THE ACTIVITIES AND PERSPECTIVES OF IMPROVEMENT THE POLLUTED WASTE IN SURROUNDING RIVERS IN BUCIM MINE AREA

T. Danevski, M. Golomeova, B. Krstev, B. Golomeov, A, Zendelska, A. Krstev, Z. Gocev

[1]University "GoceDelchev", Faculty of Natural and Technical Sciences, Shtip, R. of Macedonia
[2]Mine BUCIM, Radovis, R. of Macedonia
[3]University "GoceDelchev", Faculty of Computer Science, Shtip, R. of Macedonia

ABSTRACT. The presentation of the influence that the tailing dump or waste as well as the flotation hydro-tailing dump over the environment around the region of copper mine Bucim, surrounding rivers, places, villages, appearance of dust, pollution of ambient air and mine tailing pond. Generally speaking, the monitoring will be done for two periods. The first analysis relating to the period from the year 2005, and the second analysis relating to the period from the year 2010/2012. The monitoring with samples of waters, soil, sediments and ambient air as well as the monitoring with samples of the dust will be done.

Keywords: pollution, waste, Bucim, flotation, mining

INTRODUCTION

The flotation concentration of mineral raw materials produces large quantities of tailings with significant volumes of water that should be disposed of in appropriate place. The right discharge means better protection of the environment, prevents settling of underflow. It provides certain volumes of water for use in the technological process. The tailing dam that consists of sand dam, settling lake, drainage system and equipment for evacuation of decanted water is an important part of the mine. It must meet the requirements as follows:

- To provide good safety and stability to the dam,
- To have permanent hydraulic input of tailing,
- Permanent work of hydro cyclones during separation of sand and overflow,
- To have operational drainage system at any time,
- To provide sufficient time for the physic-chemical processes, or settling of coarse fraction and dissolving of other flotation reagents in order to obtain clear and purified water to be used in the plant or flow into the water courses without contaminating the environment,
- To possess built in collectors to receive and evacuate clear water,
- To have a sand dam with appropriate thickness and porosity to receive and evacuate the clear water,
- To possess sand dam of appropriate thickness and porosity to receive and evacuate clear and percolating water,
- To be economically justifiable in the concentration process.

Hydro tailing dams and tailing dump in copper mine

Over the past years much higher dams (reaching up to 100 meters in height) were constructed. Their economy is seen in the continuation of the lifetime of the drainage system, the collector, the flotation pulp station and the water system between the flotation plant and the tailing pond which are the major costs in construction and maintenance of the tailings dam. Larger dams make possible the housing of flotation waste, to reduce, at the same time; the costs per ton processed ore.

The terrain chosen for the construction of the tailings pond and dam must be examined in order to determine its geological characteristics and rock mechanics. The construction should be as inexpensive as possible. This requirement leads to the application of the so-called upstream method, since the centerline of the dam extends upstream or downstream. In the application of this method the small starter dam is located at the end of the favorable downstream point, whereas the dam goes upstream. Two major methods are used in dam construction – hydro cycling and spigot.

The advantages of the upstream method are its low cost and the time period necessary for the construction during each successive dyke increment.

The disadvantage is that the dam is constructed on earlier deposited unconsolidated slime. The limiting height during the construction of this type of dam (before a failure occurs) led to the less common construction of this type.

The second, so-called downstream method is fairly new system. It has evolved due to the efforts to construct larger and safer tailings dams. Unlike the upstream method, here the centerline increases downstream and the dam is founded on coarse tailings. Most procedures use cycling or produce sand for the dam construction. The method makes possible the design and construction of the tailings dam with acceptable standards. All tailing dams in seismic areas or almost all-major tailings dams were constructed using the downstream method.

The main disadvantage of the method is the large amount of sand necessary for the construction of the dam. There is also a third method the so-called center-line method - used in the construction of downstream dams, and the crest remains horizontal as the dam wall is built. The advantages are that it requires smaller volumes of sand-fill for the crest at any given height.

Sand dams differ from dyke dams since they are permanently built during the use of tailings pond by depositing new layers of hydro cyclone sand of lower compactness. The sand comes from the flotation pulp and contains 60 to 75 per cent coarse fractions. The concentration of sulphide minerals in the hydro cyclone sand is higher than in the flotation tailing, particularly higher in the hydro cyclone overflow. With the time, oxidation of sulphide minerals occurs. This changes the permeability of the sand dams and the angle of internal friction among sand grains, which is also important for the static stability of the dam.

The water from the accumulation area penetrates sand dams causing physical, chemical, hydrogeological and consolidation processes to take place during and after the construction of the dam.

Oxidation of sulphide minerals in tailings depends on the time necessary for the reaction of their surfaces with the oxygen in the air. The speed of the oxidation process is related to the quantity of air, temperature, and the degree of moisture and the specific surface of oxidizing minerals. Of all sulphide minerals - pyrite, which is most common in flotation tailings, is most prone to fast oxidation in a sand dam due to its crystal-chemical properties and easy commination. Products of pyrite oxidation are: Ferro hydroxide - $Fe(OH)_2$, Ferry hydroxide ($Fe(OH)_3$, Ferro sulphate $FeSO_4$ and sulphur hydrogen H_2S.

Seeping waters in the tailings pond often contain heavy metals such as iron, zinc, copper, nickel, and manganese. Lead is known to be of limited solubility. Larger presence of individual elements is harmful for the environment. In that regard we must prevent outflow of water with heavy metals in order to keep water safe. Understanding the chemical reactions that take place in the flotation tailings helps to prevent the aggressive action of water of concrete reservoirs whose disasters may cause undesired consequences.

The most serious issue regarding the protection of the environment related to the disposal of flotation tailings in the ponds is the discharge of contaminated waters in surface and underground courses. It must be said that it is more complex in surface courses.

Remediation of the pond envisages new and more efficient methods. The land used to be a good valley, but today it is a plane area of greyish color and a pond with no animal or plant life. Changes of the relief result in changes of the climate that have an enormous impact on the biota.

The high concentrations of heavy metals in the soil have an impact on its quality and prevent the formation of humus material. They break the bonds between the humus material and the mineral part of the soil that leads to the destruction of the soil and loss of humus and reducing the anti-erosive capacity. Heavy metals enter the plants and crops causing a number of biological distortions. Many plants are resistant to saturation of heavy metals and survive. However, saturation of heavy metals in vegetables that are consumed by humans may result in serious health problems. Possible disaster of the dam would result in serious disturbance of the environment and casualties, including great material damage. The issue should be given greater attention.

Experience has shown that disasters are caused due to various factors such as instability of slopes, earthquakes, floods, large quantities of drainage waters, poorly constructed foundations, erosion etc. In dam construction it is of importance to use all project parameters. Exceeding the dam means disposal of new layers of waste so that the body of the dam increases and the fine particles in the substrate make the large mass unstable.

The environment is a complex system consisting of mutually connected factors. The changes in one factor may cause changes in the other. So, the issue of the protection of the environment from contamination can be solved through integrated and systematic approach. Any partial solutions are not permanent solutions and mean improvisation that take us away from the real solution of the problems. The measures to be taken in protection call for good understanding of the negative effects in mining operation and their elimination. The measures include protection of waters, air, and soil. In environment protection it is important to pay attention to the reduction of pollution of water courses in which waste waters from the tailings pond are discharged. Today, large volumes of contaminated water are recycled and fresh water input does not exceed 5%. As mines use their own wells for the supply of fresh water, the use of the water from the tailings pond would be no economical.

Water and soil from tailings in copper mine

Water protection includes certain measures. The most common are those that in the flotation process the toxic reagents are replaced by non - toxic or less toxic, settling of water in the pond in order to assist decomposition of residual flotation reagents, clogging of overflow collector when the water is not sufficiently clean, temporal extension of overflow collector and drainage pipe etc. Extension of overflow collector calls for urgent measures since during the dam construction, the flotation waste has not passed the part where the overflow collector ends. The drainage system is functioning well as seen from the measurements carried out by piezometers. However, for better monitoring of filtration and rising waters it is necessary to clean the broken piezometers or replace them with new ones. The impact on ground waters is small. Each raises of the dam results in overflow and run off part of the water into the ground. The problem could be solved through controlled hydro isolation. Contamination of earlier tailings ponds has been reduced to a minimum. They have also been cultivated and do not pose any danger to the air.

For the crest and the slopes several solution are possible one being water spraying with nozzles under high and low pressure. The low-pressure nozzles work under pressure of 4 bars and have a small range amounting from 15 to 30 meters and economical use of water. This does not require installation of expensive high-pressure pumps. One of the advantages also is that the low pressure of the jet does not damage the dam. Their disadvantage is that a number of pipes have to be fixed and requires higher investment. Low-pressure nozzles are most common in dam spraying. Combined spraying is when one part (the crest) is sprayed with low-pressure nozzles, whereas the downstream slope is sprayed with high-pressure nozzles - water guns.

Possible solution is spraying with certain suppressants that form crusts husks that connect fine fractions and prevent the formation of large volumes of dust.

Lands formed from discharged flotation waste are called float salts. Because of the harmful component parts and the manner of discharge they pose multiple dangers to the environment. They have no biological importance and the chances for their revitalization are very slim.

Fig. 1 The view and location of hydro tailing in copper mine

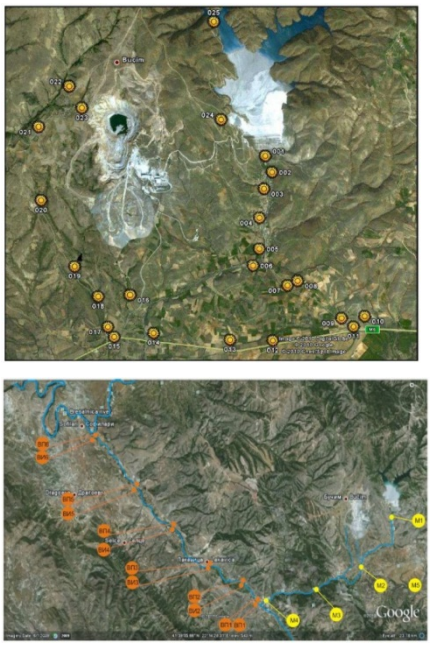

Fig. 2 The measurement points in the copper mine region

Fig. 3 The differences between river water from tailing dump in copper mine

CONCLUSION

The possible disaster of the dam may cause great material and ecological damages or losses in human lives. The issue should be paid great attention. Statistics says that collapse of dams occur due to several factors (according to data from USCOLD 1994, US Conference of Large Dams). The most common causes are unsuitability of slopes (amounting to 22%), earthquakes (17%), floods (16%), poorly constructed fundaments, excessive quantities of drainage waters (9%), erosion etc. Three dam disasters have taken place in the Republic of Macedonia over the past years. They all caused significant damages to the waters, air, and land in particular. Such were the disasters in Zletovo lead and zinc mine in Probiship, the Buchim copper mine and the latest in the Sasa lead and zinc mine (the last one in September 2003). The collapse in the Sasa flotation dam formed a crater of 120 - 160 m at a depth of 30 to 40 m. After the disaster over 1.000.000 tons of waste with heavy metals entered the River Kamenicka, further on Lake Kalimanci, the River Bragalnica and the surrounding land.

REFERENCES

Wills, B.A. (1989). Mineral Processing Technology, Pergamon Press. pp 686-698;

Klohn, E.J. (1981). Current Tailings dam design and construction methods Min Eng. 33, pp 798

Krstev B. (2000). Using Administrative Controls to Reduce Tailing Dams Risk on the Active Tailing Dams in Macedonia; /International Conference "NEW TRENDS IN MINERAL PROCESSING IV" Ostrava, Czech Republic, 26-28.6.2000/

Krstev B. (2001). Tailings Dams in the Republic of Macedonia; /International Conference "NEW TRENDS IN MINERAL PROCESSING V" Ostrava, Czech Republic, 28-30.6.2001/

Krstev B. (2001). Dust Control Technologies for Mineral Processing Plants; /IX Balkan Mineral Processing Congress, Istanbul, TURKEY 11 - 13.09.2001/