ISSN: 2750-3402

COPPER MINING METHODS, SCHEMES AND REAGENT PROCEDURES

Abdusamiyeva Lobarxon Nomonjon qizi[1]
assistant of the Department of "Mining",
[1]Tashkent State Technical University, Almalyk Branch
Jo'rakulova Sabrina Baxtiyor qizi[2]
is a student of
[2]Tashkent State Technical University Almalyk branch
https://doi.org/10.5281/zenodo.7386059

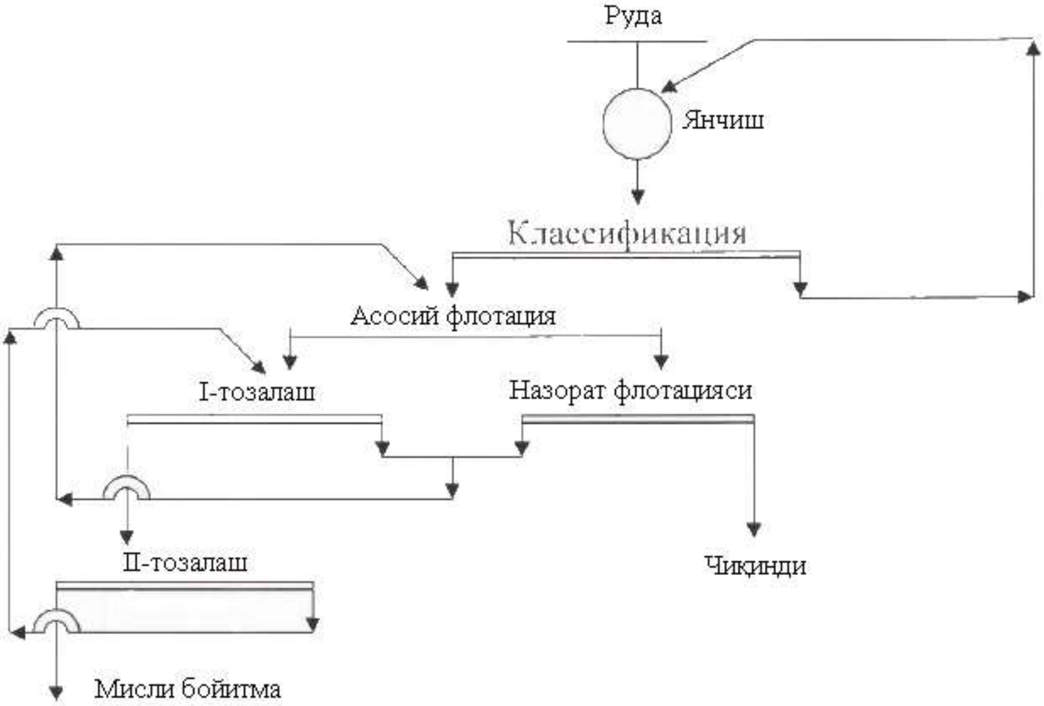
The main method of beneficiation of copper ores is flotation. Copper and copper-pyrite ores are easily beneficiated. The applied scheme and technological procedures depend on the type of ore being processed, the composition of copper minerals, their state and susceptibility to leaching, the presence of primary sludges and soluble salts, as well as the nature of mixed rocks. In copper-pyrite deposits, sulphide minerals are found in the form of chalcopyrite, chalcosine, bornite and pyrite, their total amount is 3-4%, where the relative share of pyrite is much larger than other sulphides. In the oxidation zone, these sulfides preserve malachite, azurite, brochantite, chrysocolla, and other oxidized copper minerals. 10-15% of the total amount of oxidized copper deposits are sulphide, 10-15% to 50-75% are mixed, and 50-75% are oxide ores. Sulphide ores are more industrially important, as they make up 90-95% of this type of ore reserves.

Copper sandstones are formed in sedimentary rocks, where sulphide minerals take the place of bedrock or lie in the space between them. The total amount of sulfides is 15%, in which sulfides are represented as chalcopyrite, chalcosine, bornite, some covelline, pyrite, etc. Quartz, feldspar, chlorite, calcite, sericite, etc. are the minerals of sandstones. If the amount of copper oxides is up to 10%, they belong to the class of sulphide minerals, and if they are 50-70%, they belong to the class of oxide minerals. These ores are more difficult to enrich compared to copper-porphyry and veined ores. For their enrichment, more complex schemes and flotation procedures are required.

Complete (colchedan) copper-pyrite ores are characterized by a high content of sulfides (from 50 to 90-100%). Such ores are characterized by the presence of zinc, thus they are considered copper-zinc colchedans. The main copper mineral in them is chalcopyrite, zinc mineral is sphalerite. Lesser amounts of chalcozin, bornite, etc. are found. Puch rocks appear as chlorite, sericite, quartz, and barite. These types of ores are very fine-grained and have a complex structure, which makes it difficult to separate copper minerals. Oxide-like ores are processed using the combined flotation-hydrometallurgical method or the bacterial-chemical selective dissolution method.

The role of different types of minerals in copper mining is different. For example, in the USA, Peru, Chile, and partly in Canada, 60% of copper is associated with copper-porphyry ores, about 30% - with copper sandstones, 6% with solid sulfide ores, and a small amount with vein deposits, copper-nickel and polymetallic ores. A characteristic tendency of beneficiation of copper ores in the world is aimed at extracting raw materials poor in copper. Flotation of copper ores is carried out using branched schemes, often two-stage, coarse beneficiation and recycling of intermediate products. The resulting copper beneficiation contains 8-12% to 45-47% copper, and the separation of copper in the beneficiation is 72% to 98%.

Figure 1. Scheme of one-stage flotation of copper ores



In recent years, two-stage flotation schemes are widely used in factories with medium and large production capacity. It is advisable to use such schemes in the enrichment of mines with uneven and complex minerals. They can be used in the following main options: 1. In the first stage, the finished enrichment and the rich waste are removed, and again they go to the crushing and then to the second stage of flotation. In them, copper appears in the form of secondary copper minerals (coveline and chalcosine) prone to leaching. Such schemes are widely used in the enrichment of copper-pyrite ores in the Ural mines. 2. In the first stage, the finished beneficiation, the waste to be thrown away and then to receive the intermediate product which goes to the re-grinding and the second stage of flotation. These schemes are used in the flotation of non-uniform ores and include the coarse grinding of the finished beneficiation, waste and intermediate products obtained in the first stage. In them, after re-grinding, in the second stage, flotation of copper minerals are collected. In plants with smaller production capacity, the recycled intermediate product can be returned to the first stage for flotation. 3. Waste which is discarded in the first stage and then re-grinded to get a coarse co-enrichment which goes to the second stage of flotation. Such schemes are widely used in beneficiation of copper and copper-molybdenum ores. According to these schemes, the initial ore is relatively coarsely crushed (up to 45-60%-0.074 mm class), discarded waste and coarse enrichment are obtained, and 85-95%-0.074 mm are re-crushed from then it goes to the second stage of cleaning and separation operation for copper-molybdenum enrichment and pyrite-retaining waste. Depending on the pyrite content, these tailings can either be added to the mill's tailings or re-flotation to obtain pyrite beneficiation. Over time, the schemes belonging to this group were much improved and began to be used in a number of factories under the name "Sleaner-Seavender" or "S-S" for short. This scheme envisages the use of control flotation of treatment waste after enrichment treatment. Three groups of operations are involved in the S-S scheme: ore flotation, which is often carried out without control operations, re-refining of coarse (copper-pyrite or copper-molybdenum) beneficiation and 2-3 cleaning of re-refined beneficiation, and control flotation of the 1st treatment waste. These schemes more fully represent the technological characteristics of copper-porphyry ores and have the following advantages compared to standard schemes: ore flotation accelerates at a high density of the slurry and without returning to the cycle of intermediate products, which ensures high efficiency of separation, shortens the flotation front, reduces the consumption of reagents, and combines control and automation. it is achieved that it goes smoothly; ensures crushing of ore to the minimum size, reduces crushing costs, creates good conditions for waste storage and use for various purposes, and provides high efficiency of the flotation process of the intermediate product after opening the surface of the outcrops, and creates convenient opportunities to use one-stage schemes for grinding finely crushed ore in ball mills.

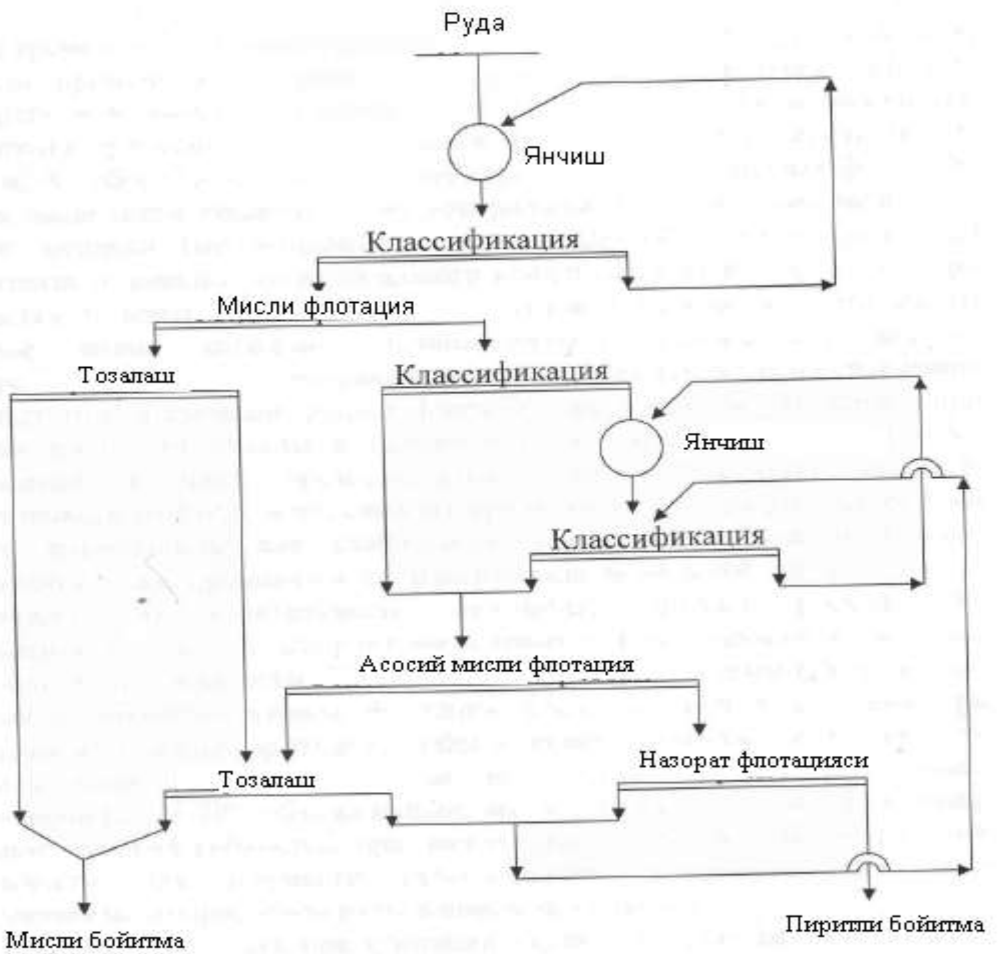


Figure 2. Scheme of two-stage flotation of copper-pyrite ores

In some cases, in flotation of copper-porphyry ores, the tailings are subjected to controlled flotation treatment in order to reduce the size of the re-smelting and re-flotation product, which is then re-smelted and treated. A similar scheme developed by "Nipromadan" institute was used in factories "Medet" and "Elatsite" (Bulgaria). Such schemes provide high-quality pyrite beneficiation even when the amount of pyrite in the initial product is small.

Separate flotation schemes of sand and slurries, which retain primary slurries and soluble salts, are used for flotation of ores prone to strong slurries during the crushing process. This scheme ensures the implementation of slurries and large particles of ore in an optimal technological order, as a result of which higher technological indicators are achieved compared to their combined flotation. Schemes of this type are used relatively less (in Jezkazgan, Almalyk factories, "Bute" and "Twin Butte" USA). In the beneficiation of similar ores, instead of the separate flotation scheme of sand and mud, an ore flotation scheme is used, in which the tailings are sent to the waste area, and the sands are flotation in the presence of hydrocarbon oils. The resulting intermediate product is sent to processing and flotation in the purification cycle. Concentrated schemes are mainly used in beneficiation of oxidized ores that are difficult to be beneficiated. According to these schemes, copper sulphide and easily flotable copper minerals are usually flotation. According to the material composition of the ore, direct selective smelting of the entire mass of the ore and precipitation of the molten copper and flotation of the precipitated copper are carried out. In some cases, in highly productive concentrators (for example, the Twin Butte plant), the process of extraction of molten copper is carried out, followed by re-extraction with cathode copper from concentrated solutions by electrolysis.

The effectiveness of the listed schemes depends on the amount of carbonate minerals in the ore, and they increase the consumption of sulfuric acid.

For beneficiation of difficult-to-beneficiate oxide ores, an integrated scheme using the "Torho" method can be used. This method involves an initial oxidative roasting in the presence of a strong reducing agent and chlorides (usually sodium chloride), resulting in the reduction of copper to metal, which is then crushed and beneficiated by flotation. In the treatment of oxidized ores, selective ammonia dissolution schemes are also important.

In the flotation of copper and copper-molybdenum ores, the main problem is the separation of copper and molybdenum sulfides from pyrite, which occurs as iron sulfides. Depending on the amount of pyrite in the ore, the nature of its condition and the amount of rare metals, pyrite can be separated into separate beneficiation, partial or full beneficiation, or waste disposal. Sulphide minerals of copper have high flotation properties in a wide range of pH (from 6 to 12-14). In this case, secondary minerals of copper are better flotation than primary minerals and are quenched at higher value of rN.

In the flotation of copper ores, iron sulfides are more sensitive to quenching properties of hydroxyl and cyanide ions than copper sulfides. Iron sulfides are quenched with relatively small amounts of lime or cyanide. Cyanides provide separation of copper sulfides from iron sulfides using only lime and are used to prevent molybdenum quenching when pH is greater than 11.5.

In the flotation of copper minerals, lime is used as a medium, and the lime is usually fed to the mill. The consumption of lime for slaking pyrite is from 250-500 grams to several kg. During the flotation of copper ores, depending on the content of pyrite, only the main mass flotation is carried out, and to separate the pyrite, the correct selective or collective flotation is used, and then the copper-pyrite collective mass is selected.

Only during double flotation, the pH of the medium is kept within 7.5-8.5, proper selective flotation of copper and copper and iron sulfides or selective separation of collective copper-pyrite enrichment is carried out in a strongly alkaline medium (pN=11-12) (2 - picture). The amount of Puch rocks in flotation of solid copper sulfides with 10-15% is more than 11.5 in basic and cleaning flotation. When the quantity of loose rocks is more, a selective or collective flotation scheme is used, followed by copper-pyrite beneficiation. In a selective flotation scheme, the flotation tailings are condensed or repulped using clean water with soda ash or other modifiers, and pyrite is flotation at great expense to the collector. In the flotation of copper and iron sulfides, xanthogenates or dithiophosphates are used as collectors. The most commonly used are ethyl, butyl (isobutyl), isopropyl, and amyl xanthogenates, which are used individually or in combination of two or three to increase their effectiveness. In addition, hydrocarbon oils and reagent Z-200 (isopropyl-ethyl-thiocarbamate) are widely used. In the flotation of ores containing partially oxidized copper minerals, high efficiency is achieved when xanthogenates with long hydrocarbon chains (containing 6 to 8 carbon atoms) are used in combination with aeroflot. If the ore contains oxidized copper minerals, about 200-300 g/t of sodium sulfide is added to the pot. A selective or collective scheme is used in which copper-pyrite beneficiation is followed by selective separation when the amount of loose rocks is more. In a selective flotation scheme, flotation wastes are pumped or repulped using clean water with soda ash or other modifiers and pyrite flotation at high collector cost.

As a foaming agent, tallow oil, OPSB, T-80, T-92, Diafros-250, methylozobutylcarbanol, castor oil, etc. are given. In some cases, two foaming agents are added at the same time - tallow oil and methylisobutylcarbanol or tallow oil and Diafros-250, etc.

In beneficiation of copper and copper-molybdenum ores, consumption of aggregates and foaming agents: from 30 to 50-100 g/t of aggregates and from 20 to i 50-70 g/t of foaming agent are used.

References:

1.Mutalova M.A., Khasanov A.A., Ibragimov I.S., Masidikov E.M "Development of Technology for Extraction of Tungsten-Containing Industrial Product from Slurry Cakes." International Journal of Advanced Research in Science, Engineering and Technology. Vol.6, Issue 12, December 2019.

2.Mutalova M.A., Khasanov A.A., Ibragimov I.S., Melnikova T.E. "Development of Technology for Producing Tungsten Product with WO3 Content Not Lower than 40% from Technogenic Waste SIE«Almalyk MMC»." International Journal of Advanced Research in Science, Engineering and Technology, Vol. 6, Issue 12, December 2019.

3.Муталова М.А., Хасанов А.А. «Разработка технологии извлечения вольфрама из отвальных хвостов НПО АО «Алмалыкский ГМК»»// Журнала «Universum: технические науки» Россия. Опубликован на сайте http://7universum.com / tech 25 января 2020 года.

4.Mutalova M.A., Khasanov A.A. «Improvement of Technology for Enrichment of Tungsten Concentrate from Cake of NPO Almalyksky MMC JSC by Gravitational Methods» International Journal of Advanced Research in Science, Engineering and Technology Vol. 7, Issue 5, May 2020.

5.Mutalova M.A., Khasanov A.A., Masidikov E.M. « Extraction of a Tungsten-Containing Product from the Left Tails of the Ingichin Factory» International Journal of Advanced Research in Science, Engineering and Technology Vol. 7, Issue 5, May 2020.

6.Ibragimov I.S., Nosirov N.I., Suyarov J.U., « Tails Recycling Technology Gold-Uranium Ores» EUROPEAN MULTIDISCIPLINARY JOURNAL OF MODERN SCIENCE https://emjms.academicjournal.io
Special Issue: Use of Modern Innovation on Integrated Research 2022.05

7.Nosirov N.I., Ibragimov I.S., Suyarov J.U., «Characteristics of Polymetallic Middlings of Enrichment of Complex Sulfide Ores and Methods of their Processing» Spanish Journal of Innavation and INTEGRITY Volume 07, 2022 07, 2022 http://sjii.indeмщдгьу

8.Хасанов А.С., Муталова М.А., Хасанов А.А. Извлечение ценных компонентов из техногенных отходов// Международная научно-техническая конференция, Ташкент-2014г. 232стр.

9.Насиров У.Ф., Хасанов А.А., Мельникова Т.Е. Рациональное использование минерального сырья и техногенных отходов// Международная научно-техническая конференция Ташкент- 2018г. 290 стр.

10.Муталова М.А., Хасанов А.А., Ачилов У., Шакаров Т. Разработка технологии извлечение вольфрамового промпродукта из отвальных кеков НПО АО «Алмалыкский ГМК»// Международная научно-практический конференции «Современные проблемы и инновационные технологии решения вопросов переработки техногенных месторождений Алмалыкского ГМК». Алмалык -2019г. 91 стр.

11.Муталова М., Хасанов А. «Разработка технологии обогащения кека НПО АО «Алмалыкский ГМК»» // Ўзбекистоннинг ижтимоий-иқтисодий ривожланишида ёшларнинг ўрни. Мавзусидаги 4- анъанавий онлайин анжуман. Наманган -2020.

12.Муталова М., Хасанов А. «Разработка технологии обогащения лежалых хвостов Ингичкинской фабрики» Ўзбекистоннинг жтимоий-иқтисодий ривожланишида ёшларнинг ўрни. Мавзусидаги 4-анъанавий онлайин анжуман