



ENRICHMENT OF THE RIVAT DEPOSIT PHOSPHORITE ORES IN THE REPUBLIC OF TAJIKISTAN

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ABSTRACT: The results of the research on the enrichment of phosphorite ores of the Rivat deposit are presented. Based on the obtained results, a flow chart of the combined flotation enrichment of phosphate raw material is proposed, which makes it possible to obtain a flotation concentrate containing 25-27% of P_2O_5 .

KEYWORDS: flotation, degree of extraction, P_2O_5 , phosphor-containing ore, enrichment, fractions, concentrate, tailings.

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INTRODUCTION

The flotation method for extracting useful components is one of the promising methods for enriching phosphorites from various deposits.

The enrichment of phosphate raw materials from the Jhamarkotri deposit (India) should be described as an operating technology for flotation enrichment of low-grade carbonate-phosphate ores [1]. The Indian Mining Bureau has developed a technology for ore enrichment, including shredded grinding and two stages of flotation - collective carbonate - phosphate flotation in an alkaline medium and selective flotation of carbonates from the bulk concentrate in an acidic medium using H_3PO_4 , after desorption of reagents. In accordance with this technology, the ore is crushed to 0.077 mm and, according to the class 0.02-0.025 mm is divided into coarse and fine fractions. After separate conditioning of the coarse and fine fractions with sodium oleate, the coarse fraction is subjected to flotation with obtaining a bulk carbonate-phosphate concentrate. The fine fraction does not participate in this stage of the flotation and, without enrichment, it is mixed with the bulk concentrate of the coarse fraction. This mixed product is sent to the acid flotation cycle, where the separation of phosphate and carbonate is carried out.

According to the patent [2], when enriching low-grade phosphate ores with a high content of alkaline earth metal carbonates by froth flotation, gelatinized starch glue is used as a depressant for waste rock, obtained by the reaction of NaOH with starch in a ratio of 1: 2 at pH = 7.5-10, and in oleic or linoleic acid is used as a collector.

According to the patent [3], natural phosphorite is washed with a NaOH solution (pH = 8) during from 20 seconds to 3 minutes. The washed ore is dried and the sediments formed during the washing process are removed, after which it is subjected to a froth flotation process using fatty acids and heavy oils to separate the phosphate concentrate.

Natural phosphorite with a high content of silicic acid and carbonates of calcium and magnesium is enriched by two-stage anionic flotation [4].

At the first stage of flotation, a significant part of silicic acid is isolated, while carboxylic acids with the addition of Na_2SiO_3 and NaOH are used as a reagent to pH = 9-10.5. The enriched phosphate containing CaCO_3 and MgCO_3 is treated with an aqueous solution of H_3PO_4 (pH = 4.5-5.8). The resulting concentrate is subjected to secondary anionic flotation in which carbonates of calcium and magnesium are isolated.

The patent [5] differs from the patent [4] in that the enriched phosphate containing CaCO_3 and MgCO_3 is treated not with phosphoric acid, but with a phosphate solution [pH = 4.5-7].

In the process of enrichment of phosphate ore by flotation for the purpose of separating silicate rock, fatty acids or ether with ethanolamine and hydroxyethylenediamine are used as a collector of the mixture, which exacerbates the separation of phosphorite and quartzite [6].

In [7], a petrographic study of deposits of phosphate ores of sedimentary origin, containing 12-15% P_2O_5 , located in Michigan (USA) is presented. The deposit belongs to the rich phosphate deposits of the Decambrian period, contains apatite and quartzite. As a result of flotation, the rock crushed to a size of 525 mesh (0.043-0.044 mm) using fatty acids as a collector, a concentrate containing 30% P_2O_5 (isolation rate 72%) was obtained, which is suitable for the production of mineral fertilizers.

According to [8] it was found that in the analysis of a pure phosphate-containing mineral, it is theoretically possible to obtain a phosphate raw material containing 33% P_2O_5 . It is indicated that flotation enrichment ore can be carried out by three methods:

1. By flotation of carbonate rock using fatty and hydrofluorosilicic acids with subsequent separation of SiO_2 by selective flocculation and flotation of phosphorite with excess fatty acid;
2. By selective flotation of carbonates and silica using an amphoteric reservoir (sodium salt of n-alkyl-aminopropionic acid);
3. By flotation of carbonates with the mentioned reagents, followed by selective flocculation and flotation of phosphorite with excess fatty acid. The use of these methods, in the opinion of the authors, can give a product containing 30% P_2O_5 . The best results are obtained with the use of the second and third methods, which provide a higher degree of P_2O_5 separation.

One of the main tasks facing the economy of Tajikistan is to provide agriculture with fertilizers from local raw materials. This work is devoted to this task. The studies were carried out on ore poor in phosphorite content, namely on the ore of the Rivat phosphorus-containing deposit.

On the territory of the Republic of Tajikistan, the phosphorites are associated with a terrigenous-carbonate formation of the Middle Eocene age in the foothills of the northern slope of the Turkestan ridge,

in the Penjikent trough, in the southwestern spurs of the Gissar ridge, in the southern Tajik depression, on the southern dip of the Bobotag ridge.

One of the most promising methods of enrichment of phosphorite ore is washing and flotation. The method includes processing and enrichment of phosphorites by separating them into heavy suspensions, sorting, heat treatment, magnetic separation, and bacterial leaching. The above scheme also includes auxiliary operations - crushing, screening, fine-graining, desliming, filtration and drying. A wide variety of technological types of phosphorite ores has led to the spread of combined enrichment schemes. Thus, the extraction of phosphate minerals from the tailings of the main washing process increases the total extraction of P_2O_5 and contributes to an increase in the complexity of the use of phosphate raw materials [9, 10].

Mineralogical analysis of the average sample of phosphate ore showed that the ore contains: quartz-phosphorite sandstones of yellowish-gray color with the inclusion of grains and rare nodules of phosphorites, fine-grained quartz and clay fraction. The content of P_2O_5 in the original sample is 5.7-6.5% [11, 12].

In the course of the experiments on the flotation of this ore, various modes of washing the original ore were carried out in order to remove clay materials with subsequent flotation, but the data obtained did not give a significant improvement in technological indicators. The flotation was carried out in an alkaline medium. Based on the preliminary studies on flotation, the following conditions were selected: the fineness of grinding was 42.5% of the class "-0.063 mm"; the pH of the medium was set with sodium carbonate (1.5 kg/t), for the depression of waste rock, liquid glass (1.5 kg/t) together with sodium carbonate was fed to the beginning of the flotation process.

Fractional reagent feeding significantly improves flotation performance. Therefore, there two main and two control flotation were carried out. Cheap and affordable mixtures of tall oil ("liquid rosin") with kerosene were used as anionic collecting reagents for flotation of phosphate-containing ores.

The kerosene consumption varied from 1 to 4 kg/t. To obtain a higher grade concentrate, the experiments were carried out in a closed cycle of 4 weighed portions of ore, but the concentrate of the main flotation was subjected to two cleanings. Table 1 shows the results of the experiments on the flotation of phosphate rock from the Rivat deposit. Phosphate rock (concentrate) was obtained with a content of 27.3% of P_2O_5 with an extraction of 94.7%.

Table 1. Flotation of phosphorite ore in a closed cycle with two cleaning of the concentrate

Product name	Yield (γ)		β content P_2O_5 , %	$\gamma \beta$ P_2O_5	Separation of P_2O_5 , %
	r	%			
Concentrate I	24	2,48	29,6	73,41	13,53
Concentrate II	48	4,96	26,02	129,06	23,80
Concentrate III	38	3,93	26,02	102,26	18,85
Concentrate IV	41	4,24	27,3	115,75	21,34
Intermediate product I	88	9,1	6,38	58,06	10,71
Intermediate product II	22	2,28	17,6	40,13	7,40
Tails I	182	18,82	0,51	9,60	1,77
Tails II	139	14,38	0,26	3,74	0,69

Tails III	197	20,37	0,26	5,30	0,98
Tails IV	188	19,44	0,26	5,05	0,93
Ore	967	100	5,42	542,36	100
Concentrate	151	17,62	27,24	480	94,75
Tails	706	82,36	0,33	26,57	5,25
Ore	857	100	5,07	506,57	100

On the basis of the results obtained, a basic technological scheme for the processing of phosphorite ores of the Rivat deposit is proposed.

Thus, on the basis of the results obtained, a basic technological scheme of combined flotation enrichment of phosphorite raw materials has been proposed, which makes it possible to obtain a flotation concentrate containing 25-27% P₂O₅ (separation rate 94.75%).

CONCLUSIONS

1. The optimal flotation conditions were selected - grinding fineness is 42.5% class of 0.063 mm, the pH = 8.5, liquid glass -1.5 kt / t, which provide P₂O₅ enrichment up to 25-27%.
2. A basic scheme of the combined enrichment of phosphate rock was proposed.

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