

DETERMINATION OF THE PHYSICO-CHEMICAL AND COMMERCIAL PROPERTIES OF A NEW TYPE OF PREPARED GRANULAR NITROGEN-SULFUR FERTILIZERS.

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The increasing per capita population and the reduction in the area under agricultural crops in the world are intensifying the problem of food security. Providing the population with high-quality food and clothing is a priority task of agriculture in each country. In this regard, the production of mineral fertilizers, which are widely used in increasing the productivity of all types of agricultural crops, is of particular importance.

The main commercial properties of the grains of samples of modified AS with the addition of $(NH_4)_2SO_4$ and NS-fertilizers obtained on the basis of nitrate, ammonium sulfate and urea, were determined using standard methods: grain strength, stickiness, porosity and diesel oil absorption.

From the data presented, it was found that with an increase in the mass fraction of modifiers added to the AS slurry in the studied ratios, the commercial properties of NS-fertilizer grains improve compared to AS.

Table 1

Main product properties of non-sticky ammonium nitrate samples with ammonium sulfate addition

NH_4NO_3 : $(NH_4)_2SO_4$	Grain strength, MPa	Grain viscosity, kg/cm2	Grain porosity, %	Grains absorb diesel oil, g
"Pure" NH_4NO_3	1,32	5,62	22,0	4,82
Magnesite-based AC	1,58	4,67	9,10	4,33
99,5 : 0,5	2,31	2,21	8,76	4,25
99,0: 1,0	2,79	2,05	8,53	4,17
98,0: 2,0	3,45	1,90	8,34	4,11
97,0: 3,0	4,03	1,84	8,20	4,06
96,0: 4,0	4,60	1,66	8,02	4,03
95,0 : 5,0	5,17	1,53	7,81	3,94

For example, the strength of the grains of modified AC samples with the addition of $(NH_4)_2SO_4$ obtained in the ratio NH_4NO_3 : $(NH_4)_2SO_4$ = (99.5-95) : (0.5-5) increased from 2.31 to 5.17 MPa, while the viscosity, porosity, and diesel oil absorption decreased from 2.21 to 1.53 kg/cm2, from 8.76 to 7.81%, and from 4.25 to 3.94 grams, respectively. These values indicate a 3-fold increase in strength and a 2.5-3-fold decrease in viscosity and porosity compared to "pure" NH_4NO_3 grains.

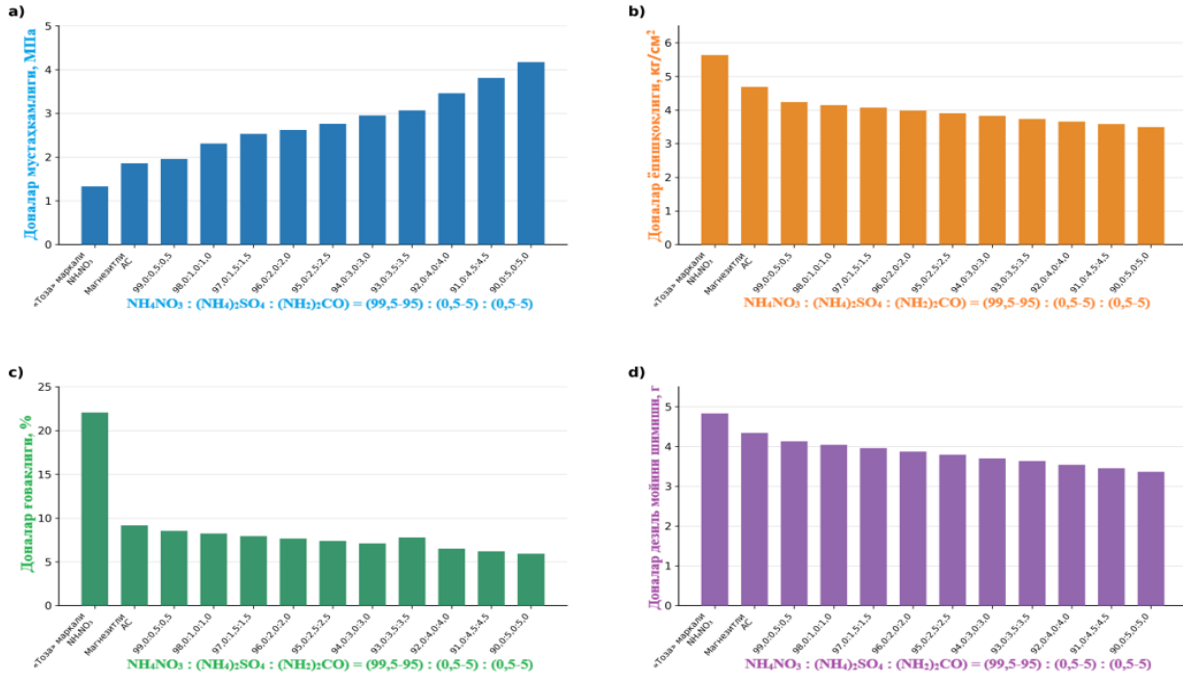


Figure 1. Grain strength (a), stickiness (b), porosity (c) and diesel fuel absorption (d) of samples of NS fertilizers based on AC liquid, ammonium sulfate and urea

It was determined that for NS-fertilizer samples—composed of NH_4NO_3, $(NH_4)_2SO_4$, and $(NH_2)_2CO$ in ratios ranging from (99.5–95) : (0.5–5) : (0.5–5)—the granule strength increases from 1.95 to 4.16 MPa. Simultaneously, granule adhesiveness, porosity, and absorption capacity decrease: adhesiveness from 4.22 to 3.48 kg/cm², porosity from 8.48% to 5.86%, and absorption capacity from 4.12 to 3.35 grams. Compared to magnesite-modified ammonium nitrate (AN) granules, these

samples exhibit, on average, double the strength, while their adhesiveness and porosity are reduced by a factor of up to 1.5.

Key commercial properties of the granules—such as strength, adhesiveness, porosity, and diesel oil absorption—for both $(NH_4)_2SO_4$-modified ammonium nitrate and NS-fertilizers derived from ammonium nitrate melt, ammonium sulfate, and urea, are illustrated more clearly in Figure 1. Table 2 presents the results regarding the dissolution kinetics in water for samples of non-caking ammonium nitrate (AN) containing $(NH_4)_2SO_4$, as well as NS-fertilizers prepared using an NH_4NO_3 melt in the presence of $(NH_4)_2SO_4$ and $(NH_2)_2CO$. As shown in Table 3.5, for non-caking AN samples containing $(NH_4)_2SO_4$—with an NH_4NO_3:$(NH_4)_2SO_4$ ratio ranging from (99.5–95):(0.5–5)—the time required for dissolution in water was found to increase from 58 to 69.15 seconds.

Table 2

Indicators of total dissolution rate of AS samples grains without ammonium sulfate additive in water

NH_4NO_3 : $(NH_4)_2SO_4$	Complete solubility of grains in water, seconds					Average indicator
	1	2	3	4	5	
Donor NH_4NO_3	45	47	42	43	46	44,60
Magnesite-based AC	51	42	47	51	43	46,80
99,5 : 0,5	62,0	51,0	63,0	49,0	65,0	58,0
99,0: 1,0	53,5	66,2	62,9	61,0	64,0	61,52
98,0: 2,0	67,9	63,4	69,2	70,4	58,5	65,88
97,0: 3,0	61,0	65,0	62,9	74,5	71,3	66,94
96,0: 4,0	67,5	68,0	66,7	70,5	67,3	68,0
95,0 : 5,0	72,0	66,8	68,6	70,7	67,65	69,15

It was found that the rate of dissolution of NS-fertilizer samples prepared in the ratio NH_4NO_3 : $(NH_4)_2SO_4$: $(NH_2)_2CO$) = (99.5-95) : (0.5-5) : (0.5-5) increases from 65.31 to 91.25 seconds.

Used literature

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Зиёев Б.Т., Набиев А.А., Тохирова Н., Маматалиев А.А., Намазов Ш.С., Granulated nitrogen-sulfur fertilizers // UNIVERSUM ТЕХНИЧЕСКИЕ НАУКИ Выпуск: 12 (117) Декабрь 2023 Часть 9 DOI 10.32743/UniTech.2023.117.12

Зиёев Б.Т., Набиев А.А., Исоков Ю.Х., Алижонов У.Н. Нитратли мураккаб ўғит олиш технологияси ва қўлланилиши. // Сборник научнқх трудов международ ного форума Нукус 2023., 5-6 март 168-169с. ISBN 978-9943-374-68-3