Efficiency of centrifugal flotation during the refining of gold-bearing enrichment products

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Abstract. The results of enriching the products of gold-antimony ore processing using centrifugal flotation are presented. A series of experiments was conducted on a laboratory centrifugal flotation machine with peripheral unloading of concentrate (CFM) and on a laboratory mechanical flotation machine (FM). The selectivity of deposition of mineral particles from the flotation mineralized foam flowing on an inclined plane after flotation under different conditions (with a collector and without the use of a collector) has been studied. It has been shown that it is possible to regulate the intensity and selectivity of deposition of material from the foam layer by using a collector. It is established that the combination of the effect of the centrifugal force of fluid rotation and the hydrophobic properties of minerals makes it possible to strengthen the selectivity of mineral separation, flotation in a centrifugal flotation machine can be used for purification operations with the aim of improving the quality of concentrate. **Keywords**: Concentration, centrifugal flotation, mineral particles, hydrophobicity, concentrate, extraction, degree of concentration.

1 Introduction

The solution of the problem of separation of minerals with close technological properties is traditionally carried out by increasing the selectivity of separation in the enrichment processes - using directional reactants, as well as selective changes in the technological properties of minerals with the help of various energy effects [1,2]. One way to influence the efficiency of the flotation process is the use of additional centrifugal forces of fluid rotation - centrifugal flotation [3].

In flotation, sulfide minerals usually pass into the concentrate, as well as rock-forming minerals, mainly in the form of slurry particles. For the subsequent cleaning of concentrates from empty rocks, a combined method of refinement is sometimes applied, which is reduced to an additional classification of the material for sand and slurry fractions and for the production of tailings in the slurry fraction [4]. Decrease in the proportion of sulfide minerals in flotation concentrates in the purification cycle is carried out in the depression mode of some of them. When processing ordinary gold-bearing ores, where the main sulfide minerals are represented by pyrite and arsenopyrite, the process of selective flotation often consists in the separation of these minerals [5].

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In the method of flotation developed at Chersky North Mining Institute of the SB of RAS (ChNMI SD RAS), the separation of mineral particles occurs by hydrophobicity in a thin layer on the surface of a rotating flow of water (pulp) [6-9]. The studies were carried out on the products of enrichment of gold-antimony ore. Sentachan gold-antimony deposit is characterized by exceptionally rich ores. [10].

Studies of the selectivity of the precipitation of mineral particles from the flotation mineralized foam flowing along the inclined plane after flotation under different regimes (with a collector and without the use of a collector) have shown that it is possible to regulate the intensity and selectivity of deposition of material from the foam layer by using a collector. The presence of heterogeneity of the flow of water under the foam (comparative results of studies with baffles) on the selectivity of detachment of particles is unimportant when using the collector, but it can have a negative effect on the process of separation of minerals in a "hungry" mode [6].

2 Methodology of experimental research:

Experimental studies were carried out on finely divided ore materials of Sentachan deposit. Preliminary a set of studies was conducted on the research of the substance composition of the materials used. For selection, processing and analysis of samples, existing methods for identifying the granulometric and mineral composition and physical properties of minerals have been used.

For the analysis of the real composition of the separation products, it is envisaged to use assay analysis (for gold), chemical analysis (for antimony and arsenic), spectral analysis of elemental composition on a serial X-ray fluorescent spectrometer Bruker SRS-3400.

Characteristics of the flotation reagent used: Butyl xanthate is the main collector for the flotation of sulfide minerals, it is used in the form of a 2-10% solution at a flow rate of 20-100 g / t [5].

The research uses a centrifugal flotation machine with peripheral discharge of concentrate, designed by the ChNMI SD RAS (protected by the RF patent) [8]. The engineering pecifications of the flotation machine are presented in Table 1.

Table 1. Specifications of the centrifugal flotation machine with peripheral unloading of concentrate

Specifications	Unit of measure	Operation parameters
Consumption of additional water	l / min	2-3
Air consumption	m^3 / min	0.05
Number of body rotations, max.	rpm	400
Motor drive power	kW	under 1.0
Size:		
diameter	mm	230
height	mm	180

Taking into account the natural flotation activity and high concentration in the samples of the minerals under study (pyrite and arsenopyrite), two flotation modes were tested - in a "hungry" mode and in a mode with the addition of potassium xanthate.

It was found that in the flotation variant with the use of a collector, the separation of most of the sulfide minerals under study from the water surface is characterized by reduced dynamics (with the exception of arsenopyrite, all minerals retain retention in the foam layer), and in a series of flotation experiments in a "hungry" mode, the selectivity of minerals separation from the surface water is significantly increased. At the same time, the retention capacity of sulfide minerals on the water surface is significantly higher when a collector is used.

3 Results

A series of experiments on flotation on CFM and on FM carried out with the products of gold-antimony ore enrichment, with the same reagent mode established that the extraction of gold and antimony in the concentrate is higher on CFM (Figure 1), and the extraction of arsenic is lower, which makes it possible to obtain the concentrate with an *As* content of 0.11%.

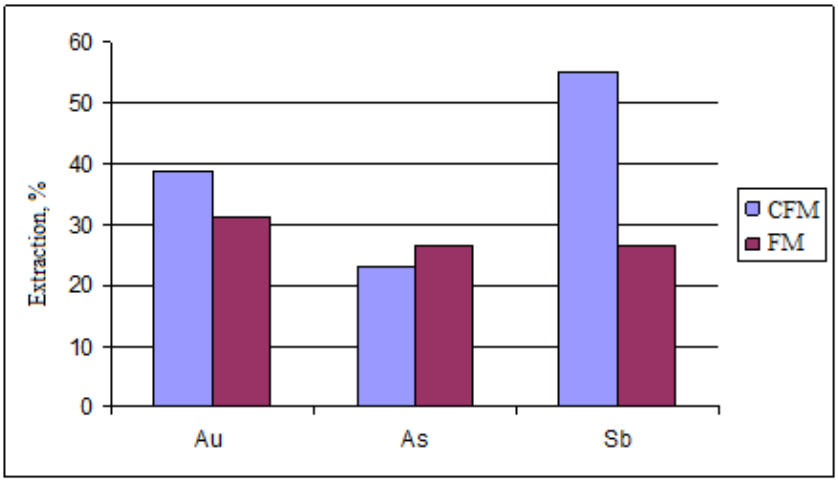

Fig. 1. Extraction of gold, arsenic and antimony into the concentrate during flotation on the centrifugal flotation machine (CFM) and on the laboratory mechanical flotation machine (FM)

Figure 2 shows that by the quality of concentrates the content of arsenic in the concentrate of CFM is lower than in the concentrate of the laboratory FM, while the content of antimony is much higher.

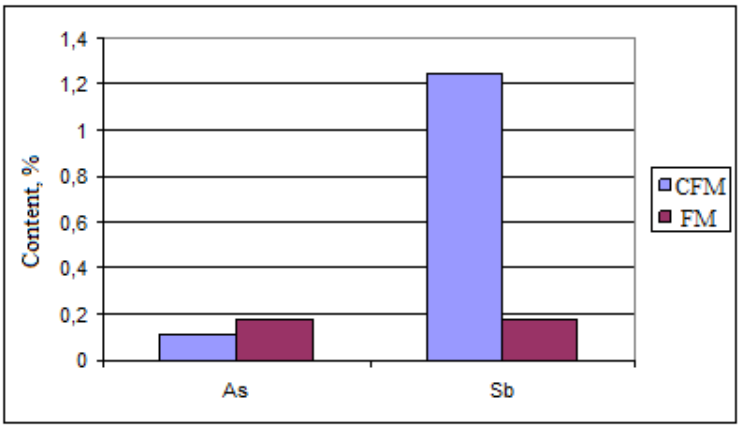

Fig. 2. The content of arsenic and antimony in concentrates of flotation of the centrifugal flotation machine (CFM) and the laboratory flotation machine (FM)

4 Conclusion

It has been experimentally established that the combination of the effect of the centrifugal force of fluid rotation and the hydrophobic properties of minerals makes it possible to strengthen the selectivity of the separation of minerals, flotation in a centrifugal flotation machine can be used for purification operations with the aim of improving the quality of concentrate.

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