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Improvement of the Technology of Industrial Wastewater Treatment in the Mining Industry

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ABSTRACTS

Mining waste reduction methods include all mining processes beginning from resource distribution until the final products in the plant. For comparing and testing possibilities of mine waste reduction, a cooperation project has been set up aiming to create a transnational network with regional networks. The activities carried out on the regional and transnational level secure better access to knowledge, state-of-the-art technologies, and good practice. The study addresses all the waste management challenges and opportunities in mining industry, giving understanding all forms of extraction of natural non-renewable resources.

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1. INTRODUCTION

The official opening ceremony of the Khandiza Mining Department was held on May 6, 2011. The decision of the President of the Republic of Uzbekistan "On effective use of the base of mineral raw materials of polymetallic ores of Khondiza and Uch Kuloch mines" laid the foundation for its development (Väli *et al*., 2008). The Ministries of Finance and Economy, as well as "Almalik KMK" to ensure efficient, rational, and complex use of the mineral raw material base of polymetallic ores of these mines, and on this basis to increase the load of the production capacities of "Almalik KMK" JSC, to increase the production of non-ferrous and precious metals JSC's proposal to build a mining-concentration complex with a capacity of 650,000 tons of ore per year, with industrial production starting from the second half of 2009, was accepted.

Geologists started prospecting for polymetallic deposits in the Khandiza mine in the early 1960s. Mining reserves were confirmed in 1974. At the same time as prospecting, the beneficiation of ores was studied and beneficiation technologies were developed at various times in the period from 1970 to 2002. Leading research institutes have dealt with these issues (Karu, 2011). They also conducted semi-industrial tests, during which the technology of beneficiation of ores of the Khandiza mine was thoroughly developed (Karu *et al*., 2008). Experts of the State Committee of Geology and Mineral Resources of the Republic of Uzbekistan called the Khandiza mine a mine of poly metals. As a result of exploration, its total reserves are 1.5 million tons of zinc, 700 thousand tons of lead, 180 thousand tons of copper, and 2.3 thousand tons of silver (Koitmets *et al*., 2003). In the second half of 2007, Almalyk Mine Metallurgical Combine (AMMC) began the construction of the mining and beneficiation complex of the Khandiza polymetal mine. Feasibility studies of the project were prepared with the participation of the Russian Institute "Mechanobr Engineering" JSC (St. Petersburg). Its specialists have developed working documents. To provide the object being built here with motor transport in a short period, the division of the AMMC motor transport department has started work with 5 auto depots and the construction department of the "Almaliq metallurgqurilish" trust, which supplies sand, gravel, and concrete for the construction.

Today, the Khandiza mine administration includes the Khandiza mine, beneficiation factory, repair-construction site, material, and technical base. Polymetallic ores are mined and enriched here. As a result, copper, zinc, and lead concentrates are obtained from them (Valgma, 2011). "We produce three types of products: zinc, lead, and copper concentrates. We send zinc and copper concentrates to OKMK zinc and copper smelters for further processing. The lead concentrate was stored in our warehouses until 2018. Since that year, it has been exported to Kazakhstan. For example, more than 47,000 tons of lead concentrate were exported in 2018, 53,000 tons in 2019, and 24,600 tons in 2020. We plan to export 48,000 tons of concentrate this year," says Botir Khojamuratov, director of the Khandiza Mining Department of JSC "Almaliq KMK".

As for the beneficiation plant, its annual production of ore is 650,000 tons. Hourly productivity is 82.07 t/h, daily productivity is 1850 tons. Specialists of the Khandiza concentrator process an average of more than 50,000 tons of polymetallic ore per month (Valgma *et al*., 2000). The technological process at this factory is somewhat more complicated than at other factories of the combine because three metal concentrates are produced here at once. Therefore, the technology of beneficiation and extraction of metal into a concentrate is quite different from the technology of monoconcentrate extraction (Karu *et al*., 2008). "For 10 years, we have changed the enrichment scheme and technology three times. As a result, the extraction of metal concentrate increased by more than 20 percent. For example, in 2012,

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concentrate extraction was 56 percent of zinc. Today, this figure is 75 percent. 44-48 percent for copper, today it is 57 percent. About 48 percent of lead, and now 63 percent," says Botir Khojamuratov. According to the expert, upgrading underground equipment is one of the main achievements of the Khandiza Mining Department. "This process started three years ago. During the year, 13 units of new equipment were purchased: six dump trucks, five PDM loaders, delivery vehicles, and two drilling rigs. This year, ten more ore-carrying dump trucks were also purchased. All this had a significant impact on the productivity of the mines," said Batir Khojamuratov. The technical equipment of production is really good. But it is very difficult to assess the position and importance of specialists working in these productions. Currently, the team of employees of the mining department consists of 930 people. Undoubtedly, the basis of the achieved achievements is rational leadership and the responsible approach of employees to their work. 39 thousand 161 tons of zinc, 7 thousand 256 tons of copper, and 14 thousand 546 tons of lead concentrate were obtained. In 2020, the enterprise exported 24,627 tons of lead concentrate. In November 2010, the Khandiza Mining Department started sending zinc concentrate produced in our country to the Almalyk zinc plant. In the same year, the first zinc metal of independent Uzbekistan was obtained.

2. METHODS

The article uses scientific abstraction, analysis, synthesis, economic-mathematical modeling, statistical, and correlation methods. This study used scientific abstraction to highlight important details of modern technologies to treat wastewater in the Khandiza Mining Department. Observing the dynamics of changes in wastewater, and the influence of various factors led to the conclusion that these processes are chaotic and unpredictable. The method of analysis and synthesis in the article is related to the thinking techniques related to the breakdown of the components of the industrial wastewater in the mining process, for example, the development of technologies relatively independent study right in the mining department and obtaining some interview with a coworker, heads of the departments and other workers as well. An analytical method was used to study the components of wastewater treatment in the Khandiza mining department. In the process of learning, the existing relationships between the elements of the wastewater treatment in the case of the Khandiza mining center were used in their general, unit study. Economic and mathematical modeling allowed enterprises to take into account all the possibilities used as a tool for theoretical development. Statistical methods were used to measure, describe, analyze, interpret, and model by using modern technologies to clarify the industrial wastewater treatment during the process.

3. RESULTS AND DISCUSSION

3.1. Theoretical review

The decision of the President of the Republic of Uzbekistan No. 442 of August 10, 2006 "On effective use of the mineral resource base of polymetallic ores of Khondiza and Uch-Kuloch mines" laid the first foundation stone for the history of the Khondiza Mining Department. It was in August of this year that the full right to develop this polymetal mine was given to the Almalyk Mining and Metallurgical Combine. Foreign investors are not expected to participate in this project. By the second half of 2007, the Almaliq Mining and Metallurgical Combine started working on the polymetallic field of the Khanjiza mine. They say that it is good to look at the past. If we look at the history, we can see that the study of polymetallic ores of Khanjiza mine continued from 1961 to 1974. Mining reserves here were confirmed in 1974. In 1970-1971, "Sredazniprosvetmet", in 1971 SNIGRI, in 1972 SAIGIMS, in 1974 SNIGRI, VNIISVETMET,

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SAIGIMS institutes carried out research and industrial tests at the VNIISVETMET pilot plant. Enrichment technology has been developed. "Marakand Minerals" company has developed a technical economic basis (TEO) based on the results of many studies conducted in Khondiza during the former union. He also presented technological indicators of semi-industrial tests conducted by VNIISVETMET.

In 1997, average ore samples were extensively studied by the Canadian "Lakefield Research" company. Both organizations have shown that there are high technological indicators of mineral formation compared to previously submitted projects. Our motherland has preserved these jewels in the Surkhan Mountains, which were explored during the time of the former Soviet Union and were found to have high values, but remained undiscovered. With the honor of independence, the people whose cotton and gold, culture, and silk became their own became the real owners of these underground resources. The construction of the mine-concentration complex based on the polymetallic ore reserves of the Khandiza mine with a capacity of 650,000 tons has been started. This project is worth 46.5 mln. 60 million dollars from own funds, as well as 60 million from the Fund for Reconstruction and Development of Uzbekistan. dollars and a total of 40 million from our country's banks. was financed by loan funds in the amount of USD. The technical and economic basis of this large project was prepared with the participation of the Russian "Mechanobr Engineering" JSC Institute (St. Petersburg) and working documents were developed.

The lifeblood of the Khondiza mining complex begins with the Khondiza mine. 54 km from the center of the district, in the central part of the Surkhantog mountains in the Hisar range, in the Sariosia region. located far away. The Khanjiza mine has an area of 40 km2, irregularly extending in the north and northwest directions. Geographically, the area of the mine is characterized by a distinct mountainous terrain. The highest point of the ore field in the north is 3075.2 m., 1300 m in the central part. (Khondiza river valley) from 1800 m. 60 km from Saryosi railway station. located far away. In the mining area, rocks with three structural layers:

(i) bottom: 280 m. around it, the Lower Cambrian metamorphic rocks, crystalline shales, two-mica gneisses, and gneissic granites of the Khandiza rock range are represented;
(ii) medium: characterized by volcanogenic-sedimentary rocks of the Carboniferous period;
(iii) upper layer: Jurassic terrigenous sedimentary rocks are formed in the sediments of the lower and middle layers.

The main ore deposits combine a series of layered ore bodies with solid ore alternating with lenticular and vein-granular zones. In general, it stretches in the sublatitude. The decline is relatively steep, with 25-300 in the south and 45-600 in the north. The greatest strength is characteristic of the inclined and flexural bending sections, and it is sharply expanded on the slopes. The deposit is bounded from above and below by the terrigenous-carbonate-pyroclastic pack on the thrust side and the volcanogenic pack on the overhang side by the contact with the horizon rocks. There are folds with a brachiform structure in the rocks and ore layers in the mine. The peculiarity of the ores is their fine-grained structure with a quantitative ratio of chalcopyrite to galena, sphalerite, and pyrite of 0.5:1:3:4.

In general, the ore bodies are located in the section of several hypsometric levels and are 10 to 30 m thick. It is characterized by non-ore layers of volcaniclastic rocks. #3, #2, #4, #6 and #8 are the largest bodies. Small lenticular bodies No. 5, No. 7, and No. 9 are placed in the intervals between them. Ore body No. 3 is one of the main deposits in the mine. It has more than 80% of all explored mineral reserves. It is 600 m in length, 780 m in roll, and 14 m in average real capacity. The ore body is not completely contoured to the north and east. The condition of the ore body No. 3 is determined by the rhyolite-porphyry tuffs of the rhyolite-dacite porphyry of the lower volcanogenic horizon. Other ore bodies are calculated as

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percentages of reserves: #4-5%; #5-5.7%; No. 6-4.7%; No. 8-2%; #7.9 to 0.5%; and No. 5-0.3%. The highest strengths of ore body No. 3 (18-21.6 m) adjusted to the central part of the body are between the +1300 and +1000 m marks and adjusted to the slope of the flexure. Below the +1000 m mark, the average power decreases to 6-8 m. Mining ores make up the main part of deposits, are divided into vein-particle and solid massive types, and form small ribbon-shaped accumulations within the main mass of ores. A special feature of mining ores is the small content of barite (1-1.5%). Elements of mixtures are found both in basic sulfides (sphalerite, galena, pyrite, chalcopyrite) and in the form of independent materials. Silver is isomorphically bound to the main sulfides, forming argentite, freybergite, prustite, and other independent minerals. In the ores, gold is found as a fine dispersion and also as an admixture in the form of galena, chalcopyrite, pyrite, and possibly telluride. Cadmium occurs as an admixture in sphalerite ores. The main minerals in the host rocks are quartz, plagioclase, potassium feldspar, muscovite, and biotite. Thus, the chemical composition of ore massifs and pile rocks is drastically different (Felix & Din, 2023). Mineral sulfides are not characteristic of aggregates or loose rocks. This makes it possible to characterize them as inert and non-aggressive rocks when exposed.

3.2. Current situation

In November 2007, JSC "Almaliq mining-metallurgical combine" started to carry out mine preparation works at the Khandiza mine, the capital mine section belonging to the Kovuldi mine. In December 2009, for the first time, ore was mined from the "Khondiza" mine. The total land area of "The Khondiza" mine is 128 ha. In 2019, to extract ore from the mine and efficiently organize ore extraction and drilling operations, 5 MT-2010 underground dump trucks, 1 SBU Simba K-102 drilling machine manufactured by the Swedish company "Epiroc" and 5 LH-307 load-carrying machines, 1 TH-320 dump truck, 1 SBU DL-210 drilling equipment manufactured by the Finnish company "Sandvik" were brought. The Khandiza mine includes the following sections: Underground mining site; Section of ventilation and reinforcement of mine solders; Mining surface section; Mining preparation site; and Electricity supply section. Mining operations in the mine are carried out in two systems: by falling from under the floors; and camera-column. To avoid open quarries, where the material is not suitable for use in buildings, we must know the quality at particular locations. The compositions of sand and gravel deposits in Harju County have been analyzed. Thus it is possible to determine precisely enough usability exploration, as well as areas where it is possible to find new gravel, sand, or complex deposits. All 27 items presently operating gravel and sand pits may be divided into groups considering their position to glaciation stadial, distance from ice margin, and genesis. In the southern part of the county, between Almalyk and Surkhandarya region, Khandiza Mining Center, glacial sediment forms four groups of deposits oriented in the direction of the ice margin, NE 45-75º, during the deglaciation here. Next deposits are characterized by a variation of gravel part 20-45% and decreasing of clay content up to 3-6% in the Khandiza Mining Center opens pits. In the Khandiza open pit, it was possible to observe, how older bedded fluvioglacial sands are deformed into folds, their upper part subsequently eroded and covered by new layers of gravel and sand.

4. CONCLUSION

Mining waste management issues have to take into consideration in all mining sites. The main aim of mining waste management is to use the Khandiza mining center in the production line, giving minimal waste and the best products. It is also a problem how to use old waste heaps as raw material. A possible solution is to test different mining waste reduction methods and choose the most practical technology for the site. Mining waste reduction methods

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include all mining processes beginning from resource distribution until the final products in the plant (Reinsalu & Valgma, 2007). For comparing and testing possibilities of mine waste reduction the study addresses all the waste management challenges and opportunities facing the Southern part of Uzbekistan, namely the Khandiza mining industry, which should be understood as extending to all forms of extraction of natural non-renewable resources. To answer the question of why there is a large amount of waste produced in mining limestone and dolostone reserves it is important to know about limestone and dolostone production methods, its standards, and specifications. To better understand the current situation as a whole, it is necessary to describe the existing standards used by the Republic of Uzbekistan for technical requirements and specifications definition in road construction projects. To avoid opening quarries, where the material is not suitable for building, we must have overall knowledge of quality at each location. Future research will focus on using environmentally friendly mining methods in all areas of mineral resource mining. For better mining waste management different pilot units have been designed to determine how to use old waste heaps as new raw material.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

6. REFERENCES

Felix, S. A. A., and Din, M. F. M. (2023). Effect of proper treatment on mineral oils. *ASEAN Journal of Science and Engineering*, *3*(3), 281-288.

Karu, V. (2011). European Union Baltic Sea region project "min-novation". *Oil Shale*, *28*(3), 464-465.

Karu, V., Västrik, A., and Valgma, I. (2008). Application of modelling tools in Estonian oil shale mining area. *Oil Shale, 25*(2S), 134-144.

Karu, V., Västrik, A., Anepaio, A., Väizene, V., Adamson, A., and Valgma, I. (2008). Future of oil shale mining technology in Estonia. *Oil Shale, 25*(2S), 125-134.

Koitmets, K., Reinsalu, E., and Valgma, I. (2003). Precision of oil shale energy rating and oil shale resources. *Oil Shale, 20*(1), 15-24.

Reinsalu, E., and Valgma, I. (2007). Oil shale resources for oil production. *Oil Shale, 24*, 9-14.

Valgma, I. (2000). Post-stripping processes and the landscape of mined areas in Estonian oil shale open casts. *Oil Shale, 17*(2), 201-212.

Valgma, I. (2003). Estonian oil shale resources calculated by GIS method. *Oil Shale, 20*(3), 404-411.

Valgma, I. (2009). Oil Shale mining-related research in Estonia. *Oil Shale, 26*(4), 445-450.

Väli, E., Valgma, I., and Reinsalu, E. (2008). Usage of Estonian oil shale. *Oil Shale, 25*(2S), 101-114.

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p- ISSN xxxx-xxxx e- ISSN xxxx-xxxx