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Management of Waste in the Mineral Processing in the Baia Mare Area

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ABSTRACT: It can be stated that there is a constant preoccupation with solving risk problems in mineral exploiting and processing activities, which have a powerful impact on the environment. This paper reports a preliminary study in which sources of pollution and waste in precious metal processing activity were identified in the Baia Mare area. Data from water, air and soil samples were analyzed by statistical methods, and the global pollution indexes of environmental factors were also established. Using the results of the study, it is possible to appreciate the impact on the environment factors, and a waste management plan is suggested.

1 INTRODUCTION

Taking into account the great interest in environment protection and internal and international laws imposed in recent years, ecological aspects are being studied more and more in Romania.

The Baia Mare mining basin İs made up of metalliferous deposits of the following types:

1. Gold-silver deposits (Bäita, Säsar, Valea Roşie, Dealul Cnıcii, Şuior) in the upper part.
2. Complex metallic sulphide deposits with a Pb and Zn content, to which Cu, Au and Ag are subsidiarily associated. At Cavnic and Bäiut, the gold- silver contente are the object of mining.
3. Cupriferous deposits, to which Au and Ag are subsidiary associated (Nistru, Baia Sprie, Toroiaga, Baia Borsa).

At Şuior, auriferous arsenous pyrites are stockpiled, forming a waste dump of 300,000 t over an area of 1,000 m^2. The stockpiling of the ores is being carried out until an adequate processing technology is found, taking into account the As content.

The dressing of auriferous-silver deposits in the Baia Mare area is done in the ore-processing plants: Säsar and Flotatia Centrals. The Meda waste dump was established by stockpiling the waste resulting from flotation and cyaniding activities at the Säsar processing plant.

The Romanian-Australian joint venture, Aurul SA, which has the production of precious metals as the object of its activity, focuses on retreating the waste that has resulted from the two ore-processing plants in Baia Mare.

The establishment of the Aurul SA. project İs related to the idea of moving waste dumps from urban areas to areas farther from the inhabited zones. Owing to the ore-dressing technology used, the above-mentioned waste has a high recoverable content of precious metals, and this has enabled the recovery process to be carried out efficiently.

The Bozanca slurry pond stores, in a safe, environmentally friendly manner, the tailings resulting from cyaniding after the recovery of gold and silver with active carbon according to the CIP method.
The Bozânta slurry pond lies 6.5 km from the plant for retreating waste on level ground, near the operating Bozanca pond and the Säsar conservation pond belonging to the Baia Mare Remin Company.

2 POLUTION LEVEL OF THE ZONE

2.1 *The Bozanca slurry pond*

The Bozanca pond is made up of two embankments of permeable material from the Säsar preserve pond. Although the uncovered ground where the pond was built was composed of clay rocks, it was completely covered with a high-density material. This has a thickness of 0.5 mm inside the starting embankment and a thickness of 1 mm under the starting embankment, on the outline and between the two embankments, in order to ensure the pond is watertight given the ground, and to avoid pollution of the environment.

Inside the outline embankment, there is a drainpipe, through which the infiltration waters are collected through the starting embankment and through the embankment built during the hydrocycloning operation.

In the Bozanla slurry pond, the waste resulting from cyaniding and the recovery of gold and silver with active coal is stockpiled in a safe and ecological way.

The working technology is based on the construction embankment of the raising by hydrocycloning with the deposition of the heavy fraction in the embankment and the light fraction on the internal beach of the pond. The clearing waters are evacuated through a reverse derrick to the pump station, from which the water is sent to the plant and used in the technological process.

In case of any technological accidents, there is a functional damage pond, on the east side, built like the big pond.

3 POLLUTION SOURCES

3.1 *Soil pollution*

The waste dumps in the area, notably Meda and Bozanca, constituting the main source of raw material for the retreating plant, have been constructed directly on the soil and are not insulated against the soil or groundwater layer.

The slurry ponds in the area have polluted the soil with metals and caused an increase in soil acidity due to the phenomenon of natural biological leaching that occurs in the waste mass. According to the assays carried out before the activity had begun, the high concentration areas exceeding the intervention thresholds are situated north-west of the ponds. The northeastern area, according to the same study, is within allowable limits, and the increasing tendency of tibe overall pollution index is from the east to the west.

The principal metals for which increases in the intervention threshold have been recorded are: Mn, Zn, Pb.

Taking into consideration the type of pollution the soil has been exposed to in the surveyed area, namely, industrial pollution due to precious metal recovery activity, the degree of pollution is quite well defined by pH, by the heavy metal content and by cyanide content.

The main effects of the Bozânfa slurry pond on the soil are:

> taking up the area (94ha);
> potential pollution with fine waste material borne by the wind and later deposited on the neighbouring terrain.

Therefore, the soil sample were assayed as follows:

- determining the pH;
- determining Cu, Zn, Pb, Mn, and Cd;
- determining cyanides.

3 *2 Water pollution*

Although the Meda dump is located in the vicinity of the Säsar river and may constitute a potential source of pollution, quantifying die impact of this pollution source is difficult due to the accumulation of several sources of pollution in the area, sources from neighbouring units.

The quality change in the groundwater layer in the surveyed area in the existing piezometers, shown mainly by the cyanide indicator, could be a signal that the surface water quality should be examined.

3.3 *Air pollution*

Atmospheric pollution in the area of the Meda waste dump may be due, first of all, to the fine waste particles carried from the pond outline, resulting in an increase in the airborne powder content.

This air pollution has been felt for a long time and is not specific to the activity carried out by S.A Aurul at the Meda waste dump.

The pollution by powders is due, to a large extent, to the transport activities in the area, taking into consideration the fact that the access ways have not been modernized. The content of airborne powders has been determined. The polluting elements in the atmosphere according to regulation STAS 12574-87 are only *Câ* and Pb. The studies undertaken at the Baia Mare dumps have shown that, in general, the Pb content is below 0.1%, while Cd is present only in trace amounts.

The dust emission at the Bozanca pond resulting from fine fractions carried by the wind is low due to the moisture of the material, and is largely due to the heavy traffic on the gravelled access ways.

4 STRATEGY REGARDING MANAGEMENT OF WASTE ÎN THE BAIA MARE AREA

In order to prevent or reduce environmental pollution in an ecological reconstruction and rearrangement of the effected zones in Baia Mare, a project of environmental management and protection is at present being undertaken by specific institutions according to environmental legislation.

When starting upon the plan of environmental management, it was necessary to define the notions of "significant impact" on the environment and the "importance of the impact".

According to the situation in the Baia Mare area, the main problem was how to define the notion of "significant impact". If the significant impact has already occurred, it Îs necessary to allocate money and time resources to evaluate it. For non-significant impact, as assessed by an objective evaluation, a report regarding this impact should be prepared so as to gain important savings in time and money.

The evaluation was structured as a three-level analysis:

- Level no. 1 - a list of categorical exclusion regarding the activities with no impact on the environment.
- Level no. 2 - an evaluation report identifying the non-significant impacts.
- Level no. 3 - a final report about me main environmental impacts.

5 RESULTS AND CONCLUSIONS

In order to measure the extent of degradation of the environment in the pond area, soil, water and air samples were processed and analyzed physically and chemically in terms of the main pollution factors which could affect the quality of the environment as a result of the activity at S.C. AURUL SA.

By analyzing and interpreting the date obtained by the chemical analysis of the soil, underground water and air samples taken from the area, we came to the conclusion that the soil and the groundwater layer are polluted as a result of previous activities.

Compared to the original degree of pollution, because of the activity carried out by S.C. Aurul SA, additional pollution is possible, namely:

> The waste dislodging technology by hydromonitoring results in die emergence of suspension, which is leaking towards the dam.

> The fine waste on the transport ways arranged along the pond during waste dislocation may be blown away by the wind.

> The dislocation technology by hydromonitoring uses process water under pressure; aerosols generated with a high cyanide content can be taken up by die wind, polluting the atmosphere.

> Taking into consideration the object of the activity at the waste retreating plant, the main potential sources of soil pollution and the principal pollution sources, the principal pollutants analysed are non-ferrous, heavy metals and cyanide.

On the basis of the concentrations determined in the soil, groundwater and air samples from Meda waste dump and Bozân{a slurry pond, the pollution index was calculated and each element was given a note. The results are shown in Table 1 and Table 2.

Due to the great amount of precipitation in January 2000 at the Bozanta mud-setting pond, a technical accident occurred, which had a great impact on the environment. This event created a breach İn me starting embankment from 20-35 m and there was a discharge of 100,000 m^3 of water, as illustrated in Figure 1. All measures for minimising pollution in this situation were taken immediately. It was necessary to conduct a waste management study for this objective.

Table 1 Analysis of environmental factors at Meda waste dump.

Environmental factors	Analyzed Element	Level I (0 05m)		Level II (0 3m)	
		IP*	NB*	IP*	NB*
Soil	CN	0 0009	9	0.0002	9
	Cu	1,89	6	1,035	6
	Zn	0 86	7	0 847	7
	Mn	0,42	8	0 359	8
	Pb	8.13	3	5 07	4
	Cd	5.67	4	5 8	4
	IPG	2,32	-	2 17	-
Ground water layer	Fe	89 6			
	Cu	2.7			
	Zn	2 4			
	Mn	825 3			
	Pb	4.8			
	Cd	25			
	IPG	9.09			
Air	Airborne powders	0.23			
	Cyanide	0			
	IPG**	1.05			

Table 2 Analysis of environmental factors at Bozanta slurry pond

Environmental factors	Analyzed Element	Level I (0 05m)		Level II (0.3m)	
		IP*	NB*	IP*	NB*
Soil	CN	0.0002	9	0 0001	9
	Cu	0 76	7	0.68	7
	Zn	0.86	7	0 95	7
	Mn	0.33	8	0 38	8
	Pb	10.8	3	19 85	2
	Cd	5.16	4	5 52	4
	IPG	2.22	-	2 39	-
Ground water layer	Fe	706 2			
	Cu	10 08			
	Zn	9.61			
	Mn	2306 2			
	Pb	9,74			
	Cd	78 6			
	IPG	23 07			
Air	Airborne powders	0 255			
	Cyanide	0			
	IPG**	1.11			

*Index pollution and beneficiation note,
**Global pollution index

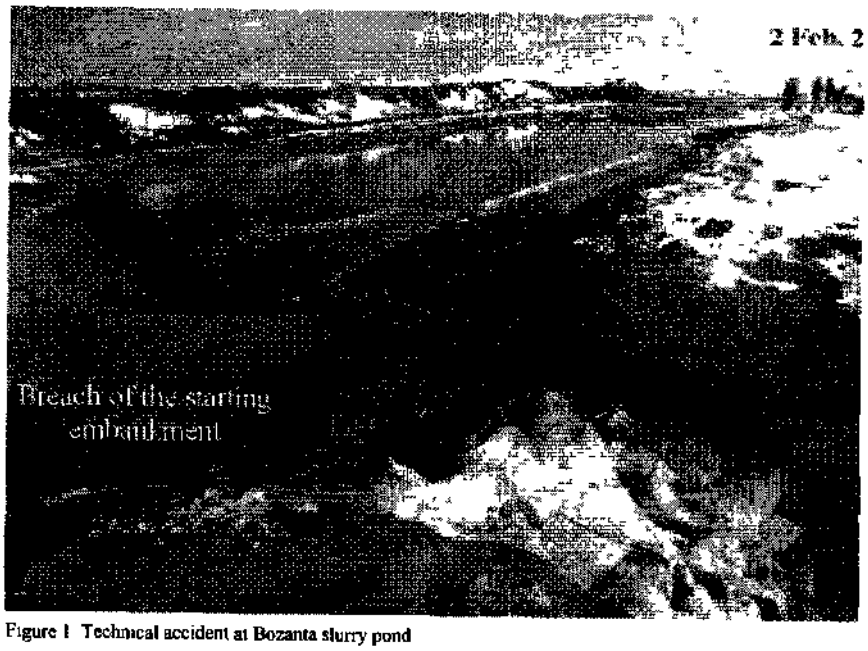

Figure 1 Technical accident at Bozanta slurry pond