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STUDYING THE PROCESSING OF COPPER-MOLYBDENUM ORES AND TECHNOGENIC WASTE FROM ENRICHMENT

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I.I.Gulomov[1], M.A.Mutalova[2], R.B.Usenov[2], Z.E.Abdatova[3], D.Sh.Abdumominova[3]

[1]Junior Researcher, Laboratory of Biotechnology and Hydrometallurgy, Institute of Mineral Resources

[2]Associate Professor of the Department of Mining at the Faculty of Mining, Almalyk State Technical Institute

[3]Student, Department of Mining, Almalyk State Technical Institute

Annotation

The task of increasing the degree of extraction of valuable components from copper-molybdenum ores into concentrate using new reagents from local raw materials is highly relevant.

Today, the high intensity of production and the accumulation of technogenic waste worldwide pose the question of their utilization in all mining countries. Firstly, they are stored in garbage dumps that occupy vast areas, and secondly, they cause enormous damage to the environment. At the same time, technogenic waste represents valuable products containing significant amounts of noble, non-ferrous, and rare metals, and does not require extraction, transportation, or crushing, thereby significantly reducing the cost of their processing.

In the republic, further processing of secondary mineral resources, their use in production, and the introduction of more modern, highly efficient technologies will allow for more complete utilization of depleting natural reserves and contribute to additional resource and energy conservation and improvement of the ecological situation. The Action Strategy for the further development of the Republic of Uzbekistan defines tasks for "raising industry to a qualitatively new level, deep processing of local raw materials, accelerating the production of finished products and mastering technologies..."1.

Keywords

sludging, secondary minerals, oxidized, sulfide, inclusion, extraction, collective concentrate, circulation, sulfhydryl collectors, high molecular weight flocculants, hydrophobizer, methylisobutylcarbinol, apollary collectors.

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Copper-porphyry disseminated ores contain up to 3-4% sulfides. By the amount of oxidized copper, they are divided into sulfide (up to 10-15%), mixed (from 10-15 to 50-75%), and oxidized (more than 50-75%).

The main method of enriching copper-molybdenum ores is flotation with the production of a collective copper-molybdenum concentrate and its subsequent separation into copper and molybdenum concentrates.

When copper-molybdenum ores are enriched, copper, molybdenum, and sometimes pyrite concentrates are obtained. If the ore contains a significant amount of free gold, then gravitational enrichment is used to capture it, the concentrate of which flows to the gold processing section. Copper-molybdenum collective concentrate typically contains 10-30% copper and 0.1-1% molybdenum .

Copper-molybdenum porphyry ores are characterized by relatively large inclusions of sulfides with waste rock minerals and close intergrowth. In this regard, at most factories, ore is ground to 40-60% of the -0.074+0 mm grade before main flotation. In some factories ("Sierrite," "Pinta-Velley," "Island-Coper"), when the minerals are finely dispersed and there are no secondary copper minerals such as covelline in the ore, capable of being overground and slagged, the ore is ground to 70-75% grade -0.074+0 mm.

The technological scheme for processing copper-porphyry ores includes three-stage grinding without preliminary sieving in stages I and II, two-stage grinding in rod and ball mills, classification, and flotation enrichment with final grinding of the products.

Due to the fact that copper-molybdenum porphyry ores are characterized by relatively large inclusions of the main mass of sulfide minerals and close interpenetration of sulfide particles between themselves, practically at all copper-molybdenum ore processing plants, a scheme of collective flotation of sulfides with subsequent separation is used.

The distinctive features of the technological scheme for processing sulfides with subsequent separation are the degree of grinding, which is related to the nature of mineral inclusions and the content of secondary minerals prone to sludge formation, the stability of the enrichment scheme, and the applied finishing cycles for raw concentrates and intermediate products. The choice of technological schemes for flotation of copper-molybdenum ores depends mainly on the nature of the constituent sulfide minerals, their quantity, phase composition, and slurry formation tendency.

The following flotation schemes are used to obtain collective concentrate:

- flotation with the separation of collective copper-molybdenum concentrate and tailings during coarse grinding of ore. The crude collective concentrate, after classification and finishing of the classifier sands, is subjected to refining. The main flotation is carried out in an open cycle. This scheme is the most economical and acceptable for coarse grinding of ore (45-55% class -0.074 mm), sufficient for high extraction of free ore minerals into the concentrate, their intergrowths with each other and with the rock.

- for the processing of ores with a high content of slimy minerals, schemes providing for control flotation of the main collective flotation tailings with the refining of the concentrate obtained in the control flotation (with or without preliminary finishing of this concentrate) or schemes with separate flotation of sands and slimes are acceptable.

- to prevent increased pyrite circulation, which complicates the flotation of copper and molybdenum sulfides, schemes with separate cycle re-flotation of intermediate products and removal of pyrite-containing tailings to the dump or with pyrite separation are preferable compared to schemes with return of intermediate products to the beginning of main flotation without separation of pyrite products.

The collective flotation cycle of sulfide copper-molybdenum ores is mainly carried out using sulfhydryl collectors for sulfide minerals: xanthogenates, dioxanthogenides, dithiophosphates, dithiocarbamates, which ensure the effective extraction of copper and molybdenum into the collective concentrate. In some factories, to increase the extraction of the natural hydrophobic mineral molybdenite, and especially when the mineral's surface is easily opened (in inclusions with quartz), a small amount of apolar reagent (for example, spindle oil and kerosene) is supplied during grinding cycles. This reduces the desorbing effect of hydroxyl, sulfide, and other ions on the collector, the oxidation of molybdenite particles, and their influence on mineral flotation.

In practice, as a rule, at least two collectors are used (a combination of sulfhydryl collector with apolar oil, ethyl xanthate with amyl, etc.).

Often, in flotation, a combination of several collectors is used, combining the strong with the weak. Xanthogenates are used as strong collectors, and aerial flotation and reagent Z-200 are used as weak collectors.

In collective copper-molybdenum flotation, it is also known to use a soda aeroflot or ethyl xanthate in combination with a number of reagents such as dioxanthogenide, "Minerek," xanthogenic acid thioanhydrides (e.g., SSM-2), xanthogenic acid thioesters (e.g., reagent S-3302), or dialkylthiocarbamates (e.g., reagent Z-200). Such combinations allow for increased extraction of molybdenum into the collective concentrate and ensure its subsequent more efficient separation into copper and molybdenum concentrates.

Selective flocculation of fine particles by sequential treatment of the pulp with a collector - hydrophobizer (butyl xanthate, apolar oil - kerosene, transformer oil) and a high-molecular-weight flocculant (polyacrylamide) increases the extraction of metals into the collective concentrate. The consumption of polyacrylamide is 5 g/t. The presence of polyacrylamide in the pulp of the collective concentrate does not affect the selective flotation of copper and molybdenum.

As a foaming agent, alcohol reagents such as pine oil, methylisobutylcarbinol, T-92, OPSB, Daufros 250 and their combinations with a total consumption of 15 to 40 g/t have become widespread. This is due to the fact that the presence of apolar collectors does not significantly affect their foaming effect.

As waste rock suppressants, it is rational to use liquid glass, sodium hexametaphosphate, etc. At the Almalyk plant, the use of hydrophosphate (25-30 g/t) in the pulp flow of the two-stage grinding cycle increased the extraction of copper by 1.4%, molybdenum by 4.8%, gold by 2.5%, and silver by 2.6%. Also, using hexamethyphosphate as an activator allows for increased extraction of copper, molybdenum, gold, and silver.

For ores characterized by the presence of oxidized copper minerals, sulfidizer at copper-molybdenum factories uses sulfurous or hydrosulfurous sodium at a rate of 50-200 g/t.

Collective copper-molybdenum flotation and finishing of collective copper-molybdenum concentrates are most often carried out in an alkaline environment, which is created during lime supply and maintained in the range of pH values of 8.5-11.2 because at higher values, molybdenite flotation depression occurs. To separate copper sulfides from pyrite, lime is used, carrying out the flotation process at a pH of about 12. If, in addition to copper sulfides, it is necessary to float molybdenite, alkalinity at a pH of no more than 11-11.6 is used for pyrite depression, and in this case, lime with a small amount of cyanide is sometimes used.

The most important tasks in obtaining and refining copper-molybdenum concentrates are to ensure effective flotation depression of iron sulfides and to extract oxides that are always present in sulfide ores and oxidized copper sulfides from the surface into the concentrate. For this, it is necessary to optimize the consumption of lime as a depressant of iron sulfides and sodium sulfide as a sulfidizer of copper minerals.

When processing poor copper-molybdenum ores containing large amounts of pyrite, the "heads" are first floated without adding a sulfhydryl collector to obtain a crude collective concentrate containing copper, molybdenum, and pyrite. Doplotation of copper and molybdenum sulfides is carried out by xanthate and refining of the crude collective concentrate in a lime environment during aeration to obtain a conditional concentrate.

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