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WASTE-FREE TECHNOLOGY FOR ENRICHMENT OF PURIFIC COPPER-ZINC ORE

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As is known, copper-zinc ores are the most difficult for selective flotation. Difficulties are associated with the nature of zinc blende and changes in its floatability under the influence of processes occurring at the deposit, during grinding and during flotation.

When separating copper and zinc minerals, the main task is to prevent the activation of zinc blende, for which it is necessary to remove existing copper ions from the pulp, prevent the oxidation of copper minerals, and prevent the appearance of copper cation in the solution as a product of the oxidation of copper sulfides. To prevent activation, reagents are used: alkalis, cyanide, zinc sulfate, depressants-reducers (sodium sulfide, sodium sulfite and sodium thiosulfate) /1/.

Technological indicators for the beneficiation of sulfide ores are significantly lower than for the beneficiation of other ores. The main reasons that reduce indicators include:

- close association of copper and zinc sulfides with pyrite, necessitating fine grinding of the ore, which in turn contributes to the appearance of a large amount of sludge;
- high ability of minerals to oxidize, both in the deposit and during the storage of ores after mining and during enrichment;
- high natural flotation activity of sphalerite and pyrite, which makes it difficult to obtain high-quality concentrates.

All these factors taken together determine low recovery of target metals during enrichment, as well as high losses of noble, rare and trace elements with flotation tailings.

A sample of copper-zinc-pyrite ore containing copper 1.50%, zinc 1.85% and iron 39.65%, sulfur 43.14%, gold 0.82 g/t, silver 13.52 g was received for laboratory testing /t /2/.

From the results of the phase analysis of the sample, it follows that with a copper content of 1.50% in the ore, 85.66% is primary sulfides, 11.68% is secondary sulfides, 2.60% is oxidized minerals.

Zinc with a content of 1.88% is 86.70% in the sulfide form, 6.92% in the oxidized form, 6.38% in the silicate form.

Based on the results of phase analysis, the sample can be attributed to the sulfide type of copper-zinc-pyrite ores.

During laboratory research, various technological schemes and flotation modes were tested.

Selective-collective scheme with inter-cycle flotation of copper.

Inter-cycle flotation included: grinding of ore in two stages to a final size of 95% class minus 0.074 mm, two stages of main copper flotation, three re-cleaning of copper concentrate; zinc-pyrite cycle with additional grinding of zinc-pyrite concentrate to a particle size of 97% class minus 0.044 mm and its subsequent division into zinc and pyrite concentrates.

Selective-collective scheme without inter-cycle copper flotation.

The scheme without inter-cycle flotation of copper included: grinding of ore in two stages to a particle size of 95% class minus 0.074 mm; copper flotation; three cleanings of copper concentrate; zinc flotation and three cleanings of zinc concentrate.

In turn, experiments according to the scheme with the isolation of copper minerals without inter-cycle flotation were carried out using cyanide and cyanide-free technology with development of modes similar to the regrinding of industrial products post-flotation of copper to a particle size of 95% class minus 0.044 mm, and without additional grinding.

Standard collective scheme with the separation of the collective concentrate after its additional grinding to a particle size of 95% class minus 0.044 mm into copper and zinc concentrates.

Using a selective-collective scheme with inter-cycle flotation, the following were obtained:

— copper concentrate with a copper content of 16.52%, zinc 8.67% with extraction of copper 56.83% and zinc 23.49% into copper concentrate;
— zinc product with a zinc content of 23.15%, copper 3.87% with the extraction of 51.66% zinc and 10.97% copper into the zinc product.

According to the scheme without inter-cycle flotation, the following were obtained:

using cyanide technology:
- copper concentrate with a copper content of 19.39%, zinc 6.50%, with the extraction of copper 62.38% and zinc 17.12% into copper concentrate. The main medido losses of 31.55% are observed in zinc flotation tailings;
— zinc product with a zinc content of 37.87%, copper 3.45% with the extraction of 54.56 % zinc and 6.07% copper into the zinc product;
using cyanide-free technology:
- copper concentrate with a copper content of 16.00%, zinc 8.45%, when extracting copper

58.70% and zinc 24.81% into copper concentrate; - zinc product with a zinc content of 28.85%, copper 3.66% with the extraction of 49.35% zinc and 7.82% copper into the zinc product.

According to the scheme with pre-flotation of industrial products without further grinding the following were obtained:

— copper concentrate with a copper content of 19.90%, zinc 8.25% with the extraction of copper 64.96% and zinc 22.36% into copper concentrate;
- zinc product with a zinc content of 30.45%, copper 3.10% with the extraction of 53.00% zinc and 6.50% copper into the zinc product.

According to the scheme with additional flotation and additional grinding of industrial products , the following were obtained:

— copper concentrate with a copper content of 21.65%, zinc 6.65% with the extraction of 70.41% copper and 17.52% zinc into the copper concentrate;
— zinc concentrate with a zinc content of 45.15%, copper 2.65% with the extraction of 60.46% zinc and 4.38% copper into the zinc concentrate.

Analysis of the results obtained for all schemes shows that the main losses of copper occur in the tailings of zinc-pyrite flotation, and losses of zinc - in the copper concentrate and in the tailings of zinc-pyrite flotation.

The table shows the technological indicators of enrichment of copper-zinc-pyrite ore.

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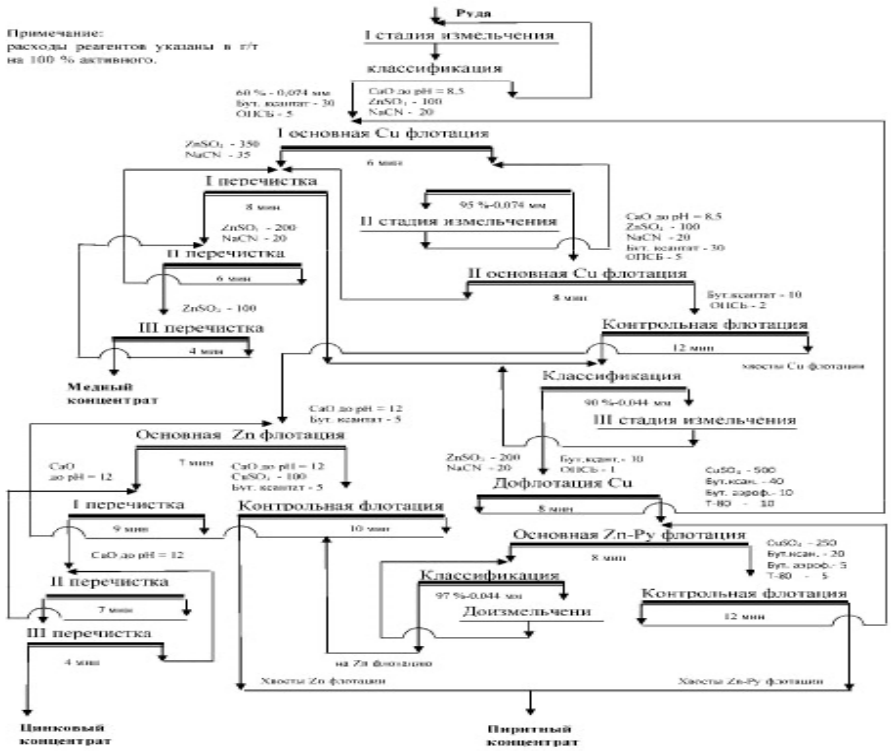

Продукты	Выход, %	Содержание, %					Извлечение, %				
		Cu	Zn	$S_{общ}$	Au, г/т	Ag, г/т	Cu	Zn	$S_{общ}$	Au	Ag
Медный концентрат	4,88	21,65	6,65	38,28	1,65	60,46	70,41	17,52	4,33	9,78	21,82
Цинковый концентрат	2,48	2,65	45,15	32,68	0,71	31,56	4,38	60,46	1,88	2,14	5,79
Хвосты цинковой флотации	36,90	0,30	0,41	44,57	0,74	10,69	7,38	8,17	38,13	33,20	29,18
Хвосты цинково-пиритной флотации	55,74	0,48	0,46	43,07	0,81	10,48	17,83	13,85	55,66	54,88	43,21
Общие хвосты (пиритный концентрат)	92,64	0,41	0,44	43,67	0,78	10,56	25,21	22,02	93,79	88,08	72,39
Руда	100,0	1,50	1,85	43,14	0,82	13,52	100,0	100,0	100,0	100,0	100,0

From the data presented in the table it follows that during the flotation of pyrite copper-zinc ore according to a selective scheme the following were obtained:

- copper concentrate with a copper content of 21.65%, corresponding to grade KM-5 according to OST 48-77-82, with a copper recovery of 70.41%;
- zinc concentrate with a zinc content of 45.15%, corresponding to the KTs-4 grade according to OST 48-31-81, with a zinc recovery of 60.46%;
- pyrite concentrate with a sulfur content of 44%, corresponding to the KSF-3 grade according to GOST 444-75, with a sulfur recovery of 93.79%.

A characteristic feature of the developed technology is the absence of flotation tailings, since the tailings of zinc and zinc-pyrite flotation are ready-made pyrite concentrate with a total sulfur content of 44% with a recovery of 93.79%.