

INVESTIGATION OF THE DECOMPOSITION PROCESS OF WASHED AND CALCINED CENTRAL KYZYLKUM PHOSPHORITE CONCENTRATE BY PARTIAL REPLACEMENT OF SULFURIC ACID WITH WET-PROCESS PHOSPHORIC ACID

Shamsiddinov Isroiljon

Namangan State Technical University – Doctor of Technical Sciences, Professor;

Xalilova Nilufar

Master's degree holder Namangan State Technical University

Abstract. In order to obtain phosphorus fertilizers containing a water-soluble form of sulfates, the processes of decomposition of washed and calcined phosphorite concentrate (WCPC) of Central Kyzylkum in an acid mixture by partial replacement of sulfuric acid with wet-process phosphoric acid, as well as the ammoniation of the resulting phosphate slurry, were investigated.

Keywords: phosphorite, fertilizer, simple fertilizer, mineral fertilizer, phosphorus fertilizer, double superphosphate, enriched superphosphate, superammophosphate, sulfasuperammophosphate.

As the mineral fertilizer industry develops, the range of products expands and their quality improves; simultaneously, cost-effective, economically viable, and environmentally friendly new technological processes are developed and implemented into production through the rational utilization of available raw materials. In this regard, developing a technology for producing phosphorus fertilizers containing water-soluble forms of calcium and sulfates is of great importance. Particular attention is paid to determining the optimal technological parameters for the partial replacement of sulfuric acid with phosphoric acid, identifying the degree of ammoniation of acidic slurries to achieve the maximum content of water-soluble sulfates, and studying the processes of obtaining concentrated nitrogen-phosphorus fertilizers containing calcium along with water-soluble sulfate forms. Currently, the chemical industry of our republic is implementing large-scale measures aimed at modernizing and improving production, constructing enterprises for the manufacturing of new and high-quality products, localizing the raw material base, and producing new types of import-substituting products, thereby achieving significant scientific and practical results [1].

In the process of phosphoric-sulfuric acid decomposition of phosphate raw materials, when part of the sulfuric acid is replaced with phosphoric acid, the conversion of calcium sulfate dihydrate into water-soluble ammonium sulfate during the ammoniation of the resulting acidic product to pH = 3.5–4.5, as well as the effect of this process on the retrogradation of the assimilable form of phosphorus, have not been investigated [2].

Therefore, this study is aimed at determining the optimal amounts of sulfuric acid that can be replaced with wet-process phosphoric acid (WPA) and the effect of the ammoniation process on the conversion degree of calcium sulfate. Central Kyzylkum (CK) phosphorites differ significantly from Karatau phosphorites in terms of chemical and mineralogical composition.

Therefore, to obtain sulfasuperammophosphate under conditions where 10, 15, and 20% of sulfuric acid is replaced with WPA (P_2O_5), the effect of WPA obtained from this raw material with a concentration of 15.76% P_2O_5 and containing 1% ammonium nitrate on the decomposition process of CK washed and calcined phosphorite concentrate (WCPC) was investigated.

During the research, washed and calcined phosphorite concentrate (WCPC) of Central Kyzylkum complying with Ts 1825:2014 and containing (wt.%): P_2O_5 = 27,12; CaO = 47,81; MgO = 1,89; CO_2 = 2,12; Fe_2O_3 = 0,64; Al_2O_3 = 1,08; SO_3 = 2,24; F = 2,75 and others, as well as wet-process phosphoric acid (WPA) obtained from it containing (wt.%): 15,76; CaO = 0,34; MgO = 0,49;

$R_2O_3 = 0,95$; $SO_3 = 1,87$; $F = 1,08$ and others, and ammonium nitrate were used as initial raw materials.

When WCPC is decomposed with WPA having a concentration of 15.76% P_2O_5 and containing 1% ammonium nitrate, by replacing 10, 15, and 20% of its P_2O_5 with sulfuric acid, and upon ammoniating the acidic slurry to $pH = 3.3$, the content of total P_2O_5 remains practically unchanged, ranging from 17.90% to 17.95% in the acidic slurry and from 17.70% to 17.71% in the ammoniated slurry (Table 4.8).

The content of the assimilable form varies from 17.55–17.62% in the acidic slurry to 17.11–17.00% in the ammoniated slurry. The content of the water-soluble P_2O_5 form varies from 16.56–16.38% in the acidic slurry to 15.53–15.14% in the ammoniated slurry. The ratio of the assimilable form of P_2O_5 to its total content in the acidic slurry is 98.04% without replacing sulfuric acid with WPA, 97.99% when replacing 10% with WPA, 98.10% when replacing 15%, and 98.16% when replacing 20%. After ammoniation, these indicators are 96.67%, 96.50%, 96.05%, and 95.99%, respectively."

The ratio of the water-soluble form of P_2O_5 to its total content in the acidic slurry is 92.51% without replacing sulfuric acid with WPA, 92.25% when replacing 10% with WPA, 91.36% when replacing 15%, and 91.31% when replacing 20%. The ratio of $P_{2O_{5w.s.}}$ to P_{2O_5} total decreases in the ammoniated slurry and amounts to 87.74% without replacing sulfuric acid with WPA, and 86.79%, 85.25%, and 85.49% when replacing 10, 15, and 20%, respectively. The decomposition coefficient of phosphorite in the ammoniated products is 83.43% without replacing sulfuric acid with WPA, 83.99% when replacing 10% with WPA, 82.69% when replacing 15%, and 83.26% when replacing 20%.

The total SO_{total} content in the ammoniated products is 1.97% without replacing sulfuric acid with WPA, 2.83% when replacing 10% with WPA, 3.31% when replacing 15%, and 3.85% when replacing 20%. After ammoniation, the content of the water-soluble form of SO_3 is 1.23% without replacing sulfuric acid with WPA, 2.14% when replacing 10% with WPA, 2.73% when replacing 15%, and 3.20% when replacing 20%. The degree of SO_3 extraction into the aqueous solution increases from 47.76% to 62.44% without replacing sulfuric acid with WPA, from 52.80% to 75.62% when replacing 10% with WPA, from 54.76% to 82.48% when replacing 15%, and from 53.59% to 83.12% when replacing 20%.

The total CaO_{total} content in the slurry amounts to 6.66–6.59% without replacing sulfuric acid with WPA, 7.22–7.13% when replacing 10% with WPA, 7.53–7.43% when replacing 15%, and 7.87–7.77% when replacing 20%. In this case, the content of the water-soluble form of CaO is 1.95–2.81%, 2.28–3.44%, 2.71–4.41%, and 2.77–4.63%, respectively. The degree of CaO extraction into the aqueous solution in ammoniated slurries increases from 42.64% without replacing sulfuric acid with WPA up to 48.25% when replacing 10% with WPA, up to 59.35% when replacing 15%, and up to 59.59% when replacing 20%.

Thus, the effect of replacing 10–20% of P_2O_5 in wet-process phosphoric acid (WPA) with sulfuric acid during the decomposition of washed and calcined phosphorite concentrate of Central Kyzylkum with an acid containing 15.76% P_2O_5 and 1% ammonium nitrate was investigated. As a result, it was established that the optimal concentration of WPA for processing this phosphate raw material into nitrogen-phosphorus fertilizers containing water-soluble forms of sulfates is 15–35% P_2O_5 . Furthermore, when conducting the process with Central Kyzylkum phosphorites and WPA obtained from them, replacing 15% of P_2O_5 in WPA with sulfuric acid and ammoniating the resulting slurries to $pH = 3.0$ – 3.5 were determined to be the optimal operating conditions.

REFERENCES

89	ISSN 2277-3630 (online), Published by International journal of Social Sciences & Interdisciplinary Research., under Volume: 15 Issue: 01 in January-2026 https://www.gejournal.net/index.php/IJSSIR
	Copyright (c) 2026 Author (s). This is an open-access article distributed under the terms of Creative Commons Attribution License (CC BY). To view a copy of this license, visit https://creativecommons.org/licenses/by/4.0/

1. Ўзбекистон Республикаси Президентининг 2019 йил 3 апрелдаги №4265 «Кимё саноатини янада ислоҳ қилиш ва унинг инвестициявий жозибадорлигини ошириш чоратadbирлари тўғрисида»ги Қарори.

2. Промышленные типы месторождений неметаллических полезных ископаемых / Карякин А.Е. и др. – М.: Недра, 1985. – 286 с.