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RHEOLOGICAL PROPERTIES OF POTASSIUM NITROPHOSPHATE FERTILIZER PORRIDGES AT DIFFERENT TEMPERATURES

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Abstract:
Guliob phosphate rock was studied with a nitric acid content of 50 and 75 and 100%, as well as in fertilizers obtained from the ratio of R2O5: K2O = 1:1. The gyroscopic points of the fertilizer size of 2-3 mm were determined at 250 ° C by the desiccator method of N.Ye. Pestov. The points of hygroscopicity of fertilizer samples with an initial moisture content of 1.0% were No. 1 -46.5%, No. 2 - 38.0% and No. 3 - 32.4%.

Keywords: phosphorite, nitric acid, desiccant method, hygroscopicity, NPK fertilizer, sorption.

Farming, cultivation of agricultural crops is one of the important processes in our republic. Nitrogen, phosphorus, and potassium minerals are a necessary source of nutrients for agricultural crops. Identification of potash deposits and production of potash fertilizers in the territory of Dehqonabad district of Kashkadarya region solves the problem of buying this mineral fertilizer from abroad with foreign currency. But this does not solve all the problems. Now we face a more serious problem, how to get a quality product from this raw material that can meet world requirements, as well as the problem of achieving waste-free results without spending excessive labor and electricity. [1].
It indicates that Guliob phosphorites belong to the type of low-grade, high-carbonate, difficult-to-enrich phosphates. Therefore, it is practically impossible to obtain high-concentration phosphorus fertilizers with high technical and economic indicators by means of sulfuric acid extraction without enriching them. World practice shows that nitrogen processing of phosphates is a more efficient and cost-effective method. In the application of this method, nitric acid not only participates in the decomposition of phosphate raw materials, but its anions remain in the product as a necessary component - nitrogen.
It should be noted that the effectiveness of partially decomposed phosphates in our and foreign agricultural practices has been proven to be equal to standard traditional fertilizers - ammophos and ordinary superphosphates.

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Therefore, in our research work, we conducted experiments on obtaining complex fertilizer based on decomposition of Guliob phosphorites in the presence of potassium chloride in an incomplete measure of nitric acid.

It is worth noting that the main component of Guliob phosphorites belongs to low-grade phosphorus ores. The ore contains a large amount of carbonate compounds (calcium modulus - $CaO:P_2O_5$=2.85), clay minerals and organic matter. Phosphorites are divided into several types when determining the concentration of phosphorous, the main component in the mining of Guliob phosphorites, using the dump radiometric method. Very low-grade ore is a mineralized mass with a P_2O_5 content of 10-12% and is currently being thrown away as waste.

It is necessary to enrich Guliob phosphorites in order to obtain a high-concentration phosphorus fertilizer - potassium nitrophosphate. Today, the processing of non-enriched Guliob phosphorites containing 17-19% P2O5 into complex fertilizers with the required content and properties and satisfactory technical and economic indicators remains one of the most urgent problems for chemical science and industry.

The analysis of scientific and technical literature shows that there are many works devoted to the problems of processing Guliob phosphorites into various types of phosphorus-containing complex fertilizers.

It is known that one of the most rapid and promising methods of acid processing of phosphates is decomposition of phosphorites in nitric acid. The advantage of this method is that during the nitric acid processing of phosphorites, the hydrogen ion in it is used to break down the phosphate mineral, while the anion remains in the product as a necessary nutrient component in the form of nitrogen.

There are only a few works devoted to nitric acid decomposition of Guliob phosphorites. In the production of complex fertilizers using known methods, thermo- and chemically enriched phosphorite concentrates and nitric acid are mainly used. Calcium is extracted by freezing to reduce the $CaO:P_2O_5$ ratio in nitric acid solution.

The main drawback of these works is the complexity of the technology, the lack of the third nutrient component potassium, and the use of expensive phosphorite concentrate, which leads to an increase in the cost of fertilizer.

It should be noted that the biological characteristics of agricultural crops and the variety of soil types in Uzbekistan are explained by the need for different proportions of nitrogen, phosphorus and potassium in the assortment of fertilizers. At the same time, when applying 6nitrogen-phosphorus-potassium fertilizers to the soil, the costs of their transportation are reduced.

The technology of obtaining nitrogen-phosphorus-potassium fertilizers based on guliob phosphorites and nitric acid consists of the following stages:

1. Mixing Guliob phosphorites with water in a ratio of f/x: water = 1:0.78.
2. Decomposing the phosphate suspension in nitric acid and ammonizing the resulting acidic solution with gaseous ammonia.
3. Adding potassium chloride to ammoniated porridge.
4. Drying, granulation, grinding and sifting.

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The process of obtaining nitrophoska fertilizer was studied in a laboratory model device under periodic conditions. The volume of the reactor was 300 ml. Based on the results of the laboratory model device, the main technological parameters of the process were developed.
Based on the results of a series of experiments in a laboratory model device, the following main technological parameters of the process of obtaining nitrophosphate fertilizers were proposed:

Temperature of HNO_3 entering the reactor, °C	20-35
Stoichiometric calculation of nitric acid, %	50-120
HNO_3 concentration, %	55-59
Decomposition process temperature, °C	40-50
Duration of the procedure, min.	40-45
Phosphorite: absorbent liquid mass ratios	1 : 0,78-0,8
The temperature of the ammonification process, °C	60-70
The duration of the ammonification process, min.	3-4
Temperature of the drying and granulation process,°C	100-110

The content of NPK-fertilizer

N_{um}, %	8,1 – 19,0
$P_2O_{5\,um}$, %	7,5 – 12,6
$P_2O_{5\,uzl}$, % (by trilon B)	6,2-7,5
$P_2O_{5\,uzl}$, % (on 2% lim. acid)	7,4 – 9,7
CaO_{um}, %	20,2 – 33,7
CaO_{uzl} % (on 2% lim. acid)	19,5 – 27,0
CaO_{water}, %	11,9 – 13,8
K_2O_{um}, %	4,1-11,4

Studying the rheological (density, viscosity) properties of ammoniated potassium nitrophosphate porridges is important to determine their suitability for storage during processing into fertilizers and driving in pipelines. In order to study the physico-chemical properties of nitrophosphate-potassium porridges, the decomposition process of high-carbonate Gulіob phosphorites in nitric acid in the presence of potassium chloride was carried out in a laboratory device. In order to reduce the foaming process, phosphorite decomposition was carried out in the liquid phase mode - the initial phosphorite in the form of a suspension was fed to the reactor in the ratio of phosphorite flour: water = 1:0.5. The amount of phosphorite suspension was charged to the reactor and nitric acid was slowly fed into it. The duration of the procedure has been equal to 40 min. The resulting mixture was ammoniated with gaseous ammonia and a calculated amount of potassium chloride was added.
The density of these porridges was determined by the pycnometric method, and the viscosity was determined by a VPJ-1 capillary viscometer at 20, 40, and 60°C.
The measurement results for potash with nitrophosphate are shown in Table 1 and Table 2. The density of potash with nitrophosphate decreases significantly from 20 to 60°C.

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Table 1 Density of potassium nitrophosphate porridges at different temperatures.

The norm HNO_3	P_2O_5:K_2O	Density at temperatures, g/cm³		
		20°C	40°C	60°C
50	1:1 1:0,7 1:0,5	1,5835 1,5650 1,5541	1,5664 1,5500 1,5342	1,5495 1,5382 1,5104
75	1:1 1:0,7 1:0,5	1,5001 1,4812 1,4651	1,4789 1,4632 1,4492	1,4666 1,4486 1,4350
100	1:1 1:0,7 1:0,5	1,4224 1,4053 1,3922	1,4050 1,3851 1,3760	1,3934 1,3702 1,3621
120	1:1 1:0,7 1:0,5	1,3570 1,3480 1,3373	1,3499 1,3341 1,3211	1,3353 1,3200 1,3072

For example, at rates of 100 and 120% of nitric acid, the density of porridge decreases when the rate of nitric acid increases from 50 to 120% in the ratio P_2O_5:K_2O – 1:0.5. In our opinion, this is explained by the increase in water in the system. At the same time, POTASSIUM NITROPHOSPHATE porridge decreases with increasing temperature at different rates of HNO_3. For example, in the range from 20 to 60°C, the density decreases from 1.4224 to 1.3570 g/cm³. A similar pattern is observed at other temperatures.

Table 2 Viscosity of potassium nitrophosphate porridges at different temperatures.

The norm HNO_3	P_2O_5:K_2O	Viscosity at temperatures, spz		
		20°C	40°C	60°C
50	1:1 1:0,7 1:0,5	75,13 68,80 63,30	49,12 46,65 44,83	43,68 41,12 40,07
75	1:1 1:0,7 1:0,5	50,36 46,72 42,40	37,31 36,22 33,42	35,90 33,19 32,03
100	1:1 1:0,7 1:0,5	33,85 31,02 27,99	24,91 24,04 23,77	23,00 22,85 22,40
120	1:1 1:0,7 1:0,5	26,34 24,31 22,65	16,87 15,64 13,14	14,62 13,55 12,04

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An increase in temperature from 20 to 60° C decreases on average 1.01-1.03 times, depending on the ratio of HNO_3 and P_2O_5:K_2O ratios of sample porridges. Porridge viscosity, like density, decreases by an average of 1.40-1.80 times depending on the temperature rise. The ratio of HNO_3 decreases from 50 to 120% and P_2O_5:K_2O from 1:1 to 1:0.5. Density and viscosity of potassium nitrophosphate porridges mainly depend on temperature, nitric acid ratio and P_2O_5:K_2O ratio.

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