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Improvement of Technology for Enrichment of Tungsten Concentrate from Cake of NPO Almalyksky MMC JSC by Gravitational Methods

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ABSTRACT: In modern conditions, requiring the expansion of the raw material base of the Republic of Uzbekistan, ore mining is increasing and at the same time, the quality of the extracted minerals is changing. First of all, the content of the useful component decreases in them. Therefore, there is a development of technology for processing industrial waste from mining with the extraction of useful components from them. The article proposes a combined technological scheme for the extraction of tungsten industrial products with a WO_3 content of up to 55-58% from industrial waste of NPO Almalyksky MMC.

KEY WORDS: tungsten industrial product, cake, scheelite, tailings, screw separator,jigging machine, concentration table.

I.INTRODUCTION

In the Republic of Uzbekistan, special attention is paid to the mining and metallurgical industry, the development of improved technologies for the processing of tungsten-containing ores. In paragraph four of the fourth direction of the Strategy for the Further Development of the Republic of Uzbekistan “Effective mechanisms to stimulate research and innovation, the application of scientific and innovative developments” important tasks are set. In this aspect, with an increase in the yield of valuable components and the intensification of the process, the additional extraction of tungsten during processing from industrial waste of NPO Almalyksky MMC is important.

II.SIGNIFICANCE OF THE SYSTEM

Since the 90s, the environmental situation at mining and processing enterprises has sharply worsened (in some regions, threatening the existence of not only biota, but also humans), there has been a progressive decrease in the production of non-ferrous and ferrous metals, mining and chemical raw materials, deterioration in the quality of processed ores and as a result, the involvement in the processing of difficult-to-concentrate ores of complex material composition, characterized by a low content of valuable components, fine impregnation and close technological properties of minerals.
The human impact on the environment in the process of economic activity is now becoming global. In terms of the scale of recoverable and displaced rocks, transformation of the relief, effects on the redistribution and dynamics of surface and groundwater, activation of geochemical transfer, etc. this activity is comparable to geological processes.
Ore dressing waste storages are objects of increased environmental hazard due to their negative impact on the air basin, groundwater and surface water, and soil cover over vast territories. Along with this, tailings are poorly studied technogenic deposits, the use of which will make it possible to obtain additional sources of ore-mineral raw materials with a significant reduction in the extent of disruption of the geological environment in the region.
The production of products from man-made deposits, as a rule, is several times cheaper than from specially extracted raw materials for this, and is characterized by a quick return on investment. However, the complex chemical, mineralogical and granulometric composition of the tailings, as well as the wide range of minerals contained in them

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make it difficult to calculate the total economic effect of their processing and determine an individual approach to the assessment of each tailings.

III. LITERATURE SURVEY

The generalization of the experience of leading enterprises in the processing of industrial wastes plays an important role in the problem of creating improved non-waste technology in non-ferrous metallurgy.
In the field of the use of ore concentration wastes, the most important is a detailed mineralogical and technological study of each specific, individual technogenic deposit, the results of which will allow developing an effective and environmentally friendly technology for the industrial development of an additional source of ore-mineral raw materials.
When solving the formulated problems, the following research methods were used: spectral, optical, chemical, mineralogical, phase, gravitational and flotation methods for analyzing the material composition and technological properties of the initial mineral raw materials and enrichment products.
Mineral processing is accompanied by the receipt of a large amount of waste, a significant part of which is still not used, is stored in dumps, storages, and settling tanks. Such wastes include flotation tails. Huge reserves of useful components are contained in industrial waste arising from the extraction, enrichment and processing of products of enrichment of ores of non-ferrous and rare metals.
In the tails of the NPO Almalyksky MMC, the proportion of unrecovered components of their amount in the source ore is respectively %: WO_3-0,05-1,5%; SiO_3 – 38-45%; Al_2O_3 -5-8%; CaO -17-30%, K_2O -1,2%; P- 0,04-0,06%; Fe- 5-12%; Co-14-18%; S-1%.

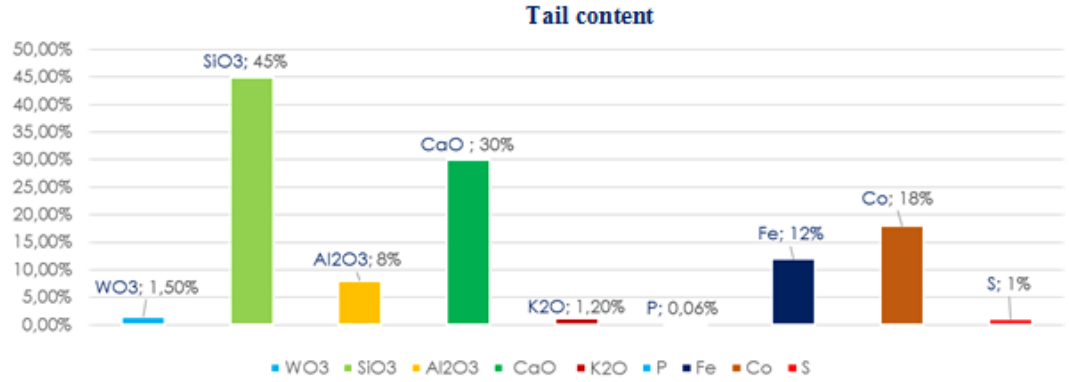

Fig. 1 The share of unrecovered components in the cakes of NPO Almalyk MMC.

To a lesser degree, associated components are recovered in the processing of complex ores. The technology for processing technogenic wastes of NPO Almalyksky MMC is selected depending on their composition and physicochemical properties. Scheelite is the main mineral of tungsten ores. Common satellites of tungsten minerals in deposits are cassiterite, molybdenite, bismuth shine, native bismuth, chalcopyrite, arsenopyrite, galena, and others. Hazardous impurities include manganese oxides, silicic acid, phosphorus, sulfur, arsenic, tin, copper, molybdenum, etc.

IV. METHODOLOGY

For research, samples were taken from the cake of the NGO Almalyksky MMC JSC and chemical analysis of the samples was carried out in the Central analytical laboratory of Almalyksky MMC JSC. The particle size distribution of the cake was determined using the method of analysis of particle size distribution by laser diffraction (Cilas). Chemical and mineralogical analyzes of slurry field samples of the Scientific and Production Association “Rare Metals and Hard Alloys” have been performed.
The first stage of the research was the analysis of samples of technological solutions taken from different sites of NPO Almalyksky MMC and a complete analysis was carried out by atomic absorption method using an ISP-MS device.
Method for complex processing of tungsten-containing ore dressing tailings, including their classification into fine and coarse fractions, helical fine fraction separation to obtain a tungsten product, sulfide-containing product and secondary dump tailings, characterized in that the tungsten product obtained after helical separation is subjected to purification on

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a screw separator to obtain a rough tungsten concentrate. The resulting draft tungsten concentrate is refined on the concentration tables to obtain gravity tungsten concentrate.

To carry out large-scale laboratory experiments on the extraction of tungsten by-product from cake, samples were taken that were subjected to sieve analysis. The weight of each sample is 50 kg. The distribution of the useful component by size classes was studied.

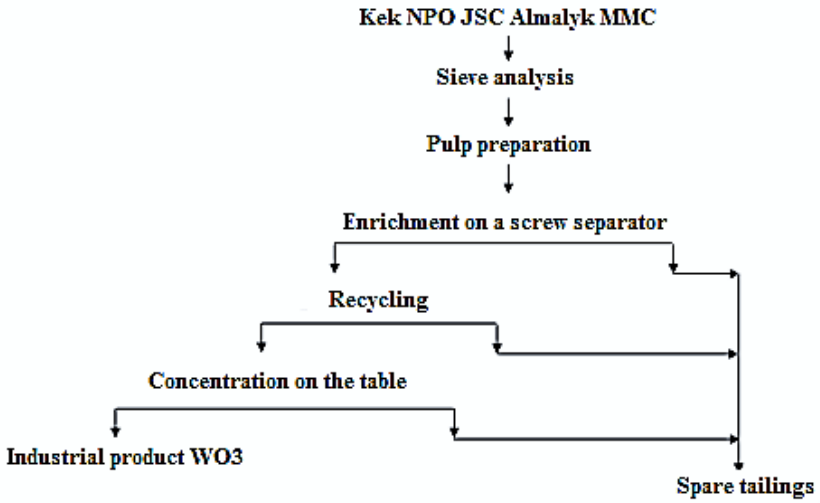
For the experiments, weighed portions with a total weight of 500 kg were prepared, which were carefully averaged. Then, 10 samples of the cake of the NPO Almalyk MMC JSC weighing 50 kg were prepared. The proposed technological scheme of cake enrichment by the gravitational method consists of the following processes: pulp preparation, enrichment on a screw separator, the separator concentrate is enriched on a concentration table and sent for cleaning. The result was a tungsten intermediate containing 10-12% WO_3.

The second series of experiments with a weight of 50 kg each was carried out in the following order: pulp preparation, enrichment on a jigging machine, jigging concentrate after re-cleaning is sent to a concentration table. The resulting concentrate after purification is handed over to the chem. laboratory for analysis. In experiments carried out in an open cycle by the gravitational method, intermediate products containing 29-35% WO_3 with an extraction of 41-50% were obtained.

The effect of cleaning operations and agitation of the resulting product with hydrochloric acid was studied. According to the results of chemical analysis, we can conclude that after two cleaning operations and agitation of the obtained concentrate with hydrochloric acid, the content of WO3 increased by 2-3%, the extraction of WO_3 increased by 3-4%.

We consider the enrichment of the cake of NPO Almalyksky MMC JSC on a screw separator with re-cleaning and on a concentration table with two re-cleaning to be ineffective.

The most effective method of cake enrichment is the gravity method of enrichment — including enrichment on a jigging machine with cleaning and control jigging, then enrichment on a concentration table, preferably with two



cleanings. It was found that by enriching the cake at the NPO Almalyksky MMC, one can obtain high-quality tungsten concentrate containing 55-56% WO_3.

Fig.№ 2. The technological scheme of enrichment of cake of NPO Almalyksky MMC JSC by the gravitational method in an open cycle.

The following experiment was carried out with the cake of the NPO Almalyksky MMC JSC in an open cycle by the gravitational method: on a jigging machine.

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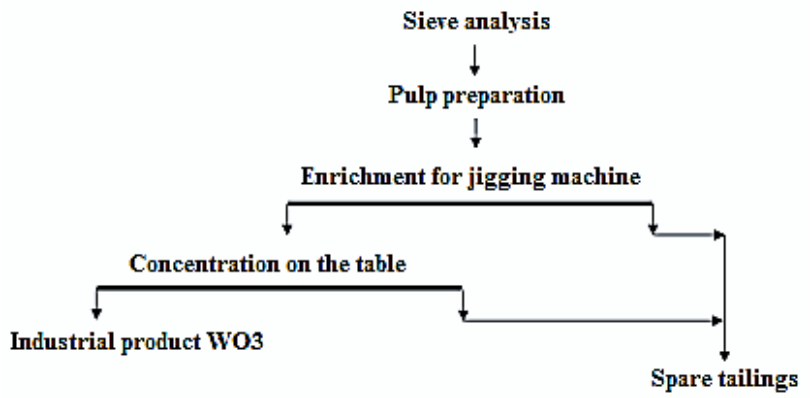

Fig. 3. Technological scheme of enrichment of cake NPO JSC "Almalyk MMC" in an open cycle by the gravitational method.

Thus, from a comparison of the gravitational method of enriching the cake of the NPO Almalyksky MMC JSC, we can assume that the effective method is the gravitational method of enrichment, which includes the process of deposition with cleaning and enrichment on a concentration table with two cleanings.

The advantage of this method in comparison with the combined method is ease of maintenance, low equipment costs and the production of high-quality tungsten concentrate.

Considering the complexity and high cost of the complex technology of cake enrichment, it can be considered that the gravitational method of cake enrichment in an open cycle on a jigging machine with a scrubbing and on a concentration table with two scrubbing is more acceptable. The technological scheme is shown in Fig. 4.

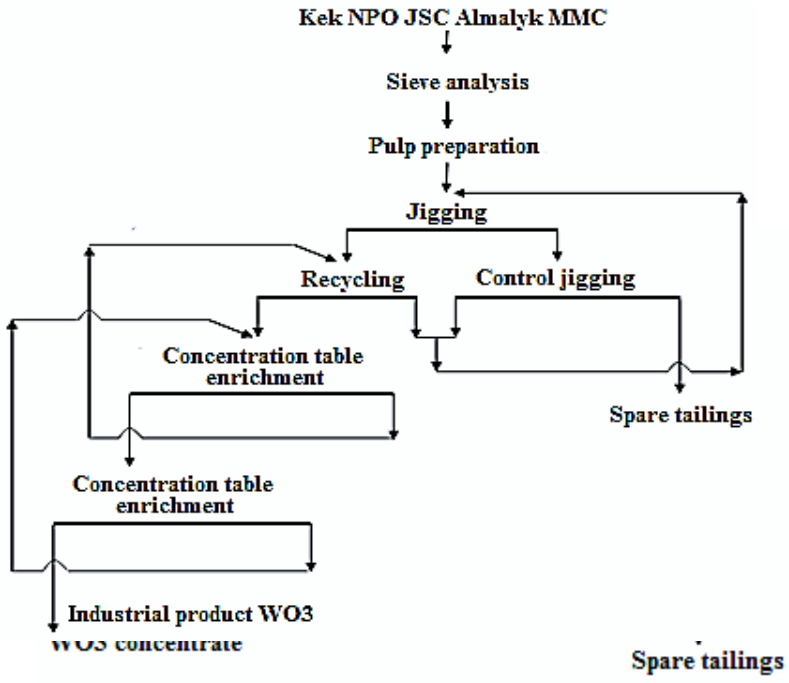

Fig.4. Technological scheme of enrichment of cake NPO JSC "Almalyk MMC" in a closed cycle by the combined method.

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V. EXPERIMENTALRESULTS

Thus, in accordance with the recommended technological scheme for enrichment of NGOs, Almalyksky MMC JSC by the gravity method on a jigging machine, 55.8% WO3 with 89.3% recovery is contained on the concentration table with the obtained tungsten concentrate.

Results cake enrichment gravitational method Table 1.

№	Product name	Output%	ContentWO_3,%	ExtractionWO_3,%
I	Tungsten product	2,29	49,48	87,4
	Tails	97,71	0,43	12,6
	Source product	100,0	1,3	100,0
II	Tungsten product	2,61	41,56	86,7
	Tails	97,39	0,51	13,3
	Source product	100,0	1,25	100,0
III	Tungsten product	2,85	32,12	78,9
	Tails	97,15	0,37	21,1
	Source product	100,0	1,16	100,0
IV	Tungsten product	2,85	29,6	77,4
	Tails	97,15	0,32	22,6
	Source product	100,0	1,09	100,0
V	Tungsten product	2,67	27,8	74,2
	Tails	97,33	0,26	25,8
	Source product	100,0	1,0	100,0
VI	Tungsten product	2,4	55,8	89,3
	Tails	97,6	0,36	10,7
	Source product	100,0	1,5	100,0

The WO3 content in the concentrate was 49.48-55.8%, recovery 87.4-89.3%. After sieve analysis, the tailings (cake) of the NPO Almalyksky MMC JSC are enriched according to the recommended technological scheme on the MOD-0.2 jigging machine, the jigging concentrate is sent to the concentration table. Tails go to the dump. The concentration table concentrate is sent for cleaning. When enriching the cake, NPO Almalyksky MMC JSC on a screw separator and on a concentration table, and after cleaning, prom. a product containing 12.36-14.6% WO3, with a recovery of 62.9-69.40%.

The results of cake enrichment by the gravitational method are shown in Table 2.

№	Product name	Output%	ContentWO_3,%	ExtractionWO_3,%
I	Tungsten product	5,52	10,62	58,6
	Tails	94,48	0,30	41,4
	Source product	100,0	1,0	100,0
II	Tungsten product	6,34	11,36	62,1
	Tails	93,66	0,22	37,9
	Source product	100,0	1,16	100,0
III	Tungsten product	5,75	11,82	62,4
	Tails	94,25	0,21	37,6
	Source product	100,0	1,09	100,0
IV	Tungsten product	5,81	10,18	59,2
	Tails	94,19	0,25	40,8
	Source product	100,0	1,0	100,0
V	Tungsten product	6,37	12,36	62,9
	Tails	93,63	0,24	37,1
	Source product	100,0	1,25	100

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VI	Tungsten product	6,18	14,6	69,4
	Tails	93,82	0,32	30,6
	Source product	100,0	1,3	100,0

VI. CONCLUSION

It is proved that the only effective and rational method of enriching the cake of the NPO Almalyksky MMC JSC is the gravitational enrichment method on a jigging machine with re-cleaning and on a concentration table with two re-cleaning.

It is proved that the only effective and rational method of enrichment of W-containing cake of NPO Almalyksky MMC JSC is the gravitational enrichment method. Based on the analysis of the generalized curves of gravitational enrichment of stale W-containing tails, it was found that dump tailings with minimal tungsten losses are a hallmark of the enrichment of technogenic raw materials in size -0.1 + 0mm. New laws of separation processes have been established that determine the technological indicators of gravitational enrichment of cake at NPO Almalyksky MMC in size + 0.1 mm.

It has been proved that from the gravity apparatus used in the enrichment of W-containing cake, for maximum extraction of tungsten from technogenic raw materials of NPO Almalyksky MMC JSC into a rough W-concentrate, a jigging machine, a screw separator and concentration tables are suitable. This technological scheme for the extraction of tungsten from the cake of NPO Almalyksky MMC JSC allowed to obtain tungsten concentrate and tungsten intermediate products, to solve the problem of depletion of mineral resources of cake of NPO Almalyksky MMC and to reduce the negative impact of the enterprise's production activities on the environment.

The essential features of the developed technology for extracting tungsten from the cake of the NPO Almalyksky MMC JSC are: - narrow classification by size of food of primary enrichment operations; - Preferred use of gravity equipment. During semi-industrial tests of the developed technology for extracting tungsten from the cake of the NPO Almalyksky MMC JSC, a tungsten concentrate containing 55.8% WO_3 with 89.3% recovery was obtained.

REFERENCES

[1] Avdokhin V. M. Fundamentals of mineral enrichment: volume 2, - M.: Gornaya kniga, 2008. - 147c.
[2] Abramov A. A. Flotation methods of enrichment: volume 4, - M.: Mountain book, 2008. -453 -454
[3] Novikov A.A., Sazonov G.T. State and prospects of development of the ore-raw material base of non-ferrous metallurgy of the Russian Federation, Mining Journal - 2000 - No. 8, P. 92-95.
[4] Beresnevich P.V. and others. Environmental protection during the operation of tailings. - M: Nedra, 1993.- 127s.
[5] Shalaev V. P. Fundamentals of mineral processing: Nedra, 1986. -144 PP.

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