for recovering the contained metals.

In recent decades many researches have been conducted for the use of ashes from coal combustion in power plants in various industrial sectors of the economy. The research was conducted for the extraction of metals for use as ash amendment in agriculture and also to establish fastening solutions and replanting of ash and slag heaps.

In a program of higher recovery of fly ash, developed in Romania for several years in a row, to investigate the possibility of extraction of chromium, titanium, vanadium, magnesium, aluminum oxide and magnetite, applying effective work processes and products that remained available had a high content of SiO_2 and CaO and were used for making bricks, masonry blocks and aggregates.

It was found, however, that the use of ash for industrial and construction providing only a small consumption of the total amount of ash produced by the plants. Put more strongly so the problem now and in the future use of ash in agriculture as a soil and even growing problem of ash dumps or at least they are fixed by grassing.

Research undertaken led to the conclusion that the chemical characteristics of ash in Romania, not recommended for use as a soil improver chemical and physical characteristics of the soil to improve the required quantities of ash, but whose transport is prohibitive.

Also, the materials of a number of dumps and tailings ponds can be used in the construction process and, as such waste that is made mosaic marble or stone dust.

A series of dumped materials, especially slag and ash can be used to achieve the construction of roads and motorways embankments or spaces intended for sporting activities in the manufacture of bricks, cement and other building materials.

By using these materials for the purposes set out above reduce areas occupied lowers pollution and economic benefit can be achieved.

Taking into question the possibility of using mining wastes in construction activity can mention:

- Using dacite, andesite, rhyolite and other resistant and unaltered rocks, coming for example from stripping coal pits or digging underground mining works, as a building stone for walls, dikes, dams etc. Of course, the used material should be appropriate in terms of size and particle to the characteristics of resistance;
- Use of flotation residues as hydraulic underground backfill, filling the voids left by exploiting deposits. In this respect we consider it appropriate to emphasize the use of this solution years ago, to backfill Bălan underground mine voids in our country, figure 1.

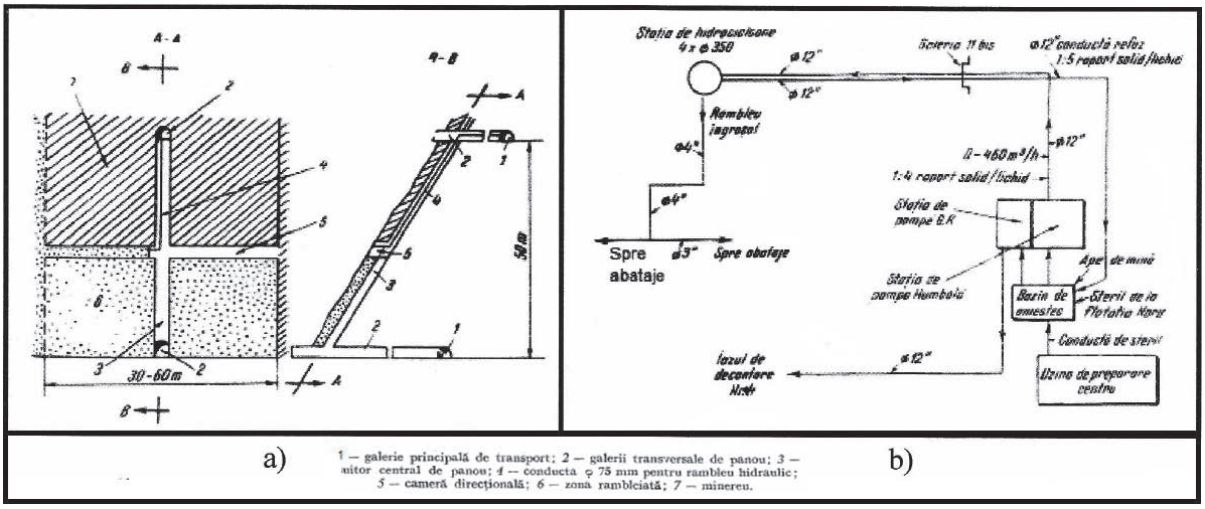

Fig. 1. Design and exploitation method in horizontal slices with hidraulical embankment to Bălan mine.

At this mine was used an embankment equipment which used the waste from flotation with a capacity of 460 t/day, in the state of pulp, with a solid-liquid ratio of 1:4-4:5. The pulp was pumped into the mine on a distance of 1.5 km, to the hydrocyclone plant. Cyclone thickened material was pumped into the coal face and the overflow was pumped into the pond. The results obtained with this technology were very good.

In coal mines, besides their residues are used for different purposes and residues from other sources, such as ash and slag resulting from power stations.

In recent years various technologies have emerged and use of residues in the mining industry, which resulted in: fire, filling the gaps in groundwater due to aggregate and cut air into the abandoned coal mining cracked prone to self-ignition; isolation long gallery, which led to the elimination of methane diffusion throughout the mine and to prevent ingress of water into the main network works; insulation of underground fires; filling of old mining works for simplifying and improving ventilation system etc.

In Figure 2 it is shown a mixture preparation station to be used in hydraulic backfilling of underground voids. The quality of filling material depends on the category of protection that we want to make sure construction on the surface. In cases in which the protection of the surface is not so important, can be used as fillers with a lower, such as, for example, crushed rock material resulting from the flotation sludge, ash powders or mixtures of these materials.

When it is wanted the effective protection of the surface, there will be embanked the galleries and the underground voids with materials that consolidate itself.

It is very important that before applying these embankment technologies to investigate the properties of mixtures employed in the laboratory and testing them underground.

Embankment material fills the gap left by the exploitation of coal, including ceiling voids formed by crumbling rocks behind the front slaughter. Enables rapid filling of a pressure balancing rocks, improves the climatic parameters of the coal face and prevents fires, especially in coal layers prone to self-ignition.

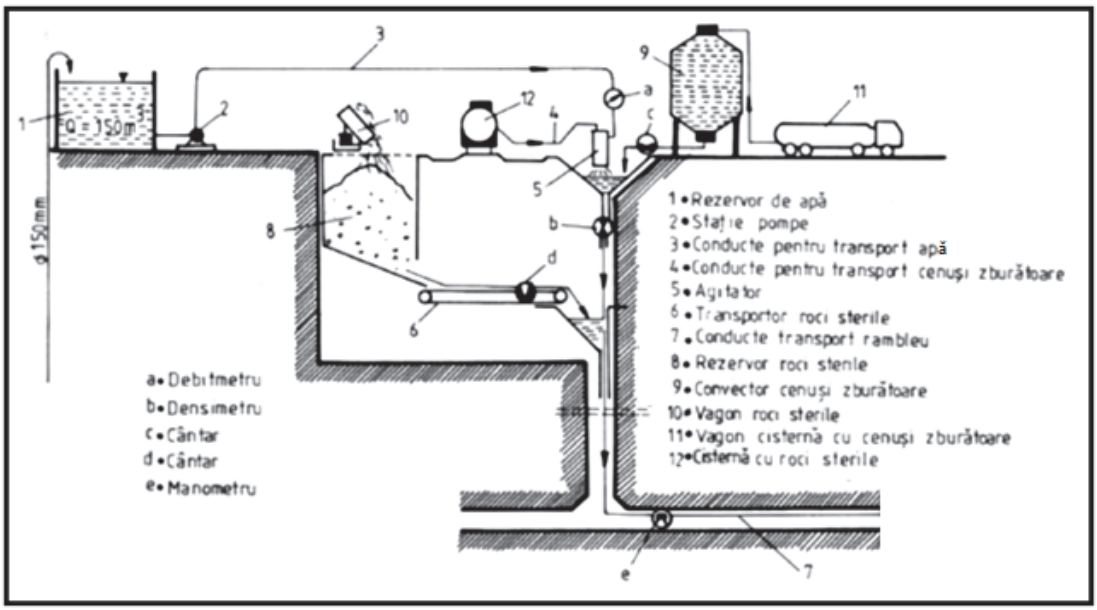

Fig. 2. Embankment equipment for coal exploitation.

The following may be mentioned as a number of uses of the mining residues as follows:

- Use of residues as natural form for making earthwork embankments and railways, are used as a bed for roads, foundations and floors for industrial buildings;
- Use of shale and coal residues for improvement of agricultural land;
- Embankment of wetlands with residues from coal washes;
- Using shales from the coal washes to obtain a good hydraulic embankment and fabrication of pre-cast concrete and concrete monolith. Here we illustrate that the shales of our plants for the preparation of coal (Lupeni, Petrila, Coroeşti) were found to be good in order to obtain a highly stable hydraulic backfill. The same residues from the three processing plants in the Jiu Valley gave good results in their use as aggregate for concrete and pre-cast concrete monolith; were obtained concrete lighter, stronger and better insulation than conventional concrete.

Reduction residues from the coal preparation plants can be made and on preliminary draining, followed by drying them in a fluidized bed furnaces, thus obtaining a product that can be stored and used in combustion power plants, either alone or in a mixture with a lower or mixed coal.

- Use of ash from burning coal in power plants for: brick, cement manufacture of weaker production of concrete for dams, embankments construction from large volumes for access ramps to bridges etc;
- Using molten slag from power plants for the production of slag wool, which is a good thermal and acoustic insulation material.

Here it is appropriate to highlight once again that it requires attention to use ash and slag resulting from power plants for different purposes and in particular the construction of housing, as these residues concentrations of radioactive elements are much higher than those found they were subjected to burning coals.

- Use of waste as building materials assumed that these residues are completely sterile, which mean it does not contain elements that could be extracted either by improving the technology first applied ore residues resulting from or through the application of new technologies.

At REMIN - Baia Mare have done research about the possibilities of recovery of materials from dumps. The results show the possibility of using sterile varieties of concrete preparation branded B-400, rough stone foundations of roads, pavements for roads and streets, crushed stone for the foundation and core layers, as chippings or if they altered rocks can be used to repair and maintenance of forest roads, site roads and those in rural areas.

Since the extraction of metals from ores is becoming more expensive, due to the exhaustion of deposits rich and easily accessible at a time becomes profitable extraction of metals from material deposited in dumps or tailings ponds.

Some dumps and tailings ponds inactive and passed conservation is currently secondary resources that can be driven into the economic recovery.

It is necessary to underline here that any metal recovery works in ponds can be made only after leaving ponds in service and after analysis to justify the technical and economic profitability of these activities. Generally in these ponds, due to the low content of metals (Cu, Pb, Zn) may be made only one problem now of possibly extraction of precious metals.

We underline in this connection that in Romania were completed several projects for recovery of precious metals from tailings flotation competition of foreign partners.

In future concerns for recovery of secondary resources resulting from mining activities will continue in the country and thus a number of dumps and tailings ponds will rejoin the economic cycle.

Starting from the truth that sustainable development is meeting the needs of the present without compromising those of future generations, we can say that for the mining industry, in our days, sustainable development means rational exploitation of the ore deposits and rational use and full of all the contents of the deposit.

Using whole tailings and waste from production processes for recovering useful components on its own, will save and protect a number of fields that will remain available to future generations.

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CONSIDERAȚII PRIVIND PRELUCRAREA ȘI FOLOSIREA STERILELOR ȘI REZIDURILOR PROVENITE DIN INDUSTRIA MINIERĂ ÎN CONTEXTUL DEZVOLTĂRII DURABILE

Dumitru FODOR[1,2], Ionut PREDOIU[2], Ioan Calin VEDINAȘ[2]

[1]Membru titular al Academiei de Științe Tehnice din România
[2]Universitatea din Petroşani

Rezumat: Zăcămintele minerale utile din România sunt numeroase și prezintă o mare diversitate de sorturi. Industria minieră din România a cunoscut până în ultimul deceniu al secolului al XX-lea o dezvoltare continuă, când producția a atins un vârf istoric, de peste 150 milioane tone anual. Minele și carierele au funcționat în 41 bazine miniere localizate pe teritoriul a 23 județe. Paralel cu obținerea substanțelor minerale utile din minereurile brute, în industria minieră s-au produs și acumulat mari cantități de roci sterile și reziduri provenite din procesele de preparare și prelucrare. La nivelul țării avem inventariate peste 750 halde de steril care înmagazinează aproximativ 2.600 milioane m^3 de roci sterile și peste 70 de iazuri de decantare care au acumulat până în prezent aproape 500 milioane m^3 steril. În contextul dezvoltării durabile care astăzi pentru minerit înseamnă extragerea și recuperarea la maxim a tuturor componenților utili din minereurile exploatate și folosirea în alte sectoare de activitate a imenselor cantități de roci sterile acumulate în halde și iazuri de decantare, au existat următoarele preocupări: tratarea haldelor și iazurilor miniere în vederea recuperării metalelor, componentelor combustibile, mineralelor nemetalifere și a altor componenți utili existenți, în condiții de eficiență economică; tratarea zgurilor și cenușelor de la termocentrale pentru recuperarea unor metale; folosirea materialului din halde și iazuri în domeniul construcțiilor; întrebuințarea rezidurilor de flotație ca rambleu hidraulic pentru umplerea golurilor subterane; întrebuințarea șisturilor și rezidurilor carbonifere pentru ameliorarea unor terenuri agricole etc. În material sunt prezentate realizări concrete și nominalizarea unităților productive și de cercetare – proiectare care au avut preocupări în acest domeniu de activitate.