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Technology of Complex Processing of Washed Burnt Concentrate of Central Kyzylkums with Nitric Acid

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ABSTRACT: The results of studies of the decomposition of washed burnt phosconcentrate of Central Kyzylkums with nitric acid at a rate of 80-120%, the ratio S:L = 1:2.5-3.3, temperature 40ºC and duration of the process 40 minutes are presented. After decomposition, the nitrocalcium phosphate pulps are divided into solid and liquid phases. The results show that, with an increase in the norm of nitric acid, the content in the nitric acid extract is $CaO_{gener.}$ and P_2O_{5gener}. the dried precipitation of products is significantly reduced, and the liquid phases, on the contrary, increase. This means that with an increase in the rate of HNO_3 in the nitrocalcium phosphate pulp, the content of calcium nitrate and monocalcium phosphate increases, which pass into the liquid phase.

I. INTRODUCTION

The production of mineral fertilizers is a large and steadily developing sector of the chemical complex of Uzbekistan. The production of nitrogen, phosphorus and potash fertilizers has become one of the key areas of the domestic economy, and these products are an important export commodity. The organization of the production of complex fertilizers is an urgent task for the chemical industry of the republic. The use of complex phosphorus-containing fertilizers on a large scale for the production of agricultural products necessitates minimal costs for their production, transportation, storage and application to the soil. The low consumption of the acid used, the full use of raw materials and the intensive implementation of the process are conditions for low production costs and capital investments, and the high quality of the products obtained (minimal or almost complete absence of ballast) determines the cost-effectiveness of their transportation and application to the soil.

II. LITERATURE SURVEY

The most common currently is the sulfuric acid method of processing natural phosphates. By processing phosphate raw materials with sulfuric acid taken in an amount corresponding to the formation of monocalcium phosphate, a simple superphosphate is obtained [1, 2]. The main disadvantage of this fertilizer is that due to the large amount of phosphogypsum in the product, the content of phosphorus pentoxide in superphosphate, depending on the quality of phosphorite, does not exceed 12-19.5%. Currently, sulfuric acid is an acutely scarce raw material in many countries of the world. In the production of double superphosphate, a twofold decomposition of natural phosphorite is required: part of it is decomposed with sulfuric acid to obtain extraction phosphoric acid (EPA), the other part – EPA to obtain the finished product. The double superphosphate contains up to 40-55% of the assimilable P_2O_5, depending on the quality of the raw materials. The disadvantages of the technology of this fertilizer are the huge consumption of scarce sulfuric acid and the presence of a number of technological difficulties that strictly limit the volume of production. Direct neutralization of EPA with ammonia produces ammophos consisting of monoammonium phosphate and partially diammonium phosphate [2]. When phosphoric and nitric acids are treated together with ammonia, balanced fertilizers with a ratio of $N:P_2O_5$ = 1:1 (nitroammophos) or with the ratio $N:P_2O_5:K_2O$ = 1:1:1 (nitroammophosphate,

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Vol. 9, Issue 8 , August 2022

diammonitrophosphate) [3]. Although the above methods [3, 4] produce the best quality products containing about 55% of nutrients, nevertheless, these processes are not very rational due to the fact that the chemical energy of nitric and phosphoric acids is not used for the decomposition of phosphorite. This in turn leads to a significant increase in the cost of 1 ton of P_2O_5 in the finished product.

In this regard, methods of production of one-sided and complex fertilizers by decomposition of phosphates with nitric acid are attracting increasing attention. The advantage of nitric acid decomposition of phosphorites is that the acid cation decomposes phosphorite, and its nitrate anion remains in the composition of fertilizers, increasing the nitrogen content in it. Technologies have been developed for obtaining nitrogen-phosphorus and nitrogen fertilizers by decomposing various types of phosphorites and apatites with nitric acid [5-8]. Also, earlier [9, 10] we studied the kinetics of decomposition of various types of phosphorites of Central Kyzylkums – unenforced phosphate raw materials, washed dried concentrate and pulverized fraction with nitric acid at a rate of 100-125%, a concentration of 55%, a temperature of 50℃ and a process duration of 25 minutes [11]. It is shown that with an increase in the norm of nitric acid, the content of CaO, P_2O_5 and R_2O_3 in the nitric acid extract decreases significantly and, depending on the phosphate raw materials, the content of P_2O_5 is 19.82-24.13%, CaO – 6.41-11.61%, R_2O_3 – 0.46-0.93%, u.p. – 3.32-4.98%.

However, the process of complex processing of phosphorites of Central Kyzylkums at wide ranges of nitric acid rates for complex granular and liquid NCA fertilizers has not been sufficiently studied.

III. RESEARCH METHODS

The purpose of this work was to determine the chemical composition, decomposition coefficient and rheological properties of the products obtained by the interaction of washed burnt phosconcentrate (WBPC) of Central Kyzylkums, having a chemical composition, weight. %: P_2O_{5gener} - 26.25; CaO - 51.64; MgO - 0.64; CO_2 - 11.46; Fe_2O_3 - 0.61; Al_2O_3 - 0.84; F- 2.65; SO_3 - 2.36, insoluble residue - 1.18 nitric acid at a rate of 80-120%.

The experiments were carried out as follows: a weighted WBPC was placed in a reactor with a capacity of 1 liter. Then 55% nitric acid was poured there at its rate of 80-120% in terms of CaO, nitrocalcium phosphate pulps with an initial moisture content of more than 30% were prepared. Mass ratio of WBPC:HNO_3 = S:L varied from 1:2.5 to 1:3.3. The phosphate-nitric acid solution was intensively stirred at a constant temperature at a temperature of 40℃ for 40 minutes.

At the same time, both decomposition and activation of phosphate raw materials occur in nitric acid, depending on the stoichiometric norm of the acid reagent. In this process, the following chemical reaction occurs:

$$2Ca_5F(PO_4)_3 + 14HNO_3 + H_2O \rightarrow 7Ca(NO_3)_2 \bullet 4H_2O + 3Ca(H_2PO_4)_2 \bullet H_2O + HF\uparrow + H_2O.$$

To improve filtration after decomposition, formed nitrocalcium phosphate pulps 20 min. defended. At the same time, the main large fraction of up to 80% is deposited and 4-7% of the condensed part is formed. Initially, the liquid part up to 93-96% was poured into a 0.7 l beaker. The composition of acidic nitrocalcium phosphate pulps obtained at different rates of HNO_3 is shown in table 1 and its rheological properties in table 2.

Table 1. - Chemical composition of acidic nitrocalcium phosphate pulps obtained on the basis of decomposition of WBPC by nitric acid

The HNO_3 norm %	S : L	Pulp chemical composition, %								$P_2O_{5assim.}$ / $P_2O_{5gener.}$ by citric acid, %	$P_2O_{5assim.}$ / $P_2O_{5gener.}$ by tr-B, %	$CaO_{assim.}$ / $CaO_{gener.}$ by citric acid, %	$CaO_{water.}$ / $CaO_{gener.}$ %	K decom. %	pH
		$N_{nitr.}$	P_2O_5 gener.	P_2O_5 assim. (citric)	P_2O_5 assim. (tr.B.)	P_2O_5 water	CaO gener.	CaO assim. (citric)	CaO water						
80	1:2,5	5,68	7,49	6,18	5,81	5,79	16,48	14,68	13,79	82,56	77,61	89,05	83,65	71,30	0,628
	1:2,7	5,38	7,03	5,82	5,47	5,44	15,58	13,90	13,06	82,85	77,88	89,19	83,84	72,06	0,653
	1,2;9	5,10	6,72	5,59	5,25	5,31	14,79	13,21	12,43	83,14	78,15	89,33	84,04	73,89	0,675
	1:3,1	4,82	6,39	5,33	5,03	4,96	14,07	12,59	11,85	83,43	78,84	89,47	84,24	74,50	0,692
	1:3,3	4,63	6,09	5,10	4,90	4,74	13,42	12,03	11,33	83,74	80,51	89,61	84,44	74,81	0,705
90	1:2,5	6,49	7,49	6,37	6,05	5,98	16,48	14,90	14,11	85,02	80,76	90,43	85,64	81,95	0,310

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Vol. 9, Issue 8 , August 2022

	1:2,7	6,15	7,08	6,04	5,74	5,66	15,58	14,11	13,38	85,32	81,05	90,57	85,85	83,47	0,326
	1,2;9	5,83	6,72	5,75	5,46	5,38	14,79	13,42	12,73	85,62	81,34	90,71	86,05	84,67	0,338
	1:3,1	5,55	6,39	5,49	5,24	5,12	14,07	12,78	12,14	85,92	81,97	90,85	86,25	85,26	0,345
	1:3,3	5,29	6,09	5,25	5,01	4,00	13,42	12,21	11,60	86,22	82,25	90,99	86,45	85,51	0,347
100	1:2,5	7,22	7,49	6,56	6,29	6,17	16,49	15,14	14,45	87,53	84,03	91,81	87,65	94,05	-0,374
	1:2,7	6,83	7,08	6,22	5,97	5,84	15,59	14,34	13,70	87,84	84,32	91,95	87,86	94,88	-0,204
	1,2;9	6,48	6,72	5,92	5,70	5,55	14,79	13,62	13,03	88,15	84,80	92,09	88,07	95,56	-0,075
	1:3,1	6,16	6,39	5,65	5,45	5,31	14,07	12,98	12,42	88,46	85,28	92,23	88,28	96,02	0,032
	1:3,3	5,88	6,09	5,41	5,22	5,07	13,42	12,40	11,88	88,77	85,66	92,37	88,49	96,25	0,123
110	1:2,5	7,83	7,50	6,76	6,56	6,40	16,52	15,40	14,82	90,11	87,40	93,20	89,71	95,25	-0,413
	1:2,7	7,41	7,10	6,42	6,23	6,07	16,63	15,52	14,96	90,45	87,74	93,34	89,93	95,48	-0,250
	1,2;9	7,03	6,53	5,93	5,75	5,57	14,83	13,86	13,37	90,79	88,07	93,48	90,15	95,75	-0,123
	1:3,1	6,68	6,40	5,83	5,66	5,38	14,10	13,20	12,74	91,13	88,40	93,62	90,37	96,08	-0,036
	1:3,3	6,37	6,10	5,58	5,41	5,23	13,44	12,60	12,18	91,47	88,73	93,76	90,59	96,48	0,029
120	1:2,5	8,60	7,55	7,01	6,83	6,63	16,64	15,74	15,28	92,83	90,51	94,62	91,84	96,28	-0,466
	1:2,7	8,13	7,14	6,65	6,49	6,28	15,73	14,90	14,49	93,19	90,86	94,74	92,09	96,71	-0,301
	1,2;9	7,65	6,72	6,29	6,13	5,92	14,79	90,02	13,66	93,55	91,21	94,88	92,34	96,98	-0,174
	1:3,1	7,33	6,44	6,05	5,90	5,68	14,18	13,47	13,13	93,91	91,56	95,02	92,59	97,15	-0,087
	1:3,3	6,99	6,14	5,79	5,64	5,43	13,52	12,87	12,55	94,28	91,92	95,22	92,84	97,21	-0,036

Table 2 - Rheological properties of acidic nitrocalcium phosphate pulps obtained on the basis of decomposition of WBPC by nitric acid

S : L	Density, (g/sm^3) at temperature, °C				Viscosity, (sPz) at temperature, ° C			
	20	40	60	80	20	40	60	80
The HNO_3 norm - 80%								
1:2,5	1,537	1,514	1,494	1,473	7,217	4,410	3,301	2,887
1:2,7	1,484	1,465	1,448	1,430	5,847	3,813	2,933	2,516
1:2,9	1,430	1,416	1,401	1,387	4,531	3,216	2,566	2,145
1:3,1	1,380	1,370	1,358	1,347	3,688	2,781	2,281	1,870
1:3,3	1,330	1,324	1,314	1,306	2,845	2,345	1,995	1,594
The HNO_3 norm - 90%								
1:2,5	1,551	1,532	1,514	1,497	8,950	4,986	3,405	2,714
1:2,7	1,505	1,489	1,472	1,457	7,377	4,378	3,161	2,535
1:2,9	1,458	1,445	1,430	1,416	5,804	3,769	2,917	2,356
1:3,1	1,415	1,404	1,391	1,378	4,784	3,309	2,708	2,201
1:3,3	1,371	1,363	1,351	1,339	3,764	2,849	2,499	2,045
The HNO_3 norm - 100%								
1:2,5	1,565	1,549	1,534	1,520	10,682	5,561	3,509	2,541
1:2,7	1,526	1,511	1,497	1,483	8,880	4,941	3,389	2,522
1:2,9	1,486	1,473	1,459	1,445	7,077	4,321	3,268	2,503
1:3,1	1,449	1,438	1,424	1,410	5,883	3,839	3,156	2,485
1:3,3	1,411	1,401	1,388	1,374	4,689	3,357	3,044	2,466
The HNO_3 norm - 110%								
1:2,5	1,595	1,578	1,561	1,545	18,142	8,511	5,228	3,642
1:2,7	1,555	1,540	1,523	1,507	15,081	7,562	5,049	3,623
1:2,9	1,514	1,503	1,485	1,469	12,020	6,613	4,869	3,603
1:3,1	1,476	1,468	1,449	1,433	9,992	5,876	4,702	4,584
1:3,3	1,437	1,432	1,412	1,397	7,964	5,138	4,535	3,564
The HNO_3 norm - 120%								

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Vol. 9, Issue 8 , August 2022

1:2,5	1,624	1,606	1,588	1,570	25,602	11,461	6,947	4,743
1:2,7	1,583	1,567	1,549	1,532	21,282	10,181	6,709	4,718
1:2,9	1,542	1,527	1,510	1,493	16,962	8,905	6,470	4,692
1:3,1	1,503	1,490	1,473	1,457	14,101	7,912	6,249	4,645
1:3,3	1,464	1,452	1,435	1,420	11,238	6,918	6,027	4,598

Nitrocalcium phosphate nitric acid extracts formed after decomposition were settled for 20 minutes. In this case, large fractions of insoluble residues are deposited as much as possible within 5 minutes, and small fractions of insoluble residues are slowly deposited. The upper liquid part was drained, and the remaining condensed part of the nitrocalcium phosphate pulp (a large fraction of up to 80% and 4-7% of the condensed part) was filtered through a conventional white ribbon filter paper, placed in a Bunsen flask and a Buechner funnel (Table 3).

Table 3 - The filtration rate of the condensed part of the pulps formed after settling nitrocalcium phosphate nitric acid extracts for 20 minutes

Technological parameter of the decomposition process		Filtration rate of condensed parts of acidic pulps, kg/m^2•h			
The HNO_3 norm, %	S : L	by condensed sludge	by pulp	by draft	by filtrate
100	1 : 2,0	0,82	402,08	180,94	221,14
	1 : 2,5	0,75	410,32	176,44	233,88
	1 : 3,0	0,69	428,65	175,75	252,90
	1 : 3,5	0,64	447,48	174,99	272,49
110	1 : 2,0	0,72	411,66	172,90	239,00
	1 : 2,5	0,67	423,16	169,26	253,90
	1 : 3,0	0,61	434,66	165,17	269,49
	1 : 3,5	0,55	450,64	160,79	289,85

The filtration rate was carried out at 30℃ and a pressure of 0.06 MPa or 450 mmHg. After filtration, the wet precipitate was washed with water and dried at a temperature of 100℃. With an increase in the norm of nitric acid and the ratio S:L, the filtration rate of nitrocalcium phosphate nitric acid extracts increases slightly in pulp and filtrate, and decreases monotonously in sediment.

The dried sediments and the liquid phase of the nitric acid extract were analyzed for the content of the main components according to standard methods.

IV. EXPERIMENTAL RESULTS

The results are summarized in tables 4 and 5.

The data in table 4 show that with an increase in the rate of HNO_3 from 80 to 120% in the obtained samples of NPCa fertilizers, the content of the general form of P_2O_5 and CaO decreases $P_2O_{5gener.}$ from 22.68 to 1.47% and from 25.51 to 19.54%. The digestible forms of P_2O_5 are both citric acid and trilon B solution, as well as a water-soluble form of calcium of more than 72%.

The relative content of the total and digestible form of P_2O_5, CaO by citric acid, and the water-soluble form of CaO within the studied limits of the HNO_3 norms, respectively, ranges from 93.98 to 80.32; from 92.88 to 87.62 and from 85.91 to 77.42%. The mass ratio of WBPC : HNO_3 = from 1 : 2.5 to 1 : 3.3 and depending on the 100% norm of nitric acid, the composition of NPCa fertilizers varies, % weight: $P_2O_{5gener.}$ from 1.59 to 2.20; $P_2O_{5assim.\ by\ citric\ acid}$ from 1.40 to 1.89; $P_2O_{5\ assim.\ by\ tr.B.}$ from 1.12 to 1.71; $P_2O_{5\ water.}$ from 1.33 to 1.79; $CaO_{\ gener.}$ from 21.15 to 22.65; $CaO_{assim.\ by\ citric\ acid.}$ from 19,17 to 20,32; $CaO_{water.}$ from 17.43 to 18.34; N from 0.15 to 0.18 (table 4).

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Vol. 9, Issue 8 , August 2022

Liquid phases of nitrocalcium phosphate pulps (table 5) at stoichiometric norm mainly consist of calcium nitrate, monocalcium phosphate and other related components. P_2O_5. The mass ratio of WBPC : HNO_3 = from 1 : 2.5 to 1 : 3.3 and, depending on the 80% norm of nitric acid in liquid phases, the content of P_2O_5 is total, $P_2O_{5assim.\ by\ citric\ acid.}$, $P_2O_{5\ assim.\ by\ tr.B.}$, P_2O_{5water}, $CaO_{gener.}$, $CaO_{\ assim.\ by\ citric\ acid.}$, $CaO_{water.}$, and $N_{nitr.}$ increase from 4.83 to 5.75%; from 4.17 to 4.90%; from 3.92 to 4.60%; from 3.87 to 4.51%; from 12.48 to 15.18%; from 11.32 to 13.68; from 10.54 to 12.66% and from 5.06 to 5.75, respectively, and depending on the 120% norm of nitric acid, the composition of liquid NPCa fertilizers varies% by weight: $P_2O_{5gener.}$ from 6.01 to 7.35; $P_2O_{5assim.\ by\ citric\ acid}$ from 5.76 to 6.95; $P_2O_{5assim.\ by\ tr.B.}$ from 5.50 to 6.64; $P_2O_{5water.}$ from 5.62 to 6.74; $CaO_{gener.}$ from 13.02 to 15.79; $CaO_{\ assim.\ by\ citric\ acid.}$ from 12.53 to 14.94; $CaO_{water.}$ from 12.30 to 14.71; N from 7.15 to 8.84. This is explained by the fact that with an increase in the rate of HNO_3 in the nitrocalcium phosphate pulp, the content of calcium nitrate and monocalcium phosphate increases, which pass into the liquid phase.

Table 4 - Chemical composition of dried sediments

The HNO_3 norm, %	S : L	Chemical composition of dried sludge, products, %									$\frac{P_2O_{5assim.}}{P_2O_{5gener.}}$ by citric acid, %	$\frac{P_2O_{5assim.}}{P_2O_{5gener.}}$ by tr-B, %	$\frac{CaO_{assim.}}{CaO_{gener.}}$ by citric acid, %	$\frac{CaO_{water.}}{CaO_{gener.}}$, %
		$N_{nitr.}$	P_2O_5 gener.	P_2O_5 assim. (citric)	P_2O_5 assim. (tr.B.)	P_2O_5 water	CaO gener.	CaO assim. (citric)	CaO water	$N_{nitr.}$				
80	1:2,5	0,14	22,68	18,22	16,38	16,80	25,51	22,35	19,75	25,4	80,32	72,23	87,62	77,42
	1:2,7	0,13	23,20	18,75	16,91	17,31	25,92	22,76	20,16	25,0	80,83	72,91	87,82	77,78
	1,2;9	0,13	23,55	19,16	17,30	17,72	26,14	23,01	20,42	24,8	81,34	73,45	88,02	78,12
	1:3,1	0,13	24,26	19,86	17,95	18,39	26,89	23,72	21,10	24,4	81,85	73,99	88,22	78,48
	1:3,3	0,13	24,48	20,16	18,25	18,70	26,94	23,82	21,24	24,4	82,36	74,54	88,42	78,83
90	1:2,5	0,15	15,98	13,24	12,00	12,36	23,85	21,14	18,88	17,2	82,88	75,09	88,62	79,18
	1:2,7	0,15	15,44	12,88	11,67	12,04	23,51	20,89	18,70	16,4	83,40	75,56	88,84	79,53
	1,2;9	0,14	14,98	12,57	11,40	11,77	22,76	20,27	18,18	16,4	83,92	76,11	89,06	79,89
	1:3,1	0,14	14,65	12,37	11,22	11,60	22,34	19,95	17,93	16,4	84,44	76,59	89,28	80,25
	1:3,3	0,14	14,48	12,30	11,15	11,55	21,95	19,65	17,69	16,0	84,96	76,97	89,51	80,61
100	1:2,5	0,18	2,20	1,89	1,71	1,79	22,65	20,32	18,34	8.2	85,96	77,88	89,73	80,97
	1:2,7	0,18	2,00	1,73	1,36	1,64	22,15	19,92	18,01	8.0	86,49	78,45	89,95	81,33
	1,2;9	0,17	1,84	1,60	1,26	1,52	21,86	19,71	17,86	7.6	87,02	78,93	90,17	81,69
	1:3,1	0,16	1,62	1,42	1,13	1,35	21,58	19,51	17,71	7.4	87,55	79,41	90,40	82,05
	1:3,3	0,15	1,59	1,40	1,12	1,33	21,15	19,17	17,43	7.2	88,08	79,89	90,62	82,41
110	1:2,5	0,18	2,05	1,82	1,46	1,74	21,69	19,70	18,00	7,8	88,61	80,37	90,84	83,01
	1:2,7	0,18	1,84	1,64	1,33	1,57	21,18	19,29	17,66	7,6	89,14	80,94	91,07	83,36
	1,2;9	0,17	1,62	1,45	1,18	1,39	20,88	19,06	17,49	7,4	89,67	81,42	91,29	83,71
	1:3,1	0,16	1,62	1,46	1,20	1,40	20,64	18,89	17,35	7,4	90,22	81,92	91,52	84,06
	1:3,3	0,15	1,62	1,47	1,21	1,42	20,98	19,25	17,71	7,2	90,73	82,38	91,75	84,41
120	1:2,5	0,19	1,94	1,78	1,49	1,72	20,61	18,96	17,54	7,2	91,82	83,46	91,97	85,11
	1:2,7	0,19	1,71	1,58	1,44	1,54	20,28	18,70	17,30	7,0	92,36	83,96	92,20	85,31
	1,2;9	0,19	1,47	1,36	1,24	1,32	19,92	18,41	17,03	6,8	92,92	84,46	92,42	85,51
	1:3,1	0,18	1,47	1,37	1,25	1,33	19,78	18,33	16,95	6,8	93,44	84,94	92,65	85,71
	1:3,3	0,17	1,47	1,38	1,26	1,35	19,54	18,15	16,79	6,6	93,98	85,43	92,88	85,91

Table 5. - Chemical composition of liquid phases

The HNO_3 norm, %	S : L	Chemical composition of liquid phases, %								$\frac{P_2O_{5assim.}}{P_2O_{5gener.}}$ by citric acid, %	$\frac{P_2O_{5assim.}}{P_2O_{5gener.}}$ by tr-B, %	$\frac{CaO_{assim.}}{CaO_{gener.}}$ by citric acid, %	$\frac{CaO_{water.}}{CaO_{gener.}}$, %
		$N_{nitrate}$	P_2O_5 gener.	P_2O_5 assim. (citric)	P_2O_5 assim. (tr.B.)	P_2O_5 water	CaO gener.	CaO assim. (citric)	CaO water				
80	1:2,5	5,99	5,75	4,90	4,60	4,51	15,18	13,68	12,66	85,15	80,04	90,14	83,40
	1:2,7	5,63	5,47	4,68	4,39	4,32	14,41	13,01	12,06	85,47	80,32	90,29	83,67
	1,2;9	5,32	5,30	4,55	4,27	4,21	13,75	12,44	11,54	85,79	80,64	90,44	83,94
	1:3,1	5,04	5,06	4,36	4,10	4,04	13,06	11,83	11,00	86,11	80,94	90,59	84,21

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International Journal of Advanced Research in Science, Engineering and Technology
Vol. 9, Issue 8 , August 2022

	1:3,3	4,79	4,83	4,17	3,92	3,87	12,48	11,32	10,54	86,43	81,24	90,74	84,49
90	1:2,5	6,72	6,45	5,64	5,30	5,27	15,32	14,02	13,14	87,44	82,19	91,49	85,77
	1:2,7	6,33	6,18	5,42	5,10	5,07	14,32	13,12	12,32	87,76	82,49	91,64	86,05
	1,2;9	5,98	5,93	5,22	4,91	4,88	13,76	12,63	11,88	88,08	82,80	91,79	86,33
	1:3,1	5,67	5,66	5,00	4,70	4,69	13,04	11,99	11,29	88,40	83,10	91,94	86,61
	1:3,3	5,39	5,40	4,79	4,50	4,50	12,44	11,46	10,81	88,72	83,40	92,09	86,89
100	1:2,5	7,27	7,21	6,48	6,12	6,13	15,68	14,56	13,83	89,82	84,88	92,83	88,18
	1:2,7	6,87	6,86	6,18	6,53	5,85	15,15	14,09	13,40	90,14	95,18	92,98	88,47
	1,2;9	6,50	6,55	5,93	5,60	5,63	14,44	13,45	12,82	90,46	85,48	93,13	88,76
	1:3,1	6,17	6,26	5,68	5,37	5,40	13,74	12,82	12,24	90,78	85,79	93,28	89,05
	1:3,3	5,88	5,97	5,44	5,14	5,18	13,11	12,25	11,71	91,10	86,09	93,43	89,34
110	1:2,5	7,99	7,29	6,72	6,38	6,43	15,71	14,80	14,24	92,16	87,55	94,18	90,63
	1:2,7	7,55	6,90	6,38	6,06	6,11	14,96	14,11	13,60	92,50	87,88	94,33	90,93
	1,2;9	7,12	6,56	6,09	5,79	5,85	14,18	13,40	12,94	92,85	88,21	94,48	91,23
	1:3,1	6,79	6,25	5,83	5,53	5,60	13,52	12,79	12,37	93,20	88,54	94,63	91,53
	1:3,3	6,44	5,97	5,58	5,31	5,37	12,94	12,26	11,88	93,55	88,87	94,78	91,83
120	1:2,5	8,84	7,35	6,95	6,64	6,74	15,79	14,94	14,71	94,61	90,35	95,53	93,13
	1:2,7	8,35	6,98	6,63	6,33	6,44	15,04	14,39	14,05	94,97	90,69	95,68	93,44
	1,2;9	7,91	6,63	6,32	6,04	6,15	14,26	13,67	13,37	95,33	91,04	95,84	93,75
	1:3,1	7,52	6,31	6,04	5,77	5,89	13,61	13,07	12,80	95,69	91,38	96,05	94,06
	1:3,3	7,15	6,01	5,76	5,50	5,62	13,02	12,53	12,30	95,88	91,56	96,24	94,47

The optimal process conditions are nitric acid norms of 100-110%, T:W=1:2.5-3.0, t=40℃ and τ=40 minutes.

We recommend processing the liquid phase into nitrogen phosphorus calcium containing liquid or solid complex fertilizers.

V. CONCLUSION

Thus, studies of the decomposition of WBPC CK by nitric acid have been carried out, optimal conditions for the technological parameter providing the maximum coefficient of decomposition of WBPC have been determined. The results of the conducted studies show that by decomposing the WBPC of nitric acid and separating insoluble residues from nitrocalcium phosphate nitric acid extract, concentrated liquid and granular nitrogen and nitrogen-phosphorus-calcium fertilizers of various compositions can be obtained.

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