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Research of the Ore Dressability of the Khandiza Polymetallic Ore Deposit

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Abstract: *The article discusses the results of technological studies on the concentration of polymetallic ore of the Chinarsay deposit. The results of studies of the material composition and flotation concentration options for technological samples of ore from the Chinarsay deposit are presented.The results of studying the material composition of ore based on spectral, chemical and rational analysis are presented. It has been established that industrially valuable ore components are lead, zinc and copper, the contents of which are given.It was shown that ore minerals are in close intergrowth with non-metallic ones - quartz, sericite, chlorite, carbonate, etc. It is noted that the studies were carried out in two directions: collective flotation of all ore minerals with further selection of the collective concentrate into lead, zinc, copper and pyrite concentrates and direct collective selective flotation to produce sequentially lead-copper, zinc and pyrite concentrates.*

As a result of enrichment, lead, zinc and copper concentrates are selected that meet the production requirements.

***Keywords**: ore, material composition, research, flotation, analysis, mineral, valuable component, selection, concentrate.*

I. INTRODUCTION

Significant growth in metal production, the integrated use of raw materials, the involvement of new types of ores in the industrial production process, lowering the cost of processing, increasing the extraction of metals from ores are the most important and urgent tasks in developing the efficiency and development of mineral resources of the bowels of Uzbekistan [1].

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II. RELETED WORK

The aim of this work is to study the material composition of ore samples and develop an effective technology for the processing of polymetallic ore of the Chinarsay deposit.

III. OBJECTS AND METHODS OF RESEARCH

Technological samples were taken at points provided by the sampling map using samplers.At the end of testing, all samples were weighed, dried, and dry weight and% solid were determined.Samples are separated according to the sample cutting procedure.

In hydrometallurgical processes physical and chemical processes proceed in water and salt solutions. This type of reactions in some cases proceeds with participation of organic solvents or sorbents at normal or elevated pressures in the conditions of temperatures 20-200 ^{0}C [2].

Before the study on the enrichment of the samples selected material for chemical, sieve and mineralogical analyzes, as well as to determine some physical properties (density, bulk, relative hardness, etc.).

Flotation tests were carried out in laboratory flotation machines with a chamber volume of 3.0; 1.5; 1.0; 0.5; 0.25; 0.2 l.In laboratory tests for flotation enrichment, 50-100 g samples were taken.Ore grinding for flotation experiments was performed in mills in an aqueous medium at a ratio of Liquid: Hard: Slurry = 1: 0.5: 6.

After that, reagents were added to the flotation machine in a certain order, mixed and air was let in.For flotation experiments, the foam was removed in two doses, with concentrates and intermediate products obtained in each experiment.

To determine the effect of contact duration on flotation results, a series of experiments were carried out with different contact times, for example, 0; 1; 2; 3; 5; 10; 20; 40 min.The pulp was mixed with the reagents in the same flotation machine.

IV. RESULTS OF THE RESEARCH

To study the material composition of the ore, average samples were taken to perform spectral, chemical, and rational analyzes, as well as samples and average ore samples with a particle size of 3-0 mm for mineralogical studies and particle size analysis.

The results of a semi-quantitative spectral analysis of the ore sample are given in Table 1.

Table 1.The results of semi-quantitative spectral analysis of ore samples

Elements	Content,%	Elements	Content,%
Silicon	> 1	Copper	0.3
Aluminum	> 1	Lead	> 1
Magnesium	0.3	Silver	0.003
Calcium	0.1	Antimony	0.01
Iron	> 1	Zinc	> 1
Manganese	0.01	Cadmium	0.01
Nickel	0.001	Gallium	0.001
Titanium	0.03	Beryllium	0.001
Vanadium	0.001	Strontium	0.01
Molybdenum	<0.001	Barium	0.03
Zirconium	0.003		

The results of the chemical analysis of the average sample are shown in Table 2. Specific gravity of the sample -2.88 g / cm^3.

Table 2.The results of a chemical analysis of an average ore sample

Components	Content,%	Components	Content,%
Silica	71.8	Lead	2.54
Iron oxide (3^+)	3.0	Zinc	5.12
Iron oxide (2^+)	1.8	Copper	0.6
Titanium oxide	0.1	Hydrocarbon oxide	-
Manganese oxide	0.01	-H_2O	0.8
Alumina	5.2	Sulfur total.	6.0
Calcium oxide	0.2	Sulfur oxide (6^+)	-
Magnesium Oxide	-	Gold, y.e.	0,0
Potassium oxide	0.15	Silver, y.e.	40.0
Sodium oxide	0.08		

According to the results of chemical analysis, the content of useful components in the sample: lead - 2.54%, zinc - 5.12%, copper - 0.6%.

To determine the distribution of the main valuable components by size class, the initial ore sample with a size of -3 + 0 mm was subjected to sieve analysis. The results of the sieve analysis of ore samples are given in table.3.

Table 3.Ore sample size distribution

Class coarseness, mm	Exit %	Content, %			
		Pb	Zn	Cu	S
-3 +2,5	9,9	1,98	4,4	0,49	2,06
-3+1	54,0	2,72	4,8	0,53	1,84
-1+0,5	14,2	1,76	5,87	0,53	1,98
-0,5 +0,25	7,4	2,27	4,6	0,61	2,47
-0,25 +0,15	3,8	2,69	4,56	0,61	2,71
-0,15 +0,1	2,8	2,38	5,04	0,73	3,25
-0,1 +0,074	2,3	2,49	5,36	0,82	3,58
-0,074+0,044	3,0	4,14	6,96	1,47	6,34
-0,044+0,0	2,0	2,99	4,94	0,9	1,06

Class coarseness, mm	Exit %	Distribution, %			
		Pb	Zn	Cu	S
-3+2,5	9,9	7,8	8,8	8,2	9,4
-2	54,0	59,0	52,7	49,2	45,9
-1+0,5	14,2	10,0	16,8	12,8	12,9
-0,5+0,25	7,4	6,7	6,9	7,7	8,4
-0,25+0,15	3,8	4,1	3,5	3,9	4,7
-0,15+0,1	2,8	2,7	2,9	3,4	4,2
-0,1+0,074	2,3	2,3	2,5	3,3	3,8
-0,074+0,044	3,0	5,0	4,2	7,5	8,7
-0,044+0,0	2,0	2,1	1,1	3,3	1,5
Ore	100,0	100	100	100	100

As follows from table 3, the content of lead, zinc and copper in small classes increases to 4.14; 4.96 and 1.47%, respectively.

The results of a rational analysis of ore are given in table 4.

Table 4The results of a rational analysis of the average ore sample

Name compounds		Content,%	Distribution,%
Lead in the form	of total	2.54	100.0
	sulfides	1.73	78.7
	oxides	0.32	14.5
	balance	0.15	6.8
Zinc in the form	of total	5.12	100.0
	sulfides	4.14	78.8
	oxides	0.58	11.0
	balance	0.64	12.2
Copper	total	0.62	100.0
	sulfide	0.61	98.4
	bound	0.01	1.6

As can be seen from the data given in Table 4, 78.7% of lead, 78.8% of zinc and 98.4% of copper are in sulfide; 14.5% lead, 11.0% zinc are in oxide form.

As a result of mineralogical analysis, it was found that polymetallic ore is represented by fragments of microquartzites of varying degrees of silicified, sericitized and chloritized.

The main ore minerals are sphalerite, galena, chalcopyrite and pyrite. The main non-metallic minerals in the ore are quartz, sericite and chlorite. Continuous massive ores are composed of mutually closely sprouted fine-grained sphalerite, galena and chalcopyrite.

The ore sample under study is characterized by a simple complex of minerals composing them, but they are distinguished by a complex, extremely thin and close mutual germination of minerals, which is a great difficulty in their separation.

The research was carried out in two directions: collective flotation of all ore minerals with further selection of the collective concentrate into lead, zinc, copper and pyrite concentrates and direct collective selective flotation to produce successively lead-copper, zinc and pyrite concentrates.

The first way is predetermined by the fact that the opening of grains of non-metallic minerals occurs earlier. As reagents were used:

Collectors - butyl xanthate, butyl airflot; blowing agents - IM-68, T-92, cresol; environmental regulators - soda ash, water glass, zinc sulfate, sodium cyanide; activators - copper sulfate, sodium sulfide; activated, sulfonated coal, etc.

Water-soluble reagents were supplied to the pulp in the form of solutions of 1-10% concentration, blowing agents in the form of droplets, coal (active sulfonated charcoal) in dry form for grinding.

Based on the experiments, the modes shown in Table 5 are selected as the optimal ones.

Table 5 Optimal collective flotation mode

Grinding, min	-0.074	Reagent consumption, g / t					
		Soda	Na2S	Liquid glass	Copper vitriol	Butyl xanthan gum.	Foam T-9 vat 2 el
90	89	750	190	200	240	125	60

And the selected mode, a relatively high extraction of all components into the collective concentrate of lead, zinc and copper is observed: 88.6; 96.0 and 79.6%, respectively, and rather low in terms of tail content.

Under optimal conditions, experience was set up with refining concentrate in order to improve product quality. The results of the experiment are shown in table 6.

Table 6.The results of flotation experiments with two purifications of the concentrate in optimal mode

Products	Yield,%	Content,%			Recovery,%		
		Pb	Zn	Cu	Pb	Zn	Cu
Collect. set	15.5	18.15	30.12	2.85	85.9	91.2	74.6
Industrial product 1	6.8	0.69	1.14	0.29	1.4	1.5	3.3
Industrial product 2	2.7	3.52	5.98	0.38	2.9	3.2	1.7
Tails	75.0	0.44	0.28	0.16	10.1	4.1	20.4
Ore	100.0	3.28	5.1	0.59	100	100	100

As can be seen from table 6, as a result of two cleanings increases the content of all components in the concentrate.

Further studies were conducted in the direction of collective concentrate breeding.

At the same time, lead-copper, then zinc concentrate was first released.

The following complexes were used as depressants of zinc minerals: sodium cyanide, sodium sulfite and zinc sulfate, sodium hydrosulfite and zinc sulfate. The best depression of zinc minerals is achieved using sodium cyanide and zinc sulfate.

It is known that as the excess amount of sodium sulfide is loaded into the pulp and its subsequent oxidation, the flotability of sulfide minerals in the pulp is restored at different rates [3-5]. The residual concentration of sulfide ions, at which the flotation of various minerals occurs, is not the same. When washing minerals treated with sodium sulfide with various amounts of water, the highest adsorption of xanthate is observed on the surface of galena.

The different behavior of minerals during flotation in the presence of sodium sulfide is also due to its activating effect on the flotation of galena and pyrite, a difference in the amount of adsorbed sulfide ion on the surface of various sulfides, etc.

For the separation of lead-copper concentrate, several variants of schemes and reagent modes were tested. Common to them was the desire for desorption of xanthate from the surface of lead and copper minerals.

Flotation of copper minerals occurs in an acidic environment (pH about 3). Sulfuric acid is necessary for two reasons:

1. In a strongly acidic environment, xanthate is destroyed quite intensively.

2. Sulfuric acid removes excess sodium sulfide from the solution, which did not have time to oxidize or to wash. To avoid the formation of hydrogen sulfide, a thorough washing operation must be carried out.

It was found that xanthate from the surface of chalcopyrite is not desorbed by sodium sulfite. Under the influence of various concentrations of sulfite, a certain amount of collector remains on the surface of galena (5x101-5mg / cm2). The floatability of chalcopyrite in the presence of sulfite ions is maximum at pH = 3.

Based on the foregoing, as well as numerous experiments to refine the copper flotation regime of the sample, the optimal reagent consumption and flotation conditions of chalcopyrite were selected.

V. CONCLUSION

Thus, technological studies of polymetallic ore samples from the Chinarsai deposit were performed. The content of useful components in the sample: lead -2.54%, zinc -5.12%, copper -0.6% and pyrite-6.0%.

Ore dressing was carried out by flotation. Laboratory tests were carried out in two directions: a) collective flotation of all sulfides with their subsequent separation; b) collective selective flotation followed by the production of individual concentrates.

As a result of enrichment, lead, zinc and copper concentrates are selected that meet production requirements.

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