TEXNIKA VA TEXNOLOGIYA

OBTAINING SLOW-ACTING FERTILIZERS BASED ON LOW-SORT PHOSPHORITES AND CAS SOLUTIONS

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Abstract. *The article presents the results of research on obtaining slow-acting complex fertilizers from the phosphate meal and the mineralized mass of the Tashkur and Central Kyzylkum phosphorites. It has been shown that when they are treated with an incomplete acid norm for the formation of dicalcium phosphate, and the nitric acid pulp is neutralized with gaseous ammonia to a pH of 5-5.5, a precipitate containing 78-87% P_2O_5 is formed in a usable form at a 57% nitric acid norm of 70-90%. Optimal technological regimes for obtaining complex NR-fertilizers by mixing the precipitates with a CAS solution have been established.*

Аннотация. *В статье приводятся результаты исследований получения сложных медленно действующих удобрений из фосмуки и минерализованной массы фосфоритов Ташкура Центральных Кызылкумов. Показано, что при их обработки не полной норме кислоты на образование дикальцийфосфата, нейтрализации азотнокислотной пульпы газообразным аммиаком до pH 5-5,5 образуются осадки, содержащие 78-87% P_2O_5 в усвояемой форме при норме 57% азотной кислоты 70-90%. Установлены оптимальные нормы технологического режима получения сложных NP-удобрений путем смешения осадков с раствором КАС.*

Аннотация. *Мақолада Марказий Қизилқум Тошқўрғон фосфоритларининг фосфорит уни ва минераллашган массасидан секин таъсир этувчи мураккаб ўғитлар олиш бўйича олиб борилган тадқиқотлар натижалари келтирилган. Уларга кислотанинг тўлиқ бўлмаган меъёрида ишлов берилганда дикалсийфосфат ҳосил бўлиши, нитрат кислотали бўтқани газсимон аммиак билан pH 5-5,5 гача нейтралланганда таркибида ўзлашувчан шаклда 78-87% P_2O_5 бўлган чўкмалар ҳосил бўлиши, нитрат кислотанинг 57% меъёрида 70-90% бўлиши кўрсатилган. Чўкмаларни КАС эритмаси билан аралаштириш орқали мураккаб NP-ўғитлар олиш технологик режимининг мақбул меъёрлари аниқланди.*

Keywords: *phosphate flour, mineralized mass, nitric acid, ammonia, carbamide, precipitate, complex fertilizers.*

Ключевые слова: *фосмука, минерализованная масса, азотная кислота, аммиак, карбамид, преципитат, сложные удобрения.*

Калит сўзлар: *фосфорит уни, минераллашган масса, нитрат кислота, аммиак, карбамид, претсипитат, мураккаб ўғитлар.*

Introduction. Liquid fertilizers have significant advantages over granulated fertilizers both in production and application. They don't get stuck, don't dust, they pump freely. Moreover, their production does not require the construction of large-capacity units, and the costs of storage, application, and transportation differ significantly, which are significantly lower for liquid fertilizers [1]. Another advantage of liquid fertilizers is that to increase agrochemical efficiency, various additives that help protect plants from insects, weeds, and yield-increasing preparations in the form of physiologically active substances and microelements can be added to their composition [2-4]. Nitrogenous and complex liquid fertilizers are in high demand [5-7]. In Uzbekistan, liquid fertilizers are not produced and used sufficiently. If in developed foreign

countries 90-95% of fertilizers are produced in liquid form (Netherlands, Israel), then in Uzbekistan this indicator does not exceed 1% [8]. Due to the effectiveness of liquid nitrogen-calcium fertilizers in saline soils, various methods of obtaining them using various types of raw materials in the form of calcium-containing nitrogen-fertilizer production waste, beneficiation waste, and low-grade phosphorites, dolomites, have been developed in recent years.

During the processing of phosphorite beneficiation waste - mineralised mass (MM) and phosphorite meal (PM), not only liquid nitrogen-calcium fertilizers but also sediments in the form of fertilizer precipitate are formed. To utilize the precipitate formed during the treatment of phosphorites with nitric acid and subsequent neutralization with gaseous ammonia, separate the phosphate precipitate, and obtain a liquid nitrogen-calcium fertilizer without free nitric acid, studies were conducted on the treatment of FM and MM with incomplete nitric acid.

Objects and methods of research. For the study of obtaining complex slow-acting fertilizers, the products of processing phosphorites of the Central Kyzylkum, obtained with an incomplete norm of nitric acid for the formation of dicalcium phosphate, were used. Phosphate meal of the composition (mass. %): P_2O_5 – 25,47: CaO – 56,03: MgO – 1,29: CO_2 – 2,88: H_2O – 0,21, mineralized mass of the composition (mass. %): P_2O_5 - 14.85: CaO – 47,28: MgO – 0,28: CO_2 – 15,93: H_2O – 0,91 and 57% nitric acid. Chemical analysis of the initial raw materials, intermediate and final products was carried out using known analysis methods.

Results and their discussion. Due to the fact that the precipitates obtained by treating NFS and MM with nitric acid and neutralized with gaseous ammonia to a pH of 5-5,5, pulped twice in water at T:L = 1:1 after drying have practically identical chemical compositions, the degree of decomposition of the phosphate raw material, and the content of assimilable forms P_2O_5 research on obtaining NP-fertilizers was conducted with MM precipitates and solutions of liquid nitrogen fertilizer KAS.

To obtain a complex (NR) fertilizer, the phosphorus-containing precipitate obtained after treatment of MM with nitric acid and repulpation was mixed with a CAS solution in a ratio of N:P_2O_5 from 0,5:1 to 1:0,5. As a phosphorus-containing component, the sediment after treatment of MM with nitric acid at a rate of 60-90% after double repulpation and drying was used. The obtained data are presented in Table 1.

Mixing the MM precipitate obtained by treating it with nitric acid, ammoniating it to a pH of 5-5,5, and spraying it with water, mixing it with carbamide, showed that carbamide has no effect on the change in the chemical composition of the NP-fertilizer and requires additional costs for the preparation of a carbamide solution. Considering this, KAS solutions were used as a nitrogen component, as a ready-made nitrogen fertilizer produced on an industrial scale. Taking this into account, further research was aimed at studying the process of obtaining NP-fertilizer by mixing the sediment after treatment of MM with nitric acid with a mixture of carbamide and ammonium nitrate in the form of nitrogen fertilizer KAS.

Table 1 presents data on the composition of NP-fertilizers obtained at a nitric acid rate of 60-90% and a ratio of N:P_2O_5 from 0,5:1 to 1:0,5.

With an increase in the norm of 57% nitric acid from 60% to 90%, there is a slight increase in the content of nitrogen in fertilizers, the total and assimilable forms of P_2O_5, and a decrease in the total form of CaO.

At a 60% nitric acid norm, with an increase in the N:P_2O_5 ratio from 0,5:1 to 1:0,5, the total nitrogen content is 8,80-21,03%, of which 4,19-6,44% is ammonium nitrogen, 1,67-4,93% is nitrate nitrogen, and 2,93-9,65% is amide nitrogen. At a 70% nitric acid norm, total nitrogen is 9,43-21,90%, ammonium nitrogen 4,88-6,93%, nitrate nitrogen 1,67-5,07%, and amide nitrogen 2,88-9,90%.

Increasing the nitric acid norm to 80% and 90% increases the total nitrogen content to 10,20-22,90% and 11,06-23,95%, respectively.

The content of the general form P_2O_5 increases with an increase in $_{N:P2O5}$ from 17,61-10,52% at a nitric acid norm of 60%, to 18,86-10,95% at a 70% norm, to 20,39-11,45% at a 80%

norm, and to 22,12-11,98% at a 90% norm. At the same time, the content of P_2O_5inc. is 11,97-7,28%, 14,90-8,80%, 18,11-10,36%, and 21,46-11,80%, respectively, at acid norms of 60, 70, 80, and 90%. The degree of decomposition of P_2O_5 with an increase in N:P_2O_5 changes insignificantly. The norm of nitric acid has a more significant influence. At a rate of 60% for MM treatment, the degree of decomposition is 67,97-69,20%, while at a rate of 70% it is 79,00-80,36%, at a rate of 80% it reaches 88,81-91,00%, and at a rate of 90% it is 97,01-99,00%.

Table 1

Influence of the nitric acid norm and the ratio N:P2O5 on the chemical composition of NP-fertilizer when mixing MM decomposition precipitate with CAS

N:P_2O_5	N, %				P_2O_5, %			CaO, %			CO_2, %	H_2O, %	(P_2O_5 P_2O_{5um} *100,
	general.	mm.	nitrate.	amide.	general.	assim.	water	general.	conv.	water			
at a rate of 60%													
0.5:1	8.80	4.19	1.67	2.93	17.61	11.97	-	31.07	9.76	0.46	7.30	1.72	67.9
0.7:1	11.31	4.66	2.34	4.30.	16.15	11.02	-	28.50	8.95	0.42	6.70	1.75	68.2
1:1	14.37	5.22	3.16.	5.99	14.37	9.86	-	25.36	7.97	0.37	5.96	1.79	68.6
1:0.7	17.74	5.84	4.06	7.84	12.42	8.56	-	21.92	6.88	0.32	5.15.	1.82	68.9
1:0.5	21.03	6.44	4.93	9.65	10.52	7.28	-	18.55	5.83	0.27	4.36.	1.85	69.2
at a norm of 70%													
0.5:1	9.43	4.88	1.67	2.88	18.86	14.90	-	29.04	12.06	0.45	5.89	1.84	79.0
0.7:1	12.04	5.31	2.38	4.35.	17.20	13.63	-	26.49	11.00	0.41	5.37	1.85	79.2
1:1	15.20	5.83	3.24.	6.13	15.20	12.10	-	23.40	9.72	0.36	4.74	1.88	79.6
1:0.7	18.62	6.39	4.17	8.05	13.03	10.29	-	20.06	8.33	0.31	4.07	1.92	79.0
1:0.5	21.90	6.93	5.07	9.90	10.95	8.80	-	16.86	7.00	0.26	3.42.	1.94	80.3
at a norm of 80%													
0.5:1	10.20	5.79	1.63	2.78	20.39	18.11	0.19	26.79	14.49	0.56	4.24.	1.85	88.8
0.7:1	12.93	6.16	2.40	4.37.	18.47	16.47	0.18	24.26	13.13	0.51	3.84	1.88	89.1
1:1	16.18	6.61	3.32.	6.26	16.18	14.50	0.15	21.25	11.50	0.44	3.36.	1.90	89.6
1:0.7	19.64	7.09	4.29.	8.27	13.75	12.39	0.13	18.05	9.77	0.38	2.86	1.92	90.1
1:0.5	22.90	7.54	5.20	10.17	11.45	10.36	0.11	15.04	8.14	0.31	2.38	1.94	91.0
at a rate of 90%													
0.5:1	11.06	6.79	1.59	2.68	22.12	21.46	0.31	24.08	21.35	0.63	2.29	1.87	97.0
0.7:1	13.91	7.09	2.42	4.4	19.88	19.34	0.28	21.64	19.19	0.56	2.06	1.89	98.0
1:1	17.25	7.45	3.40.	6.41	17.25	16.85	0.24	18.78	16.65	0.49	1.79	1.91	98.0
1:0.7	20.73	7.82	4.41	8.51	14.51	14.24	0.21	15.80	14.01	0.41	1.50	1.93	98.1
1:0.5	23.95	8.16	5.35	10.44	11.98	11.80	0.17	13.04	11.56	0.34	1.24	1.95	99.0

The CaO $content_{total}$. With an increase in N:P_2O_5 and the nitric acid norm, it decreases from 31,07% to 18,55% at a 60% acid norm, from 29,04% to 16,86% at a 70% nitric acid norm, from 26,79% to 15,04% at a 80% norm, and from 24,08% to 13,04% at a 90% norm.

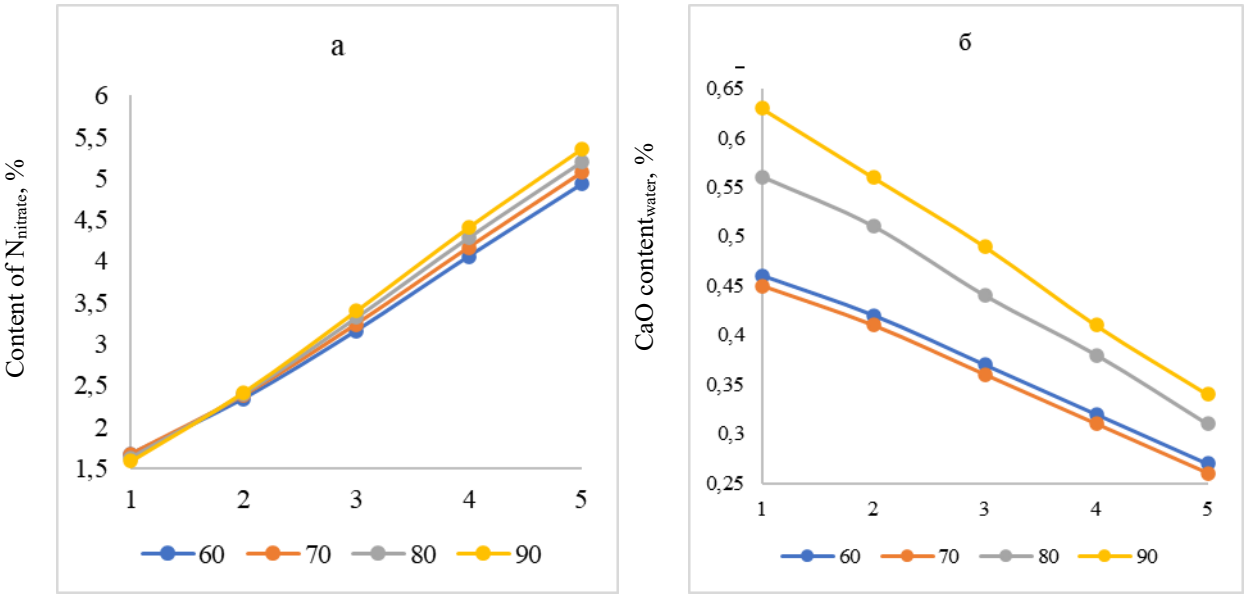

Figure 1. Influence of nitric acid norm and N:P_2O_5 ratio on nitrate nitrogen content - a and water-soluble calcium - b

The results of the influence of nitric acid norms and the N:P_2O_5 ratio on the content of nitrate nitrogen ($N_{nitr.}$) and water-soluble calcium (CaO_{water}) in complex nitrogen-phosphorus (NR) fertilizers are presented in Figure 1. The figure shows that with an increase in N:P_2O_5 or the proportion of KAS in NP-fertilizer, the nitrate form of nitrogen increases, while the water-soluble form of CaO decreases.

It should be noted that the main part of calcium in water-soluble form in fertilizers is calcium nitrate. The low content of water-soluble calcium in the fertilizer composition indicates that 94-98% of calcium nitrate is removed from the solution during filtration. Figure 1 shows that the nitrate form of nitrogen varies from 2,50 to 6,50% depending on the nitrogen-phosphorus ratio. The amount of water-soluble calcium varies from 0,2 to 0,7%. This guarantees a low calcium nitrate content in the fertilizer and does not cause difficulties in drying and storage processes.

Conclusions. Thus, based on the conducted research, the possibility of obtaining slow-acting precipitates from phosphate raw materials of the Central Kyzylkum containing 78-87% of the assimilable form of phosphorus, suitable for obtaining complex nitrogen-phosphorus fertilizers by mixing with a CAS solution, has been established. The optimal rate for treating the phosphate concentrate is 70%-57% nitric acid, and the ratio of N:P_2O_5 when mixed with a CAS solution 1 (0.5-0.7).

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