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New Types of Organomineral Fertilizers Based on Off-Conditional Phosphorites of Central Kyzyl Kum

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ABSTRACT: The article presents the results of studying the processes of obtaining organomineral fertilizers by composting cattle manure (CCM) with the addition of activated phosphorite (APh) with nitric acid, depending on the norm of nitric acid, the duration of composting, the weight ratios of the initial components and the moisture content of the composted mass. The dependence of the effectiveness of adding APh with nitric acid at a rate of 20-60% on the stoichiometry for CaO contained in phosphate raw materials and composting for three months in the range of weight ratios of cattle manure CCM: APh = 95 : 5; 90:10; 85:15; 80 : 20; 75 : 25; 70 : 30. It was shown that an increase in the mass fraction of phosphate raw materials in relation to manure leads to an increase in the content of the general form of phosphorus pentoxide in composts, but to a decrease in the relative content of the assimilable form P_2O_5.

KEYWORDS: Manure, nitric acid, activated phosphorite, phosphorus, compost, organic acids, ecology, environment.

I. INTRODUCTION:

In recent years, due to the trend of producing safer and more reliable food products that meet the desires of consumers, as well as in connection with the realization of environmentally friendly agriculture and other future prototypes of agriculture and farmers, the role assigned to experimental research has become increasingly important. more meaningful. An organic product created without mineral fertilizers and pesticides, or with their minimal and safe use, is particularly useful. Its consumption improves the health and quality of life of the population. According to the National Organic Union, 179 countries around the world are currently developing organic agriculture, employing more than 2 million producers. 89 countries have their own laws in the field of production and circulation of organic products. The annual increase in production is 12-15%.

The paper found that one of the ways to improve the efficiency of phosmoic is the preparation of composts with manure from it, which accumulates a significant amount of organic acids that form salts with ammonium, potassium and other substances. These salts interact with phosphorus, forming insoluble compounds with calcium and more mobile compounds of phosphorus with ammonium and potassium. At the same time, for composting with manure, phosmo flour was taken more than usual, that is, more than 1-2 percent of the weight of manure. It turned out that the effectiveness of phos- flour also increases with its high content in manure. Increasing the dose of phosmo for composting is determined by the following considerations: at normal doses of fossil, the amount of manure is taken at least 20 tons per hectare. It is far from always possible to apply 20 tons of manure per hectare, while a much larger area can be fertilized with phosphate flour. Therefore, a natural question arises, in what way can the efficiency of phosphate flour used in this or that farm be increased? This can be done by composting manure with a large amount of phosphorus and, accordingly, reducing the dose of manure-phosphorite composts. But, of course, it is possible to increase the content of phosphorus in

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composts with manure in such amounts that would increase the availability of phosphorus in phosphorus to plants. The availability of phosphorus for plants is ensured by the successful vital activity of microorganisms. In composts with different doses of phos-flour, the loss of dry matter and nitrogen in manure was determined. With an increase in phosphorus in the compost, the decomposition of manure organic matter is not weakened, but nitrogen losses are reduced by almost 3 times compared to losses in manure without fossil. Obviously, with a high content of phos-flour in the compost, nitrogen losses due to its volatile forms can be minimized. These studies have shown that compost prepared from manure and phosmos contains 75-80% of the phosphorus compound in its finished form, which is more available to plants. This compound contains a significant amount of phosphorus, which ensures the normal nutrition of plants throughout their growing season. The positive results of experiments on the use of high doses of phos- flour in composts with manure indicate the need for even wider research in this direction and for conducting production experiments. At the same time, it is necessary to study the conditions for preparing compost from manure with a high content of phosphorus [1-6].

The release of these substances occurs due to the decomposition contained in the waste - urea, hippuric acid, uric acid and other organic substances. At the same time, these substances can be used to bind calcium of substandard phosphorites and convert tricalcium phosphate into dicalcium phosphate, which is easily assimilated by plants, i.e. for obtaining organomineral fertilizers.

The most rational way to use substandard phosphorites and animal waste, as well as to reduce the release of harmful gases into the atmosphere, is their composting in the form of a manure-phosphorite mixture. Waste composting can significantly reduce the environmental problems associated with the accumulation of waste, turning it into a safe valuable product, which is further used as an organic or organomineral fertilizer in agriculture [7].

Based on the foregoing, a number of studies have been carried out to obtain organomineral fertilizers by composting cattle manure with the addition of substandard phosphorites of the Central Kyzylkum. As a result of the research, it was shown that the preparation of composts based on cattle manure with the addition of phosphate raw materials leads, on the one hand, to an increase in the digestible form of P_2O_5 due to the interaction of humic acids, fulvic acids and water-soluble organic substances with phosphates, on the other hand, to a decrease in the loss of nitrogen and organic substances. At the same time, the digestible form of P_2O_5 of phosphate raw materials increases by 6,5–7,0 times, the losses of nitrogen and organic substances decrease by almost 2.5–3 times, and the degree of humification of organic substances increases by 2 times [8–10].

II. MATERIALS AND METHODS.

Based on the above, in order to obtain a more concentrated fertilizer in terms of the content of the assimilable form of phosphorus and to minimize the emission of harmful gases, the processes of obtaining organic-mineral fertilizers by composting cattle manure with the CCM addition of activated Kyzylkum sludge phosphorite (SPh) with 59% nitric acid (HNO_3) were studied.

For the study, SPh and cattle manure were used, the compositions of which are shown in tables 1, 2. The experiments were carried out in the following ways. At the first stage of the work, SPh was activated with nitric acid, the HNO_3 rate was varied in the range of 20-60% of the stoichiometry for the decomposition of SPh $CaCO_3$ (Table 3). The activated SPh with nitric acid was dried at room temperature and analyzed for the content of the main components according to standard methods.

The results of the analysis are shown in Table 3, from which it can be seen that with an increase in the norm of nitric acid in the products, the content of the general form P_2O_5 decreases, and P_2O_{5ass}. according to Trilon B and in a 2% solution of citric acid, as well as the content of N_{nitr}. increases. These decomposition products of phosphate raw materials with nitric acid, obtained at different rates, were used as a phosphorus-containing component in the production of organic-mineral fertilizer based on cattle manure.

III. RESULTS AND DISCUSSION.

Composts based on cattle manure and manure activated with nitric acid are prepared in the following weight ratios of cattle manure: Manure = 95 : 5; 90:10; 85:15; 80 : 20; 75 : 25; 70 : 30. The resulting mixtures were placed in a 2.0-liter container, adding water based on the calculation to achieve a moisture content of up to 60-70%. A thin layer of soil was poured on top of the mixture. Samples were taken every 15 days and the chemical analysis of the composts was carried out. All forms of P_2O_5 were determined by the gravimetric method by precipitating the phosphate ion with a magnesia mixture in the form of magnesium ammonium phosphate, followed by calcining the precipitate at 1000–1050°C according to GOST 20851.2-75.

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Tables 4-6 show changes in the total and relative contents of digestible forms of P_2O_5 for Trilon B and 2% citric acid, depending on the rate of nitric acid, the duration of composting, and the weight ratios of the initial components. It can be seen from them that an increase in the mass fraction of SPh in relation to cattle manure in composts contributes to an increase in the content of the general form of P_2O_5 and a decrease in the relative digestible form of P_2O_5. With an increase in the norm of nitric acid and the duration of composting, the relative content of the digestible form of P_2O_5 increases. In the original SPh, the relative content of $P_2O_{5ass.}$ for Trilon B and 2% citric acid is 30,15 and 11,50%, after activation with nitric acid at a rate of 40%, these figures increase to 39,48 and 29,82%, and after composting at the same rate of nitric acid and with a ratio of cattle manure : SPh = 75 : 25 and aging of compost for 15 days, these figures increase to 42,81 and 32,98%, after 30 days – 49,40 and 39,23%, after 60 days - 67, 60 and 58,45%, and after 90 days to 76,51 and 67,86%, respectively.

Table 1
Chemical composition of SPh used for compost preparation

Kinds phosphate raw materials	Component content, %									$P_2O_{5ass.}$ / $P_2O_{5total.}$ %
	P_2O_5	CaO	Al_2O_3	Fe_2O_3	MgO	F	CO_2	SO_3	H.O.	
SPh	11,57	41,08	1,84	1,42	0,61	1,52	20,91	0,46	14,09	11,50

Table 2
Composition of cattle manure

Number of components, %								
Moisture	organic matter (total)	Humic acid	Fulvic acids	water soluble organic matter	N	P_2O_5	K_2O	CaO
72,36	23,21	2,51	2,63	2,34	0,46	0,22	0,58	0,43

Table 3
Composition of activated SPh with nitric acid

Norm HNO_3, %	P_2O_{5total}	$CaO_{total.}$	The degree of decarbonization, %
0	11,57	41,08	-
20	10,96	38,91	16,65
30	10,72	38,06	23,75
40	10,45	37,10	30,62
50	10,11	35,90	37,76
60	9,86	35,01	45,12

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Table - 4.
The content of total phosphorus ($P_2O_{5total.}$) in composts prepared on the basis of cattle manure with the addition of SPh depending on the exposure time and mass ratios, %

Mass ratio manure: SPh	Duration of composting, days						
	1	15	30	45	60	75	90
Without activation with nitric acid (sludge phosphorite - SPh)							
95 : 5	0,716	0,720	0,725	0,729	0,738	0,743	0,747
90 : 10	1,129	1,133	1,139	1,145	1,156	1,162	1,167
85 : 15	1,479	1,484	1,490	1,496	1,507	1,513	1,517
80 : 20	1,779	1,784	1,790	1,795	1,806	1,812	1,815
75 : 25	2,038	2,042	2,046	2,050	2,058	2,063	2,064
70 : 30	0,716	0,720	0,725	0,729	0,738	0,743	0,747
Norm HNO_3, 20 %							
95 : 5	0,701	0,704	0,708	0,713	0,722	0,727	0,731
90 : 10	1,106	1,110	1,116	1,122	1,132	1,138	1,142
85 : 15	1,453	1,457	1,464	1,469	1,480	1,486	1,490
80 : 20	1,754	1,758	1,765	1,770	1,780	1,785	1,789
75 : 25	2,017	2,020	2,025	2,029	2,036	2,040	2,042
70 : 30	2,250	2,253	2,256	2,259	2,264	2,267	2,269
Norm HNO_3, 30 %							
95 : 5	0,693	0,696	0,701	0,705	0,713	0,718	0,721
90 : 10	1,095	1,099	1,105	1,110	1,120	1,125	1,129
85 : 15	1,436	1,441	1,447	1,451	1,462	1,467	1,471
80 : 20	1,744	1,748	1,754	1,759	1,768	1,774	1,777
75 : 25	2,011	2,014	2,018	2,022	2,029	2,032	2,034
70 : 30	2,247	2,250	2,253	2,255	2,260	2,263	2,264
Norm HNO_3, 40 %							
95 : 5	0,681	0,684	0,688	0,692	0,700	0,704	0,708
90 : 10	1,077	1,081	1,086	1,091	1,101	1,106	1,110
85 : 15	1,420	1,424	1,430	1,435	1,444	1,450	1,454
80 : 20	1,722	1,726	1,732	1,736	1,745	1,751	1,754
75 : 25	1,989	1,992	1,996	1,999	2,006	2,009	2,011
70 : 30	2,242	2,244	2,247	2,249	2,254	2,257	2,258
Norm HNO_3, 50 %							
95 : 5	0,674	0,677	0,681	0,685	0,692	0,696	0,700
90 : 10	1,070	1,074	1,078	1,083	1,093	1,098	1,102
85 : 15	1,408	1,412	1,417	1,422	1,430	1,436	1,439
80 : 20	1,717	1,721	1,726	1,730	1,738	1,744	1,747
75 : 25	1,994	1,997	2,001	2,004	2,009	2,012	2,014
70 : 30	2,229	2,231	2,233	2,235	2,239	2,241	2,243
Norm HNO_3, 60 %							
95 : 5	0,666	0,669	0,672	0,677	0,683	0,687	0,691
90 : 10	1,053	1,056	1,061	1,067	1,075	1,080	1,084
85 : 15	1,394	1,398	1,403	1,407	1,415	1,420	1,423
80 : 20	1,697	1,701	1,706	1,709	1,718	1,723	1,725
75 : 25	1,968	1,970	1,974	1,976	1,982	1,984	1,987
70 : 30	2,212	2,213	2,216	2,218	2,221	2,223	2,224

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Table - 5

Relative content of assimilable form of phosphorus (according to trilon B, $P_2O_{5ass.}/P_2O_{5total}$) in composts prepared on the basis of cattle manure with the addition of manure depending on the exposure time and mass ratios, %

Mass ratio manure: SPh	Duration of composting, days					
	15	30	45	60	75	90
Without activation with nitric acid (Slurry Phosphorite - SPh)						
95 : 5	29,70	39,48	50,90	62,85	71,54	75,35
90 : 10	29,23	38,25	49,29	60,32	68,34	71,85
85 : 15	29,44	37,83	48,08	58,33	66,25	69,04
80 : 20	29,01	36,26	46,07	55,87	63,12	65,68
75 : 25	28,72	35,45	44,56	54,06	61,19	63,17
70 : 30	28,33	34,36	42,51	51,37	57,74	59,52
	Norm HNO_3, 20 %					
95 : 5	34,11	44,39	56,38	68,95	78,09	82,09
90 : 10	34,20	43,67	55,24	66,80	75,22	78,90
85 : 15	34,30	43,23	54,15	65,07	73,50	76,48
80 : 20	34,39	41,98	52,23	62,49	70,07	72,75
75 : 25	34,41	41,40	50,85	60,71	68,10	70,16
70 : 30	34,65	41,09	49,81	59,29	66,11	68,01
	Norm HNO_3, 30 %					
95 : 5	38,46	48,42	60,04	72,20	81,06	84,93
90 : 10	38,81	48,10	59,45	70,81	79,06	82,67
85 : 15	38,99	47,62	58,18	68,73	76,89	79,77
80 : 20	39,28	46,45	56,14	65,84	73,01	75,54
75 : 25	39,36	46,14	55,33	64,91	72,10	74,09
70 : 30	39,28	45,53	53,98	63,16	69,78	71,61
	Норма HNO_3, 40 %					
95 : 5	41,55	51,28	62,64	74,53	83,18	86,96
90 : 10	41,63	50,75	61,90	73,05	81,17	84,71
85 : 15	42,79	51,13	61,31	71,49	79,36	82,14
80 : 20	42,78	49,99	59,74	69,49	76,69	79,24
75 : 25	42,81	49,40	58,30	67,60	74,57	76,51
70 : 30	42,86	48,89	57,05	65,91	72,29	74,07
	Norm HNO_3, 50 %					
95 : 5	43,73	53,39	64,67	76,49	85,08	88,84
90 : 10	43,48	52,75	64,09	75,43	83,67	87,28
85 : 15	44,18	52,67	63,04	73,42	81,43	84,26
80 : 20	44,76	52,07	61,96	71,84	79,15	81,73
75 : 25	44,75	51,26	60,06	69,25	76,14	78,05
70 : 30	44,91	50,87	58,92	67,68	73,98	75,73
	Norm HNO_3, 60 %					
95 : 5	45,94	55,16	65,93	77,20	85,40	88,99
90 : 10	45,87	54,68	65,45	76,22	84,06	87,48
85 : 15	46,02	54,34	64,50	74,66	82,51	85,28
80 : 20	46,80	53,71	63,06	72,41	79,33	81,77
75 : 25	46,00	52,22	60,63	69,41	75,99	77,82
70 : 30	45,93	51,53	59,11	67,34	73,27	74,92

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Table - 6
The relative content of the assimilable form of phosphorus (by lim. to-those, $P_2O_{5ass}/P_2O_{5total.}$) in composts prepared on the basis of cattle manure with the addition of manure, depending on the exposure time and mass ratios, %

Mass ratio manure: SPh	Duration of composting, days					
	15	30	45	60	75	90
Without activation with nitric acid (Slurry Phosphorite - SPh)						
95 : 5	20,15	29,64	40,71	52,30	60,73	64,42
90 : 10	20,16	28,92	39,64	50,36	58,15	61,56
85 : 15	20,27	28,48	38,51	48,54	56,29	59,03
80 : 20	20,36	27,39	36,90	46,40	53,43	55,91
75 : 25	20,43	26,84	35,65	44,84	51,73	53,65
70 : 30	20,55	26,28	34,02	42,44	48,50	50,19
Norm HNO_3, 20 %						
95 : 5	24,35	34,50	46,35	58,76	67,79	71,74
90 : 10	24,45	33,93	45,53	57,12	65,55	69,24
85 : 15	24,55	33,57	44,59	55,61	64,13	67,14
80 : 20	24,58	32,31	42,77	53,23	60,96	63,69
75 : 25	24,65	31,74	41,48	51,63	59,25	61,36
70 : 30	24,72	31,43	40,52	50,39	57,50	59,48
Norm HNO_3, 30 %						
95 : 5	29,95	38,25	49,81	61,92	70,72	74,58
90 : 10	29,70	38,09	49,57	61,05	69,40	73,05
85 : 15	29,66	37,67	48,44	59,21	67,53	70,47
80 : 20	29,42	36,47	46,49	56,51	63,91	66,53
75 : 25	29,30	36,19	45,79	55,80	63,30	65,39
70 : 30	29,18	35,59	44,53	54,24	61,24	63,18
Norm HNO_3, 40 %						
95 : 5	34,18	40,92	52,28	64,17	72,83	76,61
90 : 10	34,08	40,56	51,91	63,25	71,50	75,11
85 : 15	33,86	40,94	51,43	61,91	70,02	72,88
80 : 20	33,30	39,81	49,97	60,13	67,64	70,29
75 : 25	32,98	39,23	48,64	58,45	65,82	67,86
70 : 30	32,48	38,73	47,47	56,96	63,80	65,70
Norm HNO_3, 50 %						
95 : 5	36,10	42,70	53,90	65,64	74,18	77,91
90 : 10	35,92	42,28	53,72	65,16	73,48	77,12
85 : 15	35,57	42,22	52,81	63,39	71,56	74,45
80 : 20	35,06	41,61	51,82	62,04	69,59	72,25
75 : 25	34,69	40,80	50,02	59,64	66,86	68,86
70 : 30	34,09	40,42	48,98	58,28	64,98	66,84
Norm HNO_3, 60 %						
95 : 5	38,80	44,51	55,37	66,74	75,02	78,64
90 : 10	38,18	44,23	55,28	66,34	74,38	77,90
85 : 15	37,40	44,09	54,71	65,34	73,54	76,44
80 : 20	37,04	43,40	53,34	63,29	70,64	73,23
75 : 25	36,25	41,95	51,02	60,48	67,58	69,55
70 : 30	35,12	41,26	49,57	58,61	65,11	66,92

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At a rate of nitric acid of 20%, the ratio of manure : SPh = 95:5 and aging of compost for 90 days, the relative content of P_2O_{5ass}. for Trilon B and 2% citric acid increase from the initial 30,15 and 11,50% to 82,09 and 71,74%, and with a nitric acid rate of 60%, these figures increase to 88,99 and 78,64% . That is, with an increase in the norm of nitric acid and the duration of composting, the degree of transition of phosphorus from an indigestible form to a form digestible for plants increases markedly.

Based on the consideration of the degree of transition to the digestible form P_2O_5 of phosphate raw materials, the optimal mode for preparing composts was determined: The rate of nitric acid for the activation of the initial phosphate raw materials is 20% of the stoichiometry for the content of CaCO3, the ratio of manure (cattle):= 75 : 25, the preparation - 60-65%, composting holding time 3 months. At the same time, the organomineral fertilizer has the composition (wt. %): P_2O_{5total}. – 2,042; P_2O_{5ass}. for trilon B – 1,43; P_2O_{5ass}. for citric acid – 1,34.

IV. CONCLUSION

Thus, under optimal conditions, manure has the best properties to reduce the release of harmful gases to the environment, to increase the humification of organic substances and to obtain organo-mineral fertilizers with a higher phosphorus content based on animal waste, which is a prerequisite for the development of a waste-free and environmentally friendly technology. production of phosphorus-containing organo-mineral fertilizers, and the involvement of low-grade phosphate raw materials (SPh - P_2O_{5total}. 11,57) in the production of organo-mineral fertilizers will significantly expand the phosphate raw material base.

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