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Rheological Properties of NPK Fertilizer Swamps at Different Temperatures

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Agriculture is one of the most important processes in the country. Nitrogen, phosphorus and potassium minerals are a necessary source of nutrients for agricultural crops. The identification of potassium ores in the territory of Dehkanabad district of Kashkadarya region and the launch of production of potassium fertilizers will solve the problem of purchasing this mineral fertilizer in foreign currency. But this does not solve the whole problem. Now we face a more serious problem, how to get a quality product from this raw material that can meet world standards, as well as to achieve results without waste of labor and electricity. [1].

It should be noted that the main component of Guliob phosphorites belongs to low-grade ores of phosphorus. The ore contains large amounts of carbonate compounds (calcium modulus - CaO: P₂O₅ = 2.85), clay minerals and organic matter. In the extraction of guliob phosphorites, the main component of which is the determination of the concentration of phosphorus by samosval-radiometric method, phosphorites are divided into several varieties. Very low grade ore is a mineralized mass with a P₂O₅ content of 10-12% and is currently discarded as waste..

Guliob phosphorites must be enriched to obtain high-concentration phosphorus fertilizer -NPK. Today, at the Navoi Mining and Metallurgical Combine, the particles of the high-grade part of phosphorite containing 19.5-20.5% and higher P₂O₅ are dried and ground until a certain size, and then classified. Phosphorite is then concentrated to 23-24% P₂O₅ using the dry enrichment method. Phosphorite, enriched by dry method, is sent to the furnace section, where it is fired at a temperature of 850-900 oC. As a result, 85-90% of carbon dioxide is released, and organic matter is completely burned. The amount of phosphorus in the thermoconcentrate formed after the firing process reaches 26-27%, but the CaO: P₂O₅ ratio - remains high (1.90-1.95). Since 2001, the city of Zarafshan, Navoi region, has been operating an incinerator with a capacity of 400,000 tons of thermal concentrate per year. Due to the complexity of the enrichment technology and high heat and energy costs, the cost of phosphorite concentrate, as well as phosphorus fertilizers obtained from it, will increase significantly.

Today, in the eyes of science and industry, the processing of unenriched Guliob phosphorites containing 17-19% P₂O₅ into complex fertilizers with the required composition and properties, satisfactory technical and economic performance remains one of the most pressing issues.

Analysis of the scientific and technical literature shows that there is a lot of work on the problems of processing Guliob phosphorites into complex fertilizers containing different types of phosphorus.

It is known that one of the most intensive and promising methods of acid processing of phosphates is the decomposition of phosphorites in nitric acid. The advantage of this method is that in the processing of phosphorites with nitric acid, the hydrogen ion is used in the decomposition of 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 the decomposition of guliob phosphorites by nitric acid. Thermo- and chemically enriched phosphorite concentrates and nitric acid are mainly used in the production of complex fertilizers using known methods. Nitric acid is separated by freezing of calcium to reduce the ratio of CaO: P₂O₅ in the solution.

The main disadvantages of this work are the complexity of the technology, the lack of a third nutrient component potassium and the use of valuable phosphorite concentrate, which leads to an increase in the cost of fertilizers.

It should be noted that the biological characteristics of agricultural crops and the diversity of soil types in the territory of Uzbekistan are explained by the need for different ratios of nitrogen, phosphorus and potassium in the range of fertilizers. Simultaneous application of nitrogen-phosphorus-potassium fertilizers reduces the cost of their transportation.

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

1. Mixing guliob phosphorites with water in the ratio f/x : water = 1: 0.78.

2. Decomposition of phosphate suspension in nitric acid and ammonization of the resulting acid solution with gaseous ammonia.

3. Add potassium chloride to the ammonium slurry.

4. Drying, granulation, crushing and screening.

The process of obtaining nitrophosphate fertilizer was studied in the laboratory model device under periodic conditions. The reactor capacity was 300 ml. Based on the results of the laboratory model device, the main technological parameters of the process were developed.

Laboratory device Figure.1. It consists of a X1810NT stainless steel cylindrical reactor (3) and a capacity vessel (6) for ammonium nitrocalcium phosphate slurry, an auger distributor (2) and a napor tank for nitric acid (4). Nitric acid (59.0%) flows from the pressure tank (4) to the reactor (3) and is fed simultaneously from the bunker (1) through an auger distributor to the enriched Guliob phosphorite.

The rotational frequency of the mixer in the reactor is controlled using LATR. The rotation speed of the mixer is 250-300 rpm. formed. Nitric acid was administered using a Mariotta (5) vessel. After 40 min, the sour nitrocalcium phosphate slurries were ammoniated with gaseous ammonia to pH 3.7 and 4.0. At the end of the ammonization process, a calculated amount of potassium chloride is given. The resulting nitrate-phosphate mass was dried in a drying oven at 100–1100C until 1–1.5% humidity remained. Fertilizer samples (nitrophosphate) were analyzed for key components

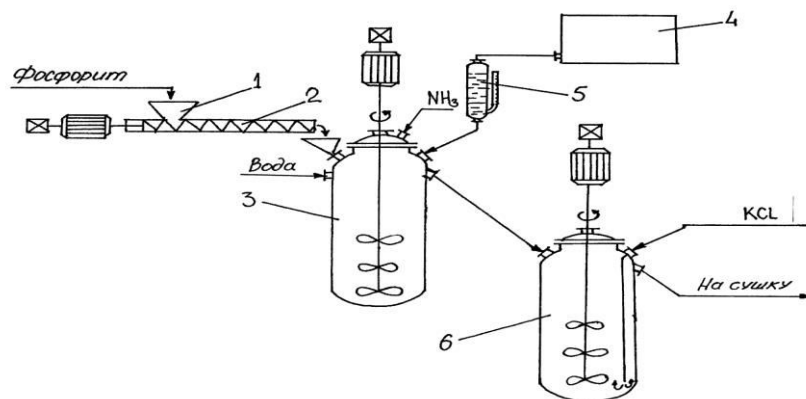


Fig. 1. Laboratory model device for obtaining NPK fertilizer

Based on the results of a series of experiments on the laboratory model device, the following basic technological parameters of the process of obtaining NPK fertilizers were proposed:



The temperature of the HNO ₃ entering the reactor, °C	20-35
In the stoichiometric calculation of nitric acid, %	50-120
NNO ₃ concentration, %	55-59
Decomposition process temperature, °C	40-50
Process duration, min.	40-45
Phosphorite: absorption fluid mass ratios	1 : 0,78-0,8
Temperature of ammonization process, °C	60-70
Duration of ammonization process, min.	3-4
Temperature of drying and granulation process, °C	100-110

The composition of NPK-fertilizer

N _{ym} , %	8,1 – 19,0
P ₂ O _{5ym} , %	7,5 – 12,6
P ₂ O _{5y3n} , % (ontrilon B)	6,2-7,5
P ₂ O _{5y3n} , % (2% lim. onacid)	7,4 – 9,7
CaO _{ym} , %	20,2 – 33,7
CaO _{y3n} , % (2% lim. on acid)	19,5 – 27,0
CaO _{cyb} , %	11,9 – 13,8
K ₂ O _{ym} , %	4,1-11,4

The study of the rheological (density, viscosity) properties of ammonium sludge sludge is important to determine their suitability for storage during processing into fertilizers and driving in pipes. To study the physicochemical properties of NPK swamps, the process of decomposition of high-carbonate Guliob phosphorites in nitric acid in the presence of potassium chloride was carried out in a laboratory device. In order to reduce the foaming process, the decomposition of phosphorites was carried out in the liquid phase mode - in the form of the initial phosphorite suspension, phosphorite flour: water = 1: 0.5 in the reactor. The calculated phosphorite suspension for the reactor was consumed and gradually nitric acid was added to it. The process takes 40 minutes. formed. The resulting slurries were ammonified with gaseous ammonia and the calculated amount of potassium chloride was given.

The density of these slurries was determined by pycnometric method, and the viscosity was determined on the VPJ-1 capillary viscometer at 20, 40, and 60 ° C.

Measurement results for nitrophosphate porridges In Tables 1 and 2, the density of nitrophosphate porridges is significantly reduced from 20 to 600C.

Table 1
Density of nitrophosphate powders at different temperatures.

NormaHNO ₃	P ₂ O ₅ :K ₂ O	Density at temperatures, g / cm ³		
		20 ⁰ C	40 ⁰ C	60 ⁰ C
50	1:1	1,5835	1,5664	1,5495
	1:0,7	1,5650	1,5500	1,5382
	1:0,5	1,5541	1,5342	1,5104
75	1:1	1,5001	1,4789	1,4666
	1:0,7	1,4812	1,4632	1,4486
	1:0,5	1,4651	1,4492	1,4350



100	1:1	1,4224	1,4050	1,3934
	1:0,7	1,4053	1,3851	1,3702
	1:0,5	1,3922	1,3760	1,3621
120	1:1	1,3570	1,3499	1,3353
	1:0,7	1,3480	1,3341	1,3200
	1:0,5	1,3373	1,3211	1,3072

For example, at 100 and 120% levels of nitric acid in the ratio $R_2O_5: K_2O - 1: 0.5$, the density of the slurry decreases when the level of nitric acid increases from 50 to 120%. This, in our opinion, is explained by the increase in water in the system. Simultaneously, NPK-containing porridges decrease with increasing temperature at different rates of HNO_3 . For example, in the range of 20 to 600S, the density decreases from 1.4224 to 1.3570 g / cm³. A similar pattern is observed at other temperatures.

Table 2

Viscosity of NPK slurries at different temperatures.

HNO ₃ norm	P ₂ O ₅ :K ₂ O	Viscosity at temperatures, spz		
		20 ⁰ C	40 ⁰ C	60 ⁰ C
50	1:1	75,13	49,12	43,68
	1:0,7	68,80	46,65	41,12
	1:0,5	63,30	44,83	40,07
75	1:1	50,36	37,31	35,90
	1:0,7	46,72	36,22	33,19
	1:0,5	42,40	33,42	32,03
100	1:1	33,85	24,91	23,00
	1:0,7	31,02	24,04	22,85
	1:0,5	27,99	23,77	22,40
120	1:1	26,34	16,87	14,62
	1:0,7	24,31	15,64	13,55
	1:0,5	22,65	13,14	12,04

An increase in temperature from 20 to 600C results in an average decrease of 1.01–1.03 times, depending on the HNO₃ norm and the $R_2O_5: K_2O$ ratios of the sample slurries. The viscosity of the slurries decreases with an average temperature increase of 1.40-1.80 times depending on the conditions, such as density, the norm of HNO₃ decreases from 50 to 120% and $R_2O_5: K_2O$ from 1: 1 to 1: 0.5. The density and viscosity of nitrophosphate porridges depend mainly on temperature, nitric acid content and $P_2O_5: K_2O$ ratio.



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