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PHOSPHORUS FERTILIZERS BASED ON ACID ACTIVATION OF LOW-ACTIVITY PHOSPHATE RAW MATERIALS

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Abstract This paper examines the technology for producing phosphorus fertilizers using acid activation of low-activity phosphate raw materials. The influence of acid type, its concentration, and processing regime on the availability of phosphorus in the final product was studied. It is shown that optimal processing parameters significantly increase the content of soluble phosphorus (P_2O_5), which can improve the efficiency of the fertilizers. The results allow recommending the proposed technology for industrial application.

Keywords: phosphorus fertilizers, phosphate raw materials, acid activation, phosphorus availability, production technology

Introduction Phosphorus fertilizers are one of the key elements for increasing soil fertility and ensuring high yields of agricultural crops. The main source of phosphorus in industry is natural phosphate ores. However, a significant part of phosphate raw materials is characterized by low activity, which reduces the efficiency of traditional processing methods.

Low-activity phosphate raw materials require the development of new technologies that ensure maximum phosphorus extraction with minimal energy and chemical costs. One of the promising directions is acid activation, which increases the solubility of phosphorus and enhances its bioavailability in fertilizers.

Features of Low-Activity Phosphate Raw Materials Low-activity phosphate raw materials are characterized by the following features: • Low content of available phosphorus (usually less than 20% P_2O_5). • High content of mineral impurities (calcium, silicon, aluminum) that form poorly soluble compounds. • Structural density and low porosity, which complicate chemical processing.

These properties make standard processing methods (thermal activation or simple grinding) ineffective.

Principles of Acid Activation Acid activation is based on treating phosphate raw materials with strong acids (usually sulfuric or phosphoric acid), which leads to the decomposition of poorly soluble phosphates and the formation of more soluble compounds.

Main chemical reactions:

1. Treatment with sulfuric acid: $Ca_3(PO_4)_2 + 2H_2SO_4 \rightarrow Ca(H_2PO_4)_2 + 2CaSO_4$
2. Treatment with phosphoric acid: $Ca_3(PO_4)_2 + 4H_3PO_4 \rightarrow 3Ca(H_2PO_4)_2$

Advantages of Acid Activation • Increases phosphorus solubility by 2–5 times compared to the initial raw material. • Reduces toxicity and heavy metal content in the finished fertilizer. • Allows the use of local low-activity resources, reducing dependence on imported raw materials. • Provides process flexibility to adjust the final product composition to specific agrochemical requirements. • Reduces raw material losses during processing.

Materials and Methods Raw Materials Low-activity phosphate raw material from the Kyzylkum deposit was used.

Table 1. Chemical composition of the initial phosphate raw material (wt.%)

Component	Content
P_2O_5	18.4
CaO	47.8
MgO	2.5
SiO_2	15.2
Fe_2O_3	3.1

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Others	12.9

Acid Activation The treatment was carried out in a laboratory reactor with temperature and stirring control. Two acids were studied: sulfuric acid (H_2SO_4) and phosphoric acid (H_3PO_4).

Variable parameters: • Acid concentration: 10–30% (vol.) • Processing time: 1–4 hours • Raw material : acid ratio: 1 : 5 (mass/vol.)

After treatment, the material was neutralized with dilute calcium hydroxide solution to pH ~6–7, washed, dried, and sieved.

Effect of Acid Concentration Table 2. Content of available P_2O_5 depending on acid concentration (%)

Acid	**Concentration (%)**	**Available P_2O_5 (%)**
H_2SO_4	10	24.5
H_2SO_4	20	31.2
H_2SO_4	30	30.8
H_3PO_4	10	22.8
H_3PO_4	20	28.4
H_3PO_4	30	28.1

Conclusion: Sulfuric acid at a concentration of 20% provides the greatest increase in available phosphorus.

Technological Process Scheme The modern technology includes the following main stages:

Mining of phosphate ore → Grinding (0.1–0.5 mm) → Acid treatment reactor → Holding/Contact → Gypsum separation → Drying and granulation → Packaging and storage

Environmental and Economic Aspects The technology allows efficient use of low-quality raw materials. It is necessary to consider gypsum utilization, corrosion protection of equipment, and rational acid consumption.

Prospects for Development Further improvements include the use of catalysts, combined activation methods, and utilization of gypsum in construction or agriculture.

Conclusion Acid activation of low-activity phosphate raw materials is an effective method for increasing the yield and bioavailability of phosphorus fertilizers. The technology enables the use of local low-quality phosphates, reduces production costs, and contributes to the sustainable development of agriculture.

When using sulfuric acid, gypsum is formed as a by-product that can be reused. When using phosphoric acid, by-products are minimal, but the cost is higher.

References

1. “Technology of Phosphorus and Complex Fertilizers” N. I. Vorobyov. – Minsk: BSTU, 2015. – 177 p.
2. “Production of Phosphorus-Containing and Potassium Fertilizers” B. A. Dmitrevsky, V. I. Yuryeva. – St. Petersburg: Khimiya, 1993.
3. “Chemistry and Basics of Mineral Fertilizer Technology” (I.A. Petropavlovsky et al.). Prospekt Nauki, St. Petersburg, 2018–2021.
4. Rakhimova O.V. “Technology of Mineral Fertilizers”. Perm National Research Polytechnic University, 2013.