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STUDY OF THE PROCESS OF OBTAINING CALCIUM NITRATE - PRODUCTS OF NITRIC ACID DECOMPOSITION OF CALCIUM-CONTAINING SLUDGE

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Introduction. It is known that calcium nitrate is an effective nitrogen fertilizer that provides high yields in all climatic and soil conditions. The effect of the application of calcium nitrate can be directly related to nitrate nitrogen and calcium in water, either separately, or in most cases as a combined action of these two nutrients.

When calcium nitrate is obtained by decomposition of calcium-containing sludge from the water treatment plant of Farg'onaazot JSC with non-concentrated nitric acid (at least 57% HNO3), intensive, stable foaming is observed, which leads to a decrease in equipment productivity. When developing a technology for obtaining new types of suspended fertilizers based on calcium nitrate, the process of foaming during nitric acid processing of calcium-containing sludge was studied.

Objects and methods of research. To study the foaming process, calcium-containing sludge was decomposed with nitric acid in a liter cylinder with constant stirring. The height of the foam and the time of complete disappearance of the foam were determined. The foam ratio Kp during nitric acid processing of raw materials was determined as the ratio of the total height of the pulp and foam to the height of the pulp according to the formula:

$$K_{П} = \frac{(h_{П} + h_{Ж})}{h_{Ж}}$$

$h_п$ – foam height, мм;

$h_ж$ – liquid phase height in mm. [1, 2].

The process of nitric acid decomposition of sludge was studied depending on the rate of nitric acid. Table 1 shows the results of a chemical analysis of a solution of calcium nitrate sludge (NCS), i.e. obtained nitric acid pulps of calcium-containing sludge.

For the synthesis of suspended complex fertilizers (SSU), with different ratios of nutrients, it is necessary to prepare a basic suspension. The basic suspension was obtained by dissolving at a temperature of 70-80 ° C and constant stirring of ammophos granules in a solution of calcium nitrate sludge. The water content in all compositions of the base suspension

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was 40% H2O. Table 2 shows the chemical composition of the base suspension depending on the ratio of calcium nitrate sludge and ammophos. Ammophos granules completely dissolve within 2-4 hours.

To obtain a high-quality suspended complex NP fertilizer, ammonium nitrate was dissolved in the base suspension of ammophos. Tables 3-4 show the chemical and salt compositions, as well as the rheological properties of the SSU, depending on the technological parameters. The process of dissolution of ammonium nitrate was carried out at a temperature of 70-90 ° C with constant stirring for 1-2 hours. The resulting SSU was cooled to room temperature with constant stirring of the mass. Thisresultsintheformationofsmallcrystals.

Chemical analysis, determination of moisture content, content of all forms of nitrogen, phosphorus, potassium, calcium in the obtained complex fertilizers are described in detail in [3-19].

RESULT AND DISCUSSION

The study of the foaming process during nitric acid decomposition of sludge showed that the foam ratio increases with an increase in the rate of nitric acid. This is due to the maximum rate of decomposition of the carbonate part of the samples. The ratio of foam, depending on the norm of the acid, is 5.83 -6.50, the life of the foam is 10-20 seconds.

It has been established that at 100% of the norm of nitric acid, a suspension of calcium nitrate is obtained, containing 9.51% nitrogen, 17.90% calcium (CaO), 0.79% magnesium (MgO), 44.38% water. The calcium nitrate slurry of the slurry mainly consists of 52.42% calcium nitrate, 2.92% magnesium nitrate and 44.38% water (Table 1).

Table 1 - Chemical composition of the suspension of calcium nitrate sludge depending on the rate of nitric acid, %

Acidrate	N	CaO	MgO	$Ca(NO_3)_2$	$Mg(NO_3)_2$	H_2O	CO_2
85	8,08	19,68	0,88	44,56	2,48	42,27	2,46
90	8,55	19,08	0,85	47,18	2,63	43,00	1,59
95	9,03	18,47	0,82	49,80	2,78	43,58	0,77
100	9,51	17,90	0,79	52,42	2,92	44,38	-

The basic suspension at a ratio of NKSh:ammophos 4:1 contains 8.93% nitrogen, 8.18% phosphorus (P2O5), 13.32% calcium (CaO). With an increase in the content of ammophos in the NCS solution, the content of phosphorus increases (table 2).

Table 2 - Chemical composition of the base suspension based on calcium nitrate sludge and ammophos, %

№	Ratio NCS:ammophos	N	P_2O_5	CaO	MgO	H_2O	$Ca(NO_3)_2$	$Mg(NO_3)_2$
1	4:1	8,93	8,18	13,32	0,58	40	39,01	2,17
2	2:1	8,24	12,49	10,16	0,44	40	29,78	1,65

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3	4:3	7,81	15,15	8,22	0,36	40	24,07	1,34
4	1:1	7,52	16,96	6,90	0,30	40	20,21	1,12

The basic suspension of ammophos at a ratio of the initial component 1:1 contains 7.52% nitrogen, 16.96% phosphorus and 6.90% calcium.

Table 3 - Chemical composition of a complex suspended NP fertilizer based on a basic suspension of ammophos and ammonium nitrate, %

N: P_2O_5	N	P_2O_5	CaO	MgO	H_2O
At a ratio of NKSH: Ammophos4:1					
1:1	8,93	8,18	13,32	0,58	40
2:1	11,99	5,99	9,76	0,43	40
3:1	13,90	4,63	7,54	0,33	40
At a ratio of NKSH: Ammophos=2:1					
1:1	10,34	10,34	8,41	0,37	40
2:1	13,72	6,86	5,58	0,24	40
3:1	15,40	5,13	4,17	0,18	40
At a ratio of NKSH: Ammophos=4:3					
1:1	11,14	11,14	6,04	0,27	40
2:1	14,42	7,21	3,91	0,17	40
3:1	16,00	5,33	2,89	0,13	40
At a ratio of NKSH: Ammophos=1:1					
1:1	11,59	11,59	4,71	0,20	40
2:1	14,78	7,39	3,00	0,13	40
3:1	16,27	5,42	2,20	0,09	40
1:2	8,10	16,20	6,60	0,29	40

It has been established that when obtaining SSU N : P2O5 = 1:1 from the basic suspension of NKSh: ammophos 4:1, ammonium nitrate is not introduced into the system.

SSU mainly consists of calcium and magnesium nitrates, and ammophos. It contains 8.93% nitrogen in the nitrate form. SSU with a ratio of N : P2O5 = 2:1 and 3:1 consists of 28.57 and 22.09% calcium, 13.64 and 10.54% ammophos and 16.02 and 26.01% ammonium nitrate, respectively. In this and other SSUs, nitrogen is in the ammonium and nitrate forms.

Table 4 - Salt composition of a complex suspended NP fertilizer based on a basic suspension of ammophos and ammonium nitrate.

N: P_2O_5	H_2O	$Ca(NO_3)_2$	$Mg(NO_3)_2$	NH_4NO_3	Аммофос
At a ratio of NKSH: Ammophos=4:1					
1:1	40	39,01	2,17	-	18,60
2:1	40	28,59	1,59	16,02	13,64
3:1	40	22,09	1,23	26,01	10,54
At a ratio of NKSH: Ammophos=2:1					

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1:1	40	24,63	1,37	15,59	10,34
2:1	40	16,35	0,91	23,50	27,05
3:1	40	12,23	0,68	35,34	11,67
At a ratio of NKSH: Ammophos=4:3					
1:1	40	17,70	0,99	15,88	25,33
2:1	40	11,45	0,64	31,47	16,38
3:1	40	8,47	0,47	38,98	12,12
At a ratio of NKSH: Ammophos=1:1					
1:1	40	13,81	0,7	18,98	26,35
2:1	40	8,81	0,49	33,84	16,80
3:1	40	6,46	0,36	40,80	12,33
1:2	40	19,31	1,07	2,69	36,84

SSA obtained from the basic suspension of ammophos (ratio of initial components 2:1), depending on the ratio of nutrients N : P2O5 from 1:1 to 3: 1, contains 10.34-15.40% nitrogen in the form of calcium nitrates (24, 63-12.23%), magnesium (1.37-0.68%) and ammonium (23.50-35.34%), 10.34-5.13% phosphorus in the form of ammophos (10.34-11 .67%). The sum of nutrients in SSU (N+P2O5+CaO+MgO) depending on the ratio N : P2O5 1:1-3:1 is 24.88-29.46%.

SSU from the basic suspension 4:3 and 1:1, depending on the ratio of nutrients, mainly consists of 17.70-11.45% and 13.81-19.31% calcium nitrate, 0.99-0.47% and 0.76-1.07% magnesium nitrate, 15.88-38.98% and 18.98-40.80% ammonium nitrate and 25.33-12.12% and 12.33-36.84% ammophos, respectively . Thesumofnutrientsis 24.35-28.59 and 23.98-31.19% respectively.

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