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# Research of the material composition of tailings storage of Copper-processing plant JSC "Almalyk Mining and Metallurgical Combine"

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**ABSTRAKT:** The article discusses the results of studying the material composition of the tailings storage of the Copper processing plant JSC “AMMC” by spectral, chemical and mineralogical analyzes. It was found that the copper content after chemical analysis of the sample averaged 0.139%. It was revealed that the mineral composition of Copper processing plant wastes is mainly represented by quartz, feldspars, sericites and, in a subordinate amount, dark-colored and secondary minerals. Pyrite is the most abundant ore mineral in Copper processing plant samples. Frequent presence of chalcopyrite, sphalerite, galenite, molybdenite and iron oxides was also noted.

**KEY WORDS:** tailings storage, chalcopyrite, sphalerite, galenite, molybdenite, iron oxides.

## I.INTRODUCTION

The current stage of deepening economic reforms requires fundamental structural changes and the transition of the economy to the path of intensive development. In the complex of urgent tasks to meet the needs of developing sectors of the national economy, a significant place is given to the introduction of a mechanism aimed at the rational use of mineral resources and the processing of man-made waste. An extensive path of development of mining, expressed in the involvement of more and more new deposits in the process of operation, is not acceptable in modern conditions. This approach leads to the depletion of many mineral deposits, to the need to use facilities with a lower quality of raw materials, with complex mining conditions, etc. Due to a decrease in the content of useful components in raw materials, to obtain the same amount of products, more rock mass has to be processed, the share of refractory ores increases, which leads to an increase in material, labor and financial costs for the production of the final product and the formation of industrial waste in a large amount. All this requires intensification of research, search for approaches to solving the problem of rational development of mineral resources and processing of man-made waste [1,2].

## II. SIGNIFICANCE OF THE SYSTEM

In this work, man-made raw materials are understood as reserves of minerals and mineral raw materials located in warehouses of substandard ores, dumps of overburden, tailing dumps, slag and sludge ponds and other waste accumulated over the years of operation of mining and metallurgical industries, characterized by certain consumer properties and potentially suitable for cost-effective processing.

Shifting the center of gravity from increasing the production of mineral raw materials to a sharp improvement in its use is impossible without the involvement of industrial waste in the production. The solution to the problem is possible, first of all, by introducing new scientific developments and technological solutions into production.

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## III. LITERATURE SURVEY

The problem of waste disposal of mining enterprises is well known [3]. This problem is relevant in our country as well. Large enterprises of Uzbekistan Navoi and Almalyk mining and metallurgical plants are unique in the world mining practice, both in their production and economic indicators, and in the complexity and novelty of scientific and technical problems solved during their operation. Despite the advanced technologies used, the mining and metallurgical production of the plants is not waste-free. At present, as a result of many years of ore processing, accumulated on the dumps of AMMC: tailings storage 960.5 million tons with a copper content of 0.17%; slag of the pyrometallurgical process 16.4 million tons with a copper content of 1.4%.
They, firstly, occupy vast areas and to a large extent pollute the environment, and, secondly, they are technogenic deposits containing a number of valuable elements, including non-ferrous, noble and rare metals.
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## IV. METHODOLOGY AND EXPERIMENTAL RESULTS

In the tailings dump No. 1 of the Copper processing plant JSC “AMMC”, on an area of 8 $km^2$, about 164.0 million tons of tailings with an average content of useful components in a hundred-meter beach area have been accumulated: 0.14-0.2% copper; 0.0029-0.0033% molybdenum; 0.3-0.4 c.u. of gold; 1.0-1.8 c.u. silver.
The purpose of this work is to study the material composition and develop an effective technology for processing technogenic waste of the Copper processing plant JSC “AMMC”.
For this purpose, we have studied the material and chemical composition of the waste of the Copper processing plant JSC “AMMC”. The chemical composition of the samples and their concentrates is determined by complete spectral and chemical analyzes for individual components.
The results of spectral analysis of the initial samples are shown in Table 1.

**Table 1**
**Results of spectral analysis of initial technological samples according to the State Enterprise "Central Laboratory"**

| Elements | Contents, c.u. | |
|---|---|---|
| | Sample №1 | Sample №2 |
| Ca | 30000 | 30000 |
| Na | >10000 | >10000 |
| K | >10000 | >10000 |
| Mg | >30000 | >30000 |
| Ba | 700 | 700 |
| Sr | 100 | 100 |
| Mn | 900 | 800 |
| V | 100 | 100 |
| Ti | 3000 | 3000 |
| Cr | 10 | 20 |
| Ag | 6 | 7 |
| Cu | 3000 | 3000 |
| Pb | 400 | 200 |
| Zn | 300 | 200 |
| Ni | 40 | 50 |
| Co | 30 | 30 |
| Mo | 10 | 20 |

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In terms of chemical composition, the wastes of the Copper processing plant are acidic with an average silica content of 66.93%. The following predominant components in the wastes of Copper processing plant are iron and aluminum oxides, where the total content of iron oxides ($FeO + Fe_2O_3$) is 18.5% and aluminum is 6.89%.
The average content of sulfur oxides ($SO_3$total) is 6.15%, of which sulfide sulfur is 2.3%. And also in a subordinate amount there are oxides of magnesium, calcium, potassium, sodium, titanium.
In the Copper processing plant JSC "AMMC", ores of porphyry copper deposits (Kalmakyr, Sary-Cheku, etc.) of the Almalyk mining region are enriched. Therefore, the composition of the waste contains minerals found in these deposits. Quartz and feldspars predominate in the tailings storages of the Copper processing plant from nonmetallic minerals. Feldspar is mainly represented by the potassium variety and, to a lesser extent, by plagioclases.
Clay minerals develop along feldspars and are found almost everywhere. In addition, the samples contain biotite, chlorite, carbonates, etc. The results of the chemical analysis of the samples are recalculated for the mineral composition and are given in table. 2. Ore minerals include pyrite, iron oxides, chalcopyrite, molybdenite, etc.

**Table 2**
**Mineral composition of tailings storage,%**

| Elements | Sample №1 | Sample №2 |
|---|---|---|
| Quartz | 33,76 | 41,71 |
| Potassium feldspar | 22,98 | 22,95 |
| Plagioclase | 11,40 | 8,25 |
| Biotite | 7,35 | 5,72 |
| Gypsum | 1,21 | 0,50 |
| Calcite | 0,68 | 0,45 |
| Rutile | 0,39 | 0,22 |
| Chlorite | 3,95 | 2,96 |
| Sericite | 2,00 | 0,50 |
| Kaolinite | 5,95 | 6,01 |
| Siderite | 0,00 | 0,00 |
| Pyrite (marcasite) | 4,42 | 4,23 |
| Iron oxides (magnetite + hematite) | 2,88 | 3,58 |
| Carbonaceous substance | 2,59 | 2,60 |
| Apatite | 0,44 | 0,32 |

Below is a description of the main ore and nonmetallic minerals found in the tailings storage of the Copper processing plant JSC "AMMC".
*Magnetite* is the main ore mineral. Particles of magnetite have a spherical, spherical shape. There are also hollow balls as a result of the swelling of the crystal at the moment of particle formation. Iron black color. Polymetallic luster. It is replaced by hematite at the edges or has mermekite intergrowths. Some grains of magnetite contain relics of pyrite and marcasite. The particle diameter ranges from 0.015 to 0.5 mm.
In the waste of the Copper processing plant, magnetite occurs in the form of isometric, irregular grains. Here it is a minor mineral after pyrite and chalcopyrite. It grows closely with hematite. It is also noted in intergrowths with pyrite and chalcopyrite.
*Hematite* is a common ore mineral. Color iron black, steel gray. Has a polymetallic luster. It develops along magnetite and replaces it along the edges in the form of edges. The form of the mineral is mainly xenomorphic. Has mermekite intergrowth with magnetite. The grain size of the mineral is 0.005-0.2 mm.
*Marcasite* is noted as relics in iron oxides, semi-oxidized and more often unaltered grains. It grows together with pyrite (pyrite-marcasite aggregate) and sometimes pyrrhotite. The shape of the marcasite, pyrite-marcasite aggregate is cubic,

isometric, complex-angular, rounded. The size of the marcasite precipitates is up to 0.5 mm. When coal is burned, it is replaced by iron oxides.
*Pyrite* is a widespread sulfide, especially in Copper processing plant JSC “AMMC” waste. The shape of the grains of the mineral is cubic, cube fragments, pentagon-dodecahedral, xenomorphic. The grain size is from 0.005 to 0.5 mm. Closely grows together with chalcopyrite. Also, cracks in pyrite are filled with galena. Inclusions of galena and chalcopyrite are noted.
*Chalcopyrite* is typical for the wastes of the Copper processing plant JSC “AMMC”. It is found in association with pyrite, quartz and other minerals. It is also noted in the form of decomposition of solid solutions in the composition of sphalerite. The size of chalcopyrite grains varies in a wide range - from 0.005 to 0.3 mm. The bulk of the mineral is in the form of xenomorphic segregations in intergrowths with pyrite or along cracks in other minerals.
*Siderite (iron carbonate)* - in the form of irregular, elongated grains, earthy masses often found in samples. The grain size is up to 0.4mm.
*Molybdenite* - observed only in samples of the Copper processing plant JSC “AMMC” in single values. It occurs in the form of inclusions in quartz or is noted separately in gravity concentrates. The shape of the grains is prismatic, scaly. Size up to 0.01 mm.
*Pyrrhotite* - It is noted in the form of xenomorphic precipitates, lamellar aggregates. It grows together with pyrite-marcasite aggregate and chalcopyrite. The grain size of the mineral is up to 0.1 mm. It corresponds to monoclinic pyrrhotite in terms of optical properties in reflected light.
*Galenite* is rarely found in intergrowths with chalcopyrite and sphalerite. In relation to other sulfides (pyrite, chalcopyrite, sphalerite), galenite develops later and replaces them along the edges or, in the form of veins, fills cracks in early minerals. The grain size is up to 0.1 mm.
*Sphalerite* is a rare mineral and is found in intergrowths with other sulfide minerals or separately. Grain size 0.006 - 0.15 mm. It is noted as emulsion dissemination (decomposition of solid solutions) in chalcopyrite.
*Quartz* is a common nonmetallic mineral in waste. Color white, light gray, gray. Has a glass luster. The shape of the grains of the mineral is irregular. Quartz from the waste of the Copper processing plant contains phenocrysts of sulfide minerals (pyrite, molybdenite, chalcopyrite).
*Potassium feldspar* is one of the most common nonmetallic minerals. Color - light pink, pinkish red, slightly altered and replaced by clay minerals.
*Biotite* is noted as a fine-flaked aggregate. It practically does not occur, and the biotite content in the wastes of the Copper processing plant JSC “AMMC” is up to 5%. It is partially or completely replaced by chlorite, and the released iron is deposited in the form of magnetite along cracks and at the contact of grains.

## V. CONCLUSION

Thus, the material composition of the tailings of the Copper processing plant JSC “AMMC” was studied by spectral, chemical and mineralogical analyzes. It was revealed that the mineral composition of the Copper processing plant JSC “AMMC” wastes is represented mainly by quartz, feldspars, sericites and, in subordinate amounts, mafic and secondary minerals. Pyrite is the most widespread ore mineral in the Copper processing plant JSC “AMMC” samples. Chalcopyrite, sphalerite, galena, molybdenite, and iron oxides are also common.
The expediency of using the method of flotation concentration of dump tailings of the Copper processing plant JSC “AMMC” for obtaining low-grade copper concentrate is shown.

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