

PHYSICOCHEMICAL ANALYSIS OF NITROCALCIUM PHOSPHATE OBTAINED FROM THE DECOMPOSITION OF PHOSPHORITE

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ABSTRACT

One of the factors accelerating the agro-industrial complex is the effective use of mineral fertilizers utilized in agriculture. An important role in this is played by the development of cost-effective and environmentally friendly technologies for the production of products through the production of a range of mineral fertilizers, the efficient transfer of raw materials from production facilities. It is essential that they are supplied with enough nutrients in order to plants grow and develop within measure.

Nitrogen, phosphorus, potassium, calcium, magnesium, sulfur and iron are the main nutrients. The contribution of this production in plants ranges from one hundred percent to several percent, and they are referred to as macronutrients. In addition, a number of chemical substances such as boron, molybdenum, copper, manganese, zinc and others which are present in one thousandth of a percent in plants and soil are required to plants and they are called micronutrients.

At present, the phosphorite complex is not able to fully supply enterprises with phosphate raw materials. In order to fully meet the demand for phosphorus fertilizers in agriculture of the Republic, it is necessary to create effective methods of obtaining mineral fertilizers using non-industrial phosphorites. Guliob phosphorites are granular species similar to the major phosphorite mines in the African-Arabian region. The 100% R₂O₅ reserves of phosphate raw material consists of 43,5 tons and can meet the demand of the Republic of Uzbekistan for phosphorus fertilizers for more than 100 years [1].

It should be noted that Guliob phosphorites is belong to low-grade ores according to phosphor which is the main component of it. The ore contains large amounts of carbonate compounds (calcium modulus - CaO:P₂O₅ = 2.85), clay minerals and organic matters. In the extraction of Kyzylkum phosphorites, in the determination the phosphorite which is the main component by samosval-radiometric method, phosphorites are divided into several types. Very low-grade ore is a mineralized mass, and also the P₂O₅ quantity of it consists of 10-12%.

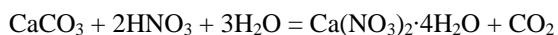
Guliob (Guliob), Auminzatag (Auminzatau), Chukay-Tukay (Chukay-Takay), Khojayli (Khojeyli), Khojakul (Khodjakul), Bolakara (Balakaraskiy), Bukantog (Bukantauskiy) and other agronomic ore mines have been identified. The local low-grade raw materials that mentioned above, differ drastically from each other in terms of chemical composition, structure and properties.

Phosphorus minerals in Guliob phosphorite, located in Sariosiya district of Surkhandarya region, are mainly composed of dallite and diadoxite minerals. The total amount of these minerals in the ore is 31%. The reserve's quantity consists of 551,000 tons of R₂O₅ [1]. Grainy phosphorites are found in black and brown colours. Its phosphorus anhydride content varies from 4.13% to 22.3%. Also, small amounts of MgO, CO₂ and F, SO₃ are found in diadoxite composition, not gypsum.

When natural phosphates decompose with nitric acid, hydrogen fluoride is released into the gas phase. In the case of obtaining complex fertilizers, about 20% of all fluorine in the feed is released into the gas phase.

The processes of decomposition of phosphorites by nitric acid can be conditionally divided into a number of parallel reactions:

- decomposition of carbonates in high-speed phosphate raw materials:



when phosphorite is mixed with nitric acid, it first reacts with carbonic acid;

- decomposition of the phosphate part of the phosphate raw material with the formation of phosphate salts;
- neutralization of free acidity in nitrocalcium phosphate mud – ammoniation with ammonia gases:



Technological processes of nitrocalcium phosphate fertilizer production consist of the following main stages:

- receipt, storage and transportation of phosphate raw materials;
- reception and storage of nitric acid;
- decomposition of phosphorite flour by obtaining nitrocalcium phosphate porridge in unconcentrated nitric acid;
- evaporation of nitrocalcium phosphate porridge;
- neutralization of evaporated porridge with ammonia gas and granulation of neutralized porridge;
- drying of the finished product;
- fractionation of the obtained product and crushing of large fractions;
- absorption of gases formed from the decomposition of phosphate raw materials;
- purification of gases from granulation and drying processes;
- plumbing cleaning;
- packaging and warehousing of the finished product.

We performed radiographic and thermal analyzes to determine the salinity of complex fertilizers formed by the decomposition of guliob phosphorites in the presence of potassium chloride with nitric acid (HNO₃ standard -75 and 100%, P₂O₅: K₂O = 1: 1). X-ray analysis of complex fertilizers on a DRON-0.5 diffractometer with filtered copper radiation, voltage 25 kV, current 8 mA, speed of the meter 2 degrees / min. was held under the same conditions. We identified the diffraction lines by comparing the intensity values of the distances between the peaks of the fertilizer samples and the expected salts. The diffraction lines 5.20; 2.79; 2.45-2.46; 2.03 Å° belong to the four aqueous calcium nitrates. The distance between the peaks is 4.23-4.24; 2.62-2.63 Å° describes the calcium dihydrate hydrothrophosphate in the fertilizer. 3.69-3.70; Diffraction peaks 3.69-3.70; 2.95 Å° prove the presence of calcium hydrate dihydrogen orthophosphate. The distance between diffraction peaks 4.23-4.24; 2.62-2.63 belongs to fluorocarbon apatite, 2.22; 3.14 Å° belongs to potassium chloride. We can say that the diffraction peaks 3.06-3.07; 2.25 and 2.27 Å° belong to ammonium nitrate. Some of the lines overlap with nitrates, phosphates, and other compounds due to the proximity of the distance between the peaks.

The sample (HNO₃ standart-100%, P₂O₅:K₂O =1:1) derivatogram (Figure 1) has been plotted on the Paulik-Erdey derivatogram at 900°C, the weight of the polished sample was 202 mg, the heating rate of TG-200 is 10 degrees / min. [2]. The loss of sample mass at 900°C consists of 60.89%.

The endothermic effects at 100-330°C characterize the loss of adsorption moisture, crystalline water of calcium nitrate and calcium hydrophosphate, and ammonium nitrate. Weak elongation effects between 330 and 400°C characterize the decomposition of SaHPO₄ to pyrophosphate. It indicates the simultaneous conversion of calcium nitrate to nitrite in the most thermoeffect areas of the sample mass.

Extensive thermal effects were observed in the samples at 510–7300C, and they are explained by the polymorphic transformation of the quartz mineral with the simultaneous decomposition of residual carbonates and other minerals.

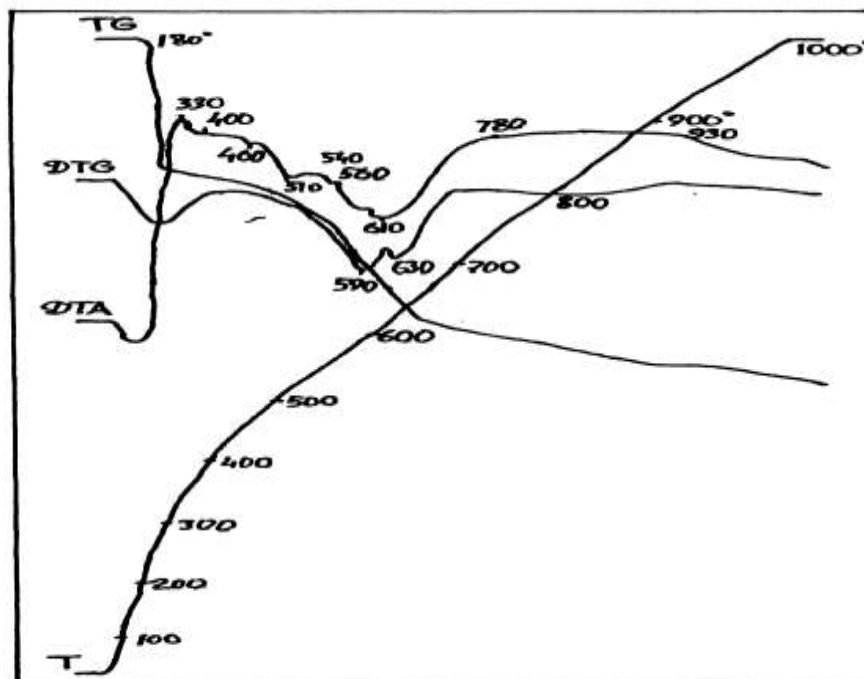


Figure.1. Derivatogram of nitrophosphates that HNO³'s standards are 100%, P₂O₅: K₂O = 1: 1.

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Thus, the results of various methods of research (thermogravimetry and radiography) of complex fertilizers which obtained based on Guliob unenriched phosphorites show that the composition of the fertilizer consists mainly of calcium and ammonium nitrate, calcium dihydrate hydrothorothrophosphate and monophosphate, activated phosphates and potassium chloride.

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