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Azimova A.B. master's student

Doniyarov N. A. DSc, professor

Asrorov A. A. PhD

Navoi State University of Mining and Technologies Uzbekistan,Navoi

STUDY OF FLOTATION FOR SULPHIDE GOLD-CONTAINING ORES

Abstract: In recent years, a lot of work has been done on the processing of sulfide ores with complex composition. Separtion of gold from such ores is of great importance. In flotation beneficiation, many results have been achieved, which ensure the technical and economic efficiency of flotation, biooxidation technology, beneficiation process technology, and environmental protection have been improved, ensures high technical and economic indicators.

Key words: Flotation, technical economic efficiency, complex use, sulphide minerals, complex ore, cyanidation, flotation reagents, magnetic separation,dibenzene disulfate, sodium dithiophosphate.

ИЗУЧЕНИЕ ФЛОТАЦИИ ДЛЯ СУЛЬФИДНЫХ ЗОЛОТОСОДЕРЖАЩИХ РУД

Аннотация: За последние годы проведена большая работа по переработке сульфидных руд сложного состава. Выделение золота из таких руд имеет огромное значение. При флотационном обогащении, достигнуты многие результаты, обеспечивающие технико-экономическую эффективность флотации, технологии биоокисления, технологии процесса обогащения и др. улучшена охрана окружающей среды, что обеспечивает высокие технико-экономические показатели.

Ключевые слова: *Флотация, технико-экономическая эффективность, комплексное использование, сульфидные полезные ископаемые,*

полиметаллические руды, цианирование, флотореагенты, магнитная сепарация, дибензолдисульфат, дитиофосфат натрия.

INTRODUCTION

The practice of beneficiation shows that in recent decades, due to high capital investment, low extraction rate and complexity of the beneficiation process, there is a steady trend of developing mines that were previously considered unprofitable. But with the depletion of the world's reserves of rich, easily processed ores, as well as the ever-increasing global demand for precious metals, mineral processing companies are forced to process ore deposits of complex composition.

The beneficiation of this type of ore involves the use of not only traditional beneficiation methods such as gravity, flotation and incineration, but also biotechnology and hydrometallurgy. The use of all these methods in a certain sequence allows to achieve high enrichment rates and obtain significant economic benefits. The experience of world leaders in the field of gold mining proves the effectiveness and high profitability of such projects.

Gold occurs in various states in primary ores. According to this characteristic, cyanidation, gravity separation, magnetic separation, flotation and other methods can be selected to extract gold. Flotation is one of the important methods for treating gold-bearing ores. The flotation process includes material preparation, adjusting the pH value of the slurry, adding flotation reagents, flotation and other processes. When gold ore containing high sulphide minerals is processed by flotation, gold particles can be effectively enriched in the concentrate of sulphide ore, and a large amount of tailings can be thrown away, which can reduce the cost of dressing and smelting. When polymetallic gold ores are treated by flotation, gold and other non-ferrous metal concentrates can be effectively separated, improving the comprehensive utilization of valuable minerals. If the gold ore is a refractory ore that cannot be treated by the mercury amalgamation

process or the cyanide process, you can choose to use a combined beneficiation process including flotation process to increase the recovery rate of gold particles.There are four types sulphide gold-containing ores: gold-bearing pyrite, gold-bearing copper-lead-zinc sulphide ores, gold-bearing copper sulfide ores and gold-bearing copper-iron ores.

Gold-bearing pyrite: The separation of pyrite and arsenopyrite is great significance for the processing of gold-bearing arsenic sulphide ores. It is mainly based on the selective effect of lime, copper sulfate, inorganic oxidants, organic inhibitors and other chemicals on these two minerals. During flotation, you can first try to activate arsenopyrite with copper sulfate, and then preferentially float it out in the lime medium, while the pyrite remains in the flotation tank. To preferentially float out pyrite, enough ammonium chloride can be added to the lime medium during flotation to suppress arsenopyrite.

Gold-bearing copper-lead-zinc sulphide ore: Generally, a copper-lead partial mixed flotation process is used, and then the mixed concentrate is separated to obtain copper concentrate and lead concentrate. Gold is often enriched in the copper concentrate. Due to the similar floatability of copper and lead sulphide minerals and the complex symbiotic relationship, the mixed concentrate is difficult to flotation separate, and thus qualified gold-containing copper concentrate and lead concentrate cannot be obtained. In order to improve the gold recovery rate, the carbonation conversion-flotation method can be used to process the gold-containing copper-lead mixed concentrate to comprehensively recover gold, silver and precious metals while separating copper and lead.

Gold-bearing copper sulfide ore: Most of the natural gold in this ore exists in chalcopyrite and pyrite, and gold can be extracted by preferential flotation or mixed flotation. During flotation, lime can be added to the slurry to suppress pyrite, and copper sulfide will be preferentially flotated to obtain qualified gold-containing copper and sulphide concentrates.

Gold-bearing copper-iron ore: The main minerals are chalcopyrite and magnetite, and natural gold exists in chalcopyrite as fine particles. When processing this kind of ore, a combined process of flotation and magnetic separation can be used to obtain gold-containing copper concentrate and iron concentrate. [1]

Collectors are important for a successful flotation process. Among the sulfhydryl-type collectors, the two most important and widely used industrial groups are distinguished: xanthate and dithiophosphate (aeroflot). In foreign practice, the most widely used phenolic dithiophosphates are: ethyl, a mixture of ethyl and secondary butyl, secondary butyl, isopropyl, isobutyl.

Dithiophosphates are widely used in the flotation of gold ores in a mixture with xanthates, as substitutes for xanthates and at the same time as foaming agents. Fine grains of minerals are better floated using farflots than xanthates.

For the flotation of gold ores, di-alkyl dithiophosphates were tested as a collector: ethyl - Hostaflot LET, isobutyl - Hostaflot LIB, secondary butyl - Hostaflot LSB, as well as their combinations with potassium butyl xanthate. The results obtained were analyzed using potassium butyl xanthate as a collector.

Hostaflot L brand reagents are fast-acting collectors for which a short conditioning time is sufficient. They are a colorless liquid and are anionic. These reagents can be mixed with water in any ratio, and can also be introduced into the pulp undiluted. When using Hostaflot L brand reagents in composition with potassium butyl xanthate, both collectors can be dosed from a joint solution.

LET Collector is the most selective reagent for any sulfide iron minerals such as pyrite, marcasite, pyrrhotite, arsenopyrite, etc. In this ore, sulfide minerals are represented mainly by pyrite (2.5%), marcasite (0.7%).

LIB Collector is superior to other aliphatic dithiophosphates in activity. Its advantage is the ability to collect larger classes as well.

We studied the ores of Karakutan mine.The Karakutan gold deposit is located within the Katyrmay sedimentary-metamorphic sequence, which composes the

northwestern part of the Ziyaetdin mountains. The sedimentary metamorphic formation is conditionally subdivided into two subformations from bottom to top: calcareous-shale 200 m in thick and siltstone shales 1000 m in thick.

The ores of the Karakutan mine belong to the series of ore deposits that are difficult to enrich. The difficulty of their beneficiation is explained by the presence of rare metals with sulphide minerals in the form of fine particles and the combination of several minerals in one mine. An important aspect of processing technology for such ores is the need to develop special rational conditions for beneficiation. Comprehensive use of minerals makes it possible to make poor ores economically efficient, reduce the cost of production and increase the material resources of the state.

Currently, in world practice, the mining and metallurgical industry has developed a tendency to process industrial waste accumulated over many years. The reason is that at the moment, the reserves of mines with high initial grades of metal and easily processed ores are almost exhausted. This led to the need to reduce the volume of processing of conditioned ores and involve in the processing of industrial waste, hard-to-be-enriched ores and off-balance low-grade ores.

The ore of the Karakutan deposit is a complex ore, and primary separation from non-sulphide minerals is carried out by flotation, in which case sorption is used as the main operation for preparation for washing (cyanidation).

Table 1. (List of minerals in the oxidation zone of the Karakutan mine)

Main	Secondary	Rare
Fe hydroxides	Pettitsit	Covelin
Au	Ceruscite	Chalcosin
Mimethesis	Crocoit	Uranium mica
Pyrargyrite	Chrysocolla	Mn oxides
Scorodite	Calcite	wulfenite
Anglesite	Gypsum	Malachite

The main objective of flotation of gold-bearing sulphide minerals is to increase the recovery of precious metals and reduce production costs by achieving maximum selectivity of the process. The possibilities of beneficiation of complex ores by the flotation method largely depend on the quality and assortment of the flotation reagents used. In recent years, more and more attention has been paid to the search for new types of selective reagents for extracting precious metals from technologically complex gold ores.

Table 2. (Chemical composition of gold and platinoids in ores and industrial products of their technological processing of the Karakutan deposit, in%)

Minerals	Au	Fe	Ag	Cu	As	Pt	S
Fe-Au	90,08	7,99	0,06	1,13			
As-Au	46,15				53,58		
Fe-Pt		8,35				91,65	
Pt-Ag		1,41	7,06			3,65	3,61

Creation and introduction of new effective flotation reagent regimes for beneficiation of ores with complex composition by flotation method is one of the main directions of development of raw material base of precious metals and its rational use.

Conclusion

Currently, a lot of research is being done to obtain high-quality gold. Our research has shown that sulphide gold ores are difficult to beneficiate due to their complex composition.We have studied the flotation process in beneficiation of sulphide gold ores of the Karakutan mine, and we have considered the options of reducing the time as a result of increasing the consumption of reagents and reducing the consumption of reagents by increasing the time.

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