INVESTIGATION OF THE PROCESS OF OBTAINING EXTRACTION PHOSPHORIC ACID FROM A MIXTURE OF PHOSPHORITES OF KARATAU AND CENTRAL KYZYLKUM

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ABSTRACT

In the ongoing studies, it was necessary to investigate the processes of obtaining extraction phosphoric acid (EPA) from various types of phosphate mixtures of raw materials, including from Karatau and Central Kyzylkum(CK).

Currently, the global consumption of phosphate raw materials is about 43 million tons of P_2O_5 per year. Taking into account population growth and other factors, it is assumed that the consumption of phosphate raw materials will increase by 2.5% per year, which led to an annual increase in its consumption in the period up to 2010 by about 1 million tons of P_2O_5, and in the next decade an increase of 1.3 million tons is expected, in 2021-2030 - by 2 million tons. [1].

Keywords: Karatau phosphorites, phosphorites,washed burnt phosconcentrate (wbp), filter, sedimentary rocks,

INTRODUCTION

Currently, phosphorites of the CK are the main phosphate raw materials for enterprises of the Republic of Uzbekistan producing phosphorus-containing simple and complex fertilizers. Phosphorites are sedimentary rocks, the main component of which is crypto- or microcrystalline calcium phosphates from the apatite group. [1] In addition to calcium phosphates, its composition includes quartzite (SiO_2), calcite ($CaCO_3$), dolomite ($CaCO_3$-$MgCO_3$), glauconite, limonite, aluminosilicate, clay particles, compounds of heavy metals, iron, magnesium, fluorine, as well as various organic substances.[2]. Kazakhstan is also one of the largest producers of phosphate raw materials and ranks second in terms of total and explored reserves of phosphate

rocks among the CIS countries. The total reserves of phosphorites of the Karatau deposit are 1.5-2.0 billion tons, and the predicted reserves to a depth of 1000 m are estimated at 6 billion tons of ore [3]. Significant progress in the production of EPA was the transition to continuous installations and the dilution of 75 and 93% sulfuric acid not with water or a weak washing solution, but with an EPA solution, i.e. diluting solution. Natural phosphates containing large amounts of acid-soluble compounds of magnesium, aluminum, and iron are unsuitable for the sulfuric acid decomposition method. Impurities of iron-containing minerals are especially undesirable and harmful. [4]

METHODS

The raw materials, intermediates and final products were analyzed for the content of the following components: phosphates, sulfates, fluorides of sodium, magnesium, calcium, aluminum, iron. The determination of phosphates was carried out by a differential photometric method based on the formation of a yellow colored phosphor-vanadium-molybdenum complex and photometric measurement of the optical density of this complex at a wavelength of λ = 430-450 nm relative to a reference solution containing a known amount of P_2O_5. [5]

The extraction of phosphates was carried out with a solution of nitric acid. Calcium and magnesium were determined by the complexometric method, based on a change in the color of the indicator (fluorexone in the determination of calcium and acid chromium dark blue in the determination of magnesium) during the interaction of calcium and magnesium ions with trilon B. [6]. The determination of sulfates was carried out by the weight method, based on the precipitation of sulfates with barium chloride in an acidic medium and subsequent weighing of the precipitate. The iron and aluminum content was determined by the complexometric method [7]. Determination of fluorides was carried out by the ionometric method, based on measuring the concentration of fluorine in solution using a fluoride-selective electrode without prior extraction of fluorine. Water in solid samples was determined by drying in a drying cabinet to a constant mass at a temperature of 100-105 ° C [8]. To characterize the intermediate and final products, some of their physicochemical properties were studied: density, viscosity, pH. The density of solutions and pulps was determined using a PZH-2 pycnometer according to [9]. The kinematic viscosity of solutions and pulps was measured with glass capillary viscometers VPJ-1 and VPJ-2 [5], the pH of solutions and suspensions was determined by the electromechanical method [10].

RESULTS

At the initial stages of the experimental work, the composition of phosphorites of washed burnt phosconcentrate (wbp) CK and Karatau was studied using modern methods of physico-chemical analysis. Figure 1 shows a radiograph of the WBP.

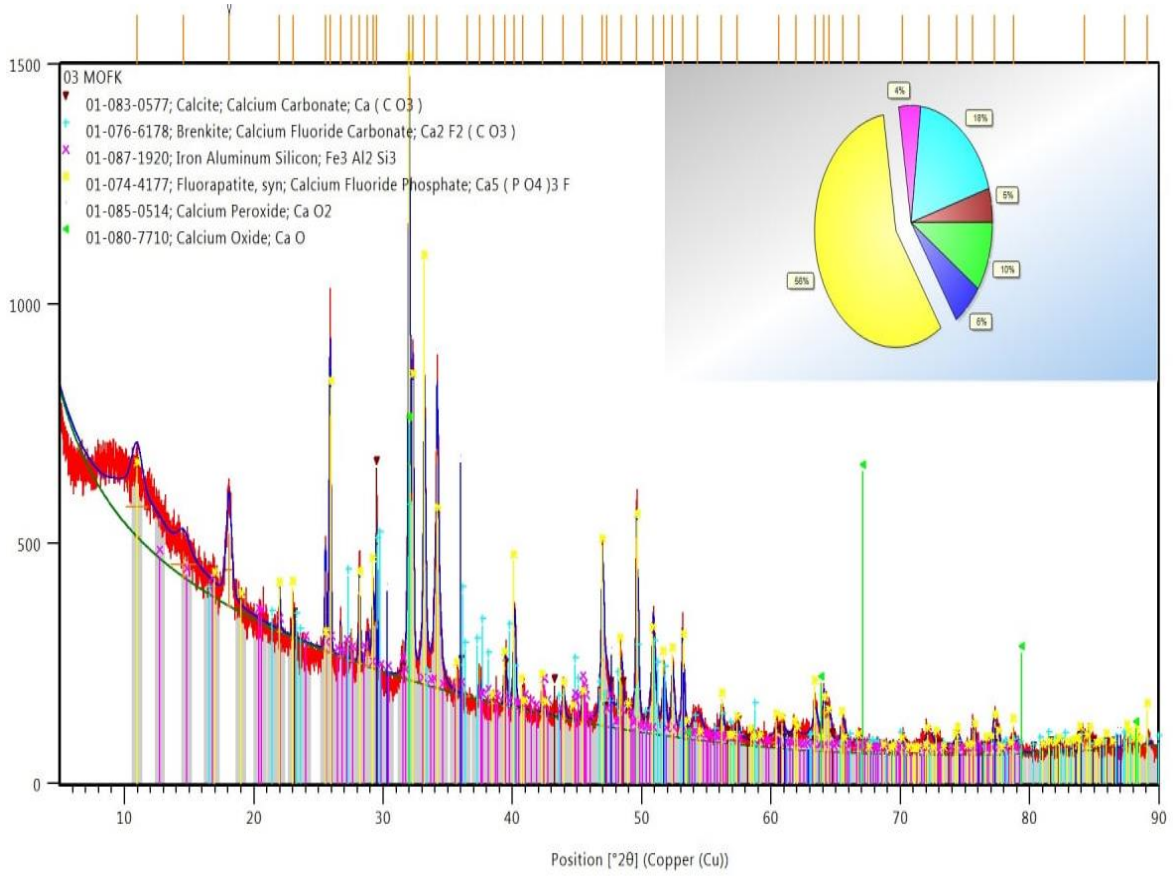

Figure 1 Radiograph of the WBP

During the sample, a camera with rotation was used, where the rotation speed is 30 rpm./min. The transcription of the radiographs was carried out using the database of the American card file "American mineralogist crystal structure database" and the radiometric mineral determinant Mikheev. The X-ray image is analyzed using peaks containing $Ca_5(PO_4)_3F$ - 56%, $Ca_2F_2(CO_3)$ - 18%, $Fe_3Al_2Si_3$ - 4%, $CaCO_3$ - 6%, CaO - 16%. The composition of Karatau phosphorites, chosen as the object of study, was also studied using physicochemical analysis methods. Based on the results of X-ray diffraction analysis, it was found that the composition of these phosphorites mainly consists of CaO and P_2O_5, in addition to the presence of $Fe_3Al_2Si_3$ compounds. (Fig.2). The IR spectrum shows clear bandwidth in the frequency range of 586.39 cm-1 and 1050.29 cm-1, corresponding to antisymmetric and deformation vibrations of the $RO_4$3-ion. The substitution of the PO_4 3-ion by the CO_3 2-group is probably explained by the shift of the maxima of the PO_4 3-oscillation band to the high-frequency region due to the superposition of the carbonate absorption band in the structure of the phosphate mineral. In the wbp spectrum, the oscillation frequencies of 1445.71 cm-1 refer to the carbonate ion. The regions of 773.49 cm-1 are characteristic of valence vibrations of Si-O-Si bonds. The results of IR spectral analysis of Karatau phosphorites are presented in Figure 3

Figure 2 Radiograph of Karatau phosphorites

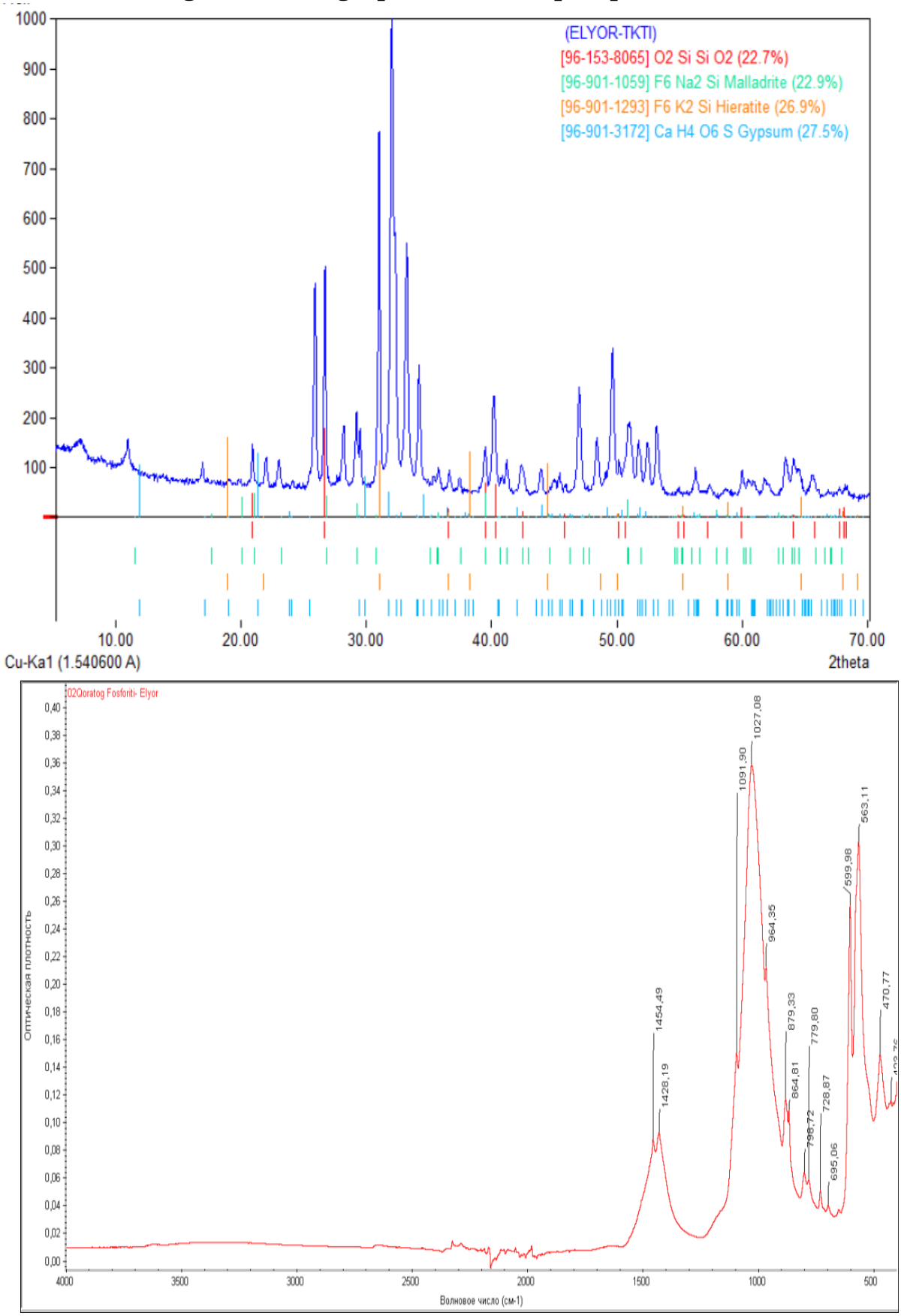

Figure 3 IR spectrum of Karatu phosphorites

The study of the filtration process of the thickened part in the process of obtaining EPA by decomposition of Karatau and WBP CK in the presence of sulfuric acid in various proportions. During the experiment, the effect of the ratio of raw materials and the S:L phase on the filtration rate was studied. Table 1. Filtration rate at an acceptable ratio of S:L 1:2.7, the acidity rate of 103%, the ratio of raw materials (Karatau: WBP) 30:70 was next. For pulp it was 2387 kg/m^{2}*h, for residues - 1313 kg/m^{2} *h, and for filtrate - 1074 kg/m^{2*}h. At higher ratios and acid norms, the filtration rate increased slightly, but 103% of the acid norm was considered acceptable due to the fact that an increase in acid consumption negatively affects the profitability of the enterprise.

Table 1

The effect of the acid norm and the S:L ratio on the filtration rate of the condensed part of the pulp obtained by the sulfuric acid decomposition of Karatau and WBP CK based on the formation of EPA

\	S:L	Technological parameter of the decomposition process				
		The ratio of raw materials. gr		Filter speed. kg/m2 * h		
		Karatau	МОФК	by pulp	by sediment	by filtrate
Standard H_2SO_4 100						
1.	1:2.5	70	30	1165	640	525
2.	1:2.5	50	50	1644	904	740
3.	1:2.5	30	70	2003	1168	955
4.	1:2.7	70	30	1217	670	547
5.	1:2.7	50	50	1716	945	771
6.	1:2.7	30	70	2215	1213	1002
7.	1:3	70	30	1410	776	634
8.	1:3	50	50	1986	1093	893
9.	1:3	30	70	2063	1415	1148
Standard H_2SO_4 103						
10.	1:2.5	70	30	1234	678	556
11.	1:2.5	50	50	1993	1096	897
12.	1:2.5	30	70	2245	1235	1010
13.	1:2.7	70	30	1314	723	591
14.	1:2.7	50	50	1850	1017	833
15.	1:2.7	30	70	2387	1313	1074
16.	1:3	70	30	1437	804	633
17.	1:3	50	50	2024	1113	911
18.	1:3	30	70	2411	1436	1175

DISCUSSION

For the production of concentrated, water-soluble phosphoric fertilizers and phosphoric acid salts, extraction phosphoric acid (EPA) is necessary, produced only from washed burnt phosconcentrate (wbp) of Central Kyzylkums (CK). However, due to a specific property - a high ratio of CaO : P_2O_5 in raw materials, the consumption of sulfuric acid for decomposition increases, the thermal effect of the decomposition reaction per unit of raw materials and the temperature of the pulp in the extractor significantly increase, which leads to the formation of agglomerates clogging the extractor and constrains the productivity of the technological system.

Another distinctive feature is also the geological location of the phosphorite-bearing layers of the CK deposit and the high content of organic, clay substances, which complicates their extraction and enrichment. Therefore, the production capacity of the Kyzylkum Phosphate Combine (KPC) is 717 thousand tons of WBP, while the republic's demand for phosphate raw materials is more than 3,500 thousand tons per year. The enterprises Republic provide only 30% of the need for phosphorus fertilizers.

In this regard, in order to meet the internal needs of the republic with phosphorus fertilizers, it is necessary to involve Karatau phosphorites in production and improve technological and economic indicators for the joint processing of phosphorites of WBP and Karatau are the main conditions for the normal operation of the EPA workshop, and research aimed at solving these problems is very topical and in demand.

CONCLUSION

The processes of decomposition of a mixture of Karatau phosphorites and WBPC CK with sulfuric acid at its various forms and concentrations, L:S ratios, duration and temperature of the process are investigated.

The processes of filtration of acid pulp obtained by decomposition of a mixture of phosphorites of Karatau and WBP CK with sulfuric acid are investigated, their rheological properties are studied, the formed liquid phase (EPA) is a mass that is filtered or medium filtered at the ratios L:S = 1:3. Therefore, a mixture of Karatau phosphorites and wbp CK was used in further studies.

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