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7. Tojiev P.J “Разработка технологии получения высоконаполненных полиолефинов на основе местного сырья” Диссертация на соискание ученой степени доктора философии (PhD) по техническим наукам.Термез 2019г.

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BENTONITE AND PHOSPHORITE PRODUCTION OF ORGANOMINERAL FERTILIZERS BASED ON RAW MATERIALS AND NITROGEN-FIXING MICROORGANISMS ((CD:B:NFM=100:5:(0-4)), (CD:B:PF:NFM=100:5:5:(0-4)))

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Abstract:

Objective. This article deals with production of organomineral fertilizers based on local raw materials cattle dung (cattle). local ores (Kyzilkum phosphorite flour (PF) and Navbahor bentonite) and nitrogen-fixing microorganisms. Based on the experiments. the following results were obtained. During 60 days. the raw materials selected for the experiment were used in optimal proportions: cattle dung: bentonite: nitrogen-fixing microorganisms solution (NFM) (100:5:0-4) and the main chemistry of organomineral fertilizers obtained on the basis of cattle dung. bentonite. phosphorite flour and nitrogen-fixing microorganisms. Composition (CD:B:PF:NFM=100:5:5:(0-4)) was analyzed.

Methods. The obtained results from our side were first studied the quantities of organomineral fertilizers based on cattle dung. bentonite and nitrogen-fixing microorganisms. Cattle dung. bentonite and nitrogen-fixing microorganisms of the type Azotobacterium were used for laboratory research. For this. cattle dung: bentonite ratios were taken in the range of 100:(2.5-5) and the resulting mixture was processed with nitrogen-fixing microorganisms (NFM) grown in Fedorov medium in the ratio of 100:(2.5-5):(0.5-4.0).

Results Physico-chemical and commercial properties of the obtained new type of organomineral fertilizers. It is known that physico-chemical (dispersibility. natural slope angle. etc.) and commodity properties (hygroscopic point. grain strength. etc.) are important properties of solid and powder fertilizers used in agriculture. Because these properties. especially commodity properties. determine the conditions of storage of fertilizers in warehouses. transportation in vehicles and direct application.

Conclusions Laboratory experiments on the production of organomineral fertilizers based on nitrogen-fixing microorganisms. cattle dung and bentonite were carried out and their optimal ratios were determined: depending on the change of the CD:B:NFM ratio. it is in the range of 0.336-0.35%. and in the case after 60 days it is 1.138-1.513%. It can be seen that the amount of nitrogen in the obtained fertilizer samples increases 3.4-4.6 times.

Keywords. Kyzylkum phosphorite flour (PF), Navbahor bentonite, cattle dung, biofixation, humic substances, fulvic acids, composting, physicochemical, commodity, nitrogen.

Introduction. Due to the rapid increase in the number of people in the world. providing them with sufficient food products is one of the important problems. Adequate use of organomineral fertilizers (OMF) through nitrogen-fixing microorganisms is necessary to solve this problem. By creating an optimal nutrient environment for nitrogen-fixing microorganisms. it is important to research in the direction of achieving the process of maximum nitrogen fixation in the air and creating a flexible technology for the production of OMFs enriched with various components.

The analysis of the studied literature and scientific articles shows that the employees of the Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan have studied various processes of obtaining OMF based on the lignite of the Angren mine. OMF with the following composition (wt.%) was obtained by oxidation of Angren lignite with nitric acid and subsequent decomposition of Central Kyzylkum phosphorites with nitric acid-coal slurry: total P_2O_5. - 9.41; P_2O_5 absorbed by citric acid. - 7.71; absorbed P_2O_5 on trilon B.- 4.78; CaO water. - 11.27; N - 7.75; OS - 23.62 [1].

Processes for obtaining liquid and solid nitrogen-humic fertilizers by stepwise oxidation of lignite are presented in [2].

In [3. 4]. the oxidation of lignite with nitric acid in the presence of phosphogypsum. followed by neutralization of the oxidized products with ammonia. contained 14.19% nitrogen. 20.70% HA. 32.26% OS. 5.38% water-soluble SO_3 and OMFs containing 2.31% water-soluble CaO were obtained. Currently. the level of use of phosphorus fertilizers is on average 15-25%.

O'.Sh.Temirov. A.M. Reymov and Sh.S.Namazov carried out scientific and research work on obtaining organomineral fertilizers based on phosphate waste. nitric acid. cattle dung and poultry waste [5-17].

In these works. several options for obtaining OMFs were developed: cattle dung and phosphorites; poultry waste and phosphorus; cattle dung. phosphorites. various mineral fertilizers. phosphogypsum and bentonite; on the basis of poultry waste. phosphorites. various mineral fertilizers. phosphogypsum and bentonite. Experiments were conducted on the preparation of phosphorous fertilizers based on mineralized mass and cattle dung. In addition. options for obtaining OMF by composting phosphorites (MM and FSh) with a mixture of recycled poultry waste with nitric acid and activating phosphorites with nitric acid and then processing with poultry waste were studied. The economic efficiency of obtaining OSs was calculated and agrochemical tests were carried out on cotton plants on ordinary gray soils. However. this research work has not been applied to industry. It is clear from the above information that the creation of rational technologies for the production of organic fertilizers based on low-grade phosphorites with high agro-ecological value and efficiency and on the basis of nitrogen-fixing microorganisms is a major task.

The main raw materials used in laboratory work for scientific research were cattle and poultry dung. phosphorite flour

(PF) from Central Kyzyl-Kum phosphate raw materials. and various bentonite samples. The main chemical composition of these raw materials is presented in Table 1 [18, 19].

Microorganisms of the type Azotobacterium were used to fix molecular nitrogen from the air. In addition. urea. ammonium sulfate and potassium chloride from mineral fertilizers produced at chemical plants of our country were used to obtain organomineral fertilizers with different nutrient components.

Table 1

The main chemical composition of cattle dung. phosphorite flour and bentonite

Raw material	Humidity	Organic substances	Humic acids	Fulvic acids	Water-soluble organic substances	NonWater-soluble organic substances	P_2O_5	N	K_2O	CaO	Extra substance
Cattle dung	55.4	26.53	7.1	3..7	2.52	13.24	0.28	0.51	0.58	0.59	16.11
PF	P_2O_5	CaO	Al_2O_3	Fe_2O_3	MgO	F	CO_2	SO_3	Э.қ..	$P_2O_{5ўзл}$. $P_2O_{5уму}$ м. %	CaO/ P_2O_5
	17.75	47.52	0.95	0.73	1.78	2.0	17.03	3.27	5.27	17.74	2.67
Navbahor bentonite	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	N	K_2O	P_2O_5	CO_2	E.S
	57.9	0.35	13.69	5.10	1.84	0.48	1.53	1.75	0.43	0.75	16.17

Methods. The obtained results from our side were first studied the quantities of organomineral fertilizers based on cattle dung. bentonite and nitrogen-fixing microorganisms. Cattle dung. bentonite and nitrogen-fixing microorganisms of the type Azotobacterium were used for laboratory research. For this. cattle dung: bentonite ratios were taken in the range of 100:(2.5-5) and the resulting mixture was processed with nitrogen-fixing microorganisms (NFM) grown in Fedorov medium in the ratio of 100:(2.5-5):(0.5-4.0).

The obtained results are presented in Table 2. An increase in humic and fulvic acids. water-soluble organic matter (WSOM) is observed in the fertilizer samples obtained as a result of processing a mixture of cattle dung and bentonite with nitrogen-fixing substances. For example. in the mixture of organomineral fertilizers on the day of preparation. the amount of HA. FA and WSOM is 2.48%. 2.60% and 2.46%. respectively. and when NFM is processed with microorganisms. it is 2.43%. 2.54% and 2.41%. but after 60 days this numbers are as below 4.10%. 4.10-4.29% and 4.06%.

Table 2

Chemical composition of organomineral fertilizer samples based on cattle dung. bentonite and nitrogen-fixing microorganisms (CD:B:NFM=100:5:(0-4))

Ratio	P_2O_{5total}. %	CaO_{total}. %	OM. %	HA. %	FA. %	WSOM. %	K_2O. %	N_{total}. %	Humidity. %
				After a day					
100 : 5 : 0	0.236	0.630	19.93	2.48	2.60	2.46	0.572	0.336	63.48
100 :5 : 0.5	0.235	0.627	19.85	2.48	2.59	2.45	0.570	0.335	63.63
100 : 5 : 1	0.234	0.624	19.77	2.47	2.58	2.44	0.567	0.333	63.78
100 : 5 : 2	0.232	0.619	19.61	2.45	2.56	2.43	0.563	0.331	64.07
100 : 5 : 4	0.230	0.614	19.46	2.43		2.41	0.558	0.328	64.36
				After 60 days					
100 : 5: 0	0.298	0.796	21.08	3.58	3.75	3.55	0.723	0.350	53.83
100: 5 : 0.5	0.301	0.804	21.42	3.75	3.92	3.71	0.731	1.138	53.35
100 : 5 : 1	0.304	0.813	21.82	3.92	4.10	3.88	0.739	1.280	52.86
100 : 5 : 2	0.306	0.817	22.07	4.01	4.19	3.97	0.743	1.374	52.61
100 : 5 : 4	0.308	0.821	22.38	4.10	4.29	4.06	0.747	1.513	52.35

It was also found to increase nitrogen content in dung samples recycled with NFMs. The nitrogen content of the fertilizer sample taken without treatment with NFM on the day of preparation is 0.336%. and after 60 days it is 0.35% in the same condition. that is. the total nitrogen content in this case is slightly reduced. but with treatment with NFM depending on the change of CD:B:NFM ratios on the day of preparation. it is in the range of 0.335-0.328%. and after 60 days it is 1.138-1.513%. It can be seen that the amount of nitrogen in the obtained fertilizer samples increases 3.4-4.6 times.

It can be seen from the results of Table 3. when the mixture made of phosphorite flour. cattle dung and bentonite is processed with nitrogen-fixing microorganisms (NFM). NFM has an effect on increasing the content of HA. FA and WSOM and nitrogen in the obtained organomineral fertilizers. For example. 0.917% total P_2O_5 in compost 1 day after preparation when the CD:B:PF:NFM ratio is 100:5:5:4. and the amount of its relative absorbable form is equal to 23.15%. these values in the obtained compost (ready organomineral fertilizer) after 60 days are equal to 1.246 and 73.17%. respectively. In this case. not only the amount of total P_2O_5 increases. but also an increase in its relative absorbable form is observed.

[21]. In the compost prepared in the same proportions. the amounts of HA. FA. WSOM. K_2O and nitrogen will be equal to 2.57. 2.69; 2.55; 0.558 and 0.408% respectively. After 60 days. in the composition of organo-mineral fertilizers taken in the same ratio. the amounts of HA. FA. WSOM. K_2O and nitrogen will be equal to 4.78.; 5.00; 4.74; 0.759 and 1.913% respectively. General legalities of this type are also observed in other relations of CD: B:PF:NFM.

In addition. the following can be seen from the results of this table: with an increase in the amount of NFMs. the amount of the relative absorbable form of phosphorus increases. and the amount of nitrogen in the obtained organomineral fertilizers also increases. For example. if the ratio of CD: B:PF: NFM is 100:5:5:0.5 and the value of the relative absorbable form of phosphorus in the compost obtained after 60 days is 68.31% and the amount of nitrogen is 1.415%. bu when the ratio of CD: B:PF: NFMs is 100:5:5:4.0. it is equal to 73.17and 1.913% respectively.

Table 3

The main chemical composition of organomineral fertilizers obtained on the basis of cattle dung. bentonite. phosphorite flour and nitrogen-fixing microorganisms (CD:B:PF:NFM=100:5:5:(0-4))

Ratio	P_2O_5 total.. %	Relative value of P_2O_{5usv} according to Tr.B. (%)	CaO_{total}. %	Org subs. %	HA. %	FA. %	WSOS. %	K_2O .%	N_{total}. %	Humidity. %
After a day										
100:5:5:0	0.940	21.62	2.52	19.93	2.63	2.76	2.61	0.572	0.418	63.48
100:5:5:0.5	0.936	21.89	2.50	19.85	2.62	2.74	2.60	0.570	0.416	63.63
100:5:5:1	0.932	22.43	2.49	19.77	2.61	2.73	2.59	0.567	0.415	63.78
100:5:5:2	0.925	22.73	2.47	19.61	2.59	2.71	2.57	0.563	0.411	64.07
100:5:5:4	0.917	23.15	2.45	19.46	2.57	2.69	2.55	0.558	0.408	64.36
After 60 days										
100:5:5:0	1.188	59.82	3.18	21.08	4.13	4.31	4.09	0.723	0.435	53.83
100:5:5:0.5	1.201	68.31	3.21	21.42	4.31	4.51	4.27	0.731	1.415	53.35
100:5:5:1	1.213	69.39	3.25	21.82	4.50	4.71	4.46	0.739	1.592	52.86
100:5:5:2	1.220	71.10	3.26	22.07	4.60	4.81	4.56	0.743	1.709	52.61
100:5:5:4	1.246	73.17	3.34	22.75	4.78	5.00	4.74	0.759	1.913	51.58

Results. Physico-chemical and commercial properties of the obtained new type of organomineral fertilizers. It is known that physico-chemical (dispersibility. natural slope angle. etc.) and commodity properties (hygroscopic point. grain strength. etc.) are important properties of solid and powder fertilizers used in agriculture. Because these properties. especially commodity properties. determine the conditions of storage of fertilizers in warehouses. transportation in vehicles and direct application.

To study the hygroscopic points of this type of fertilizers. the samples of organomineral fertilizers listed in Table 4 below were used.

The initial moisture content of organomineral fertilizer samples taken to determine hygroscopic points was as follows: %: 1 - 3.11%; 2 - 3.32. The hygroscopic points of these samples were as follows: sample 1 - 76%. sample 2 - 74%.

Table 4

The main chemical composition of organomineral fertilizers

Samples of fertilizers	Sample humidity. %	Chemical composition %						Hygroscopic point. %
		P_2O_5 total.	Relative value of P_2O_{5usv} according to Tr.B. (%)	CaO_{total}. %	CaO total.. %.	K_2O.%	N	
CD: B: NFM.	3.11	0.308	-	22.38	0.821	0.747	1.513	76
CD: B:PF:NFM.	3.32	1.246	73.17	22.75	3.34	0.759	1.913	74

As can be seen from these values. the obtained organomineral fertilizer samples correspond to the average atmospheric humidity. but during storage in the autumn-winter and winter-spring periods. when the relative humidity is very high. they absorb water. that is. they become wet. Therefore. it is recommended to store and transport them in polypropylene bags.

In the subsequent experiments. some physico-chemical properties (dispersibility. natural slope angle. etc.) of powdered organomineral fertilizer samples were determined. The dispersibility of organomineral fertilizers was determined using a Mering funnel. The experiments were carried out as follows: first. the outlet of this flask was checked for cleanliness and its suitability. that is. it was not damaged and not bent. then the flask was installed on three legs and its bottom hole was closed with a metal plate or cardboard paper while holding it by hand. and a sample of 100 g of organomineral fertilizer powder was drawn into the funnel.

After that. the covering metal plastic or cardboard paper was removed and at the same time the stopwatch was started. The stopwatch was stopped when the last powder fell from the funnel hole. The dispersion of fertilizer samples was calculated in points [22. 23].

Table 5.

Some physicochemical indicators of new types of organomineral fertilizers

Fertilizer samples	H_2O. *%*	Pile weigh . *g/cm³*	Volumetr c gravity.*г/cm³*	Durabilit y . *mPA/cm²*	Dispers ion. point	Natural slope. *o*	Fluidity. *c*
CD: B: NFM.	3.11	0.621	0.84	1.73	7.8	40.7	42
CD: B:PF: NFM.	3.32	0.611	0.94	1.85	8.05	41.8	45

The obtained results are presented in Table 5. The results showed that the dispersibility of the fertilizer samples was 7.8. 8.05 points respectively. This shows that the values have a good dispersion in the ten-point system. In addition. the natural slope angle of the free surface of the samples plays an important role in evaluating the mobility of fertilizer particles.

The smaller the natural angle of inclination. the more mobile the powder-like substance is. The natural imaginary angles of the above organomineral fertilizer samples are 40.7° 41.8°. This shows that the mobility of these samples is close to each other. The bulk weight of organo-mineral fertilizers. which describes the size of their movement in storage warehouses and modes of spillage from bunkers and supply equipment.

The purpose of determining the weight of the pile is to calculate the dimensions of the bunkers. the efficiency of the transport and supply equipment. and to determine the pressure exerted on the walls and the mechanism of opening and closing of the container of spraying substances.

The bulk weight of these 2 organomineral fertilizer samples is 0.621. 0.611 g/cm3. respectively. which fully meets the general requirements set by production plants [24]. In our subsequent works. the mineral composition of the above-obtained organomineral fertilizers was studied through elemental and X-ray phase studies [25].As can be seen from these results. the organomineral fertilizer obtained in the ratio CD: B: NFM.=100:5:4 contains 55% SiO_2. 4% dolomite. 3% potassium chloride. 2% sodium aluminum silicate. 20% potassium aluminum hydrosilicate. 10% calcium strontium silicate. 6 There are % calcium carbonate and calcium magnesium iron carbonates. Figure 2. this organomineral an x-ray analysis of the fertilizer is given. in which the mineral composition of the fertilizer is given.

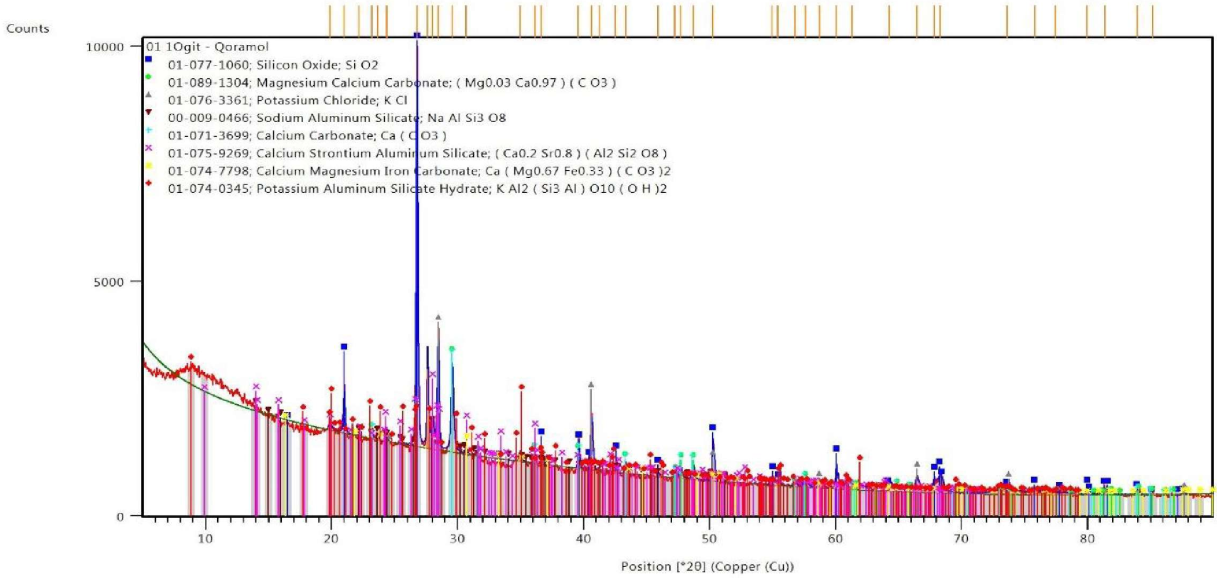

Fig. 1. X-ray analysis of a sample of organomineral fertilizer with a ratio of CD:B:NFM.=100:5:4.

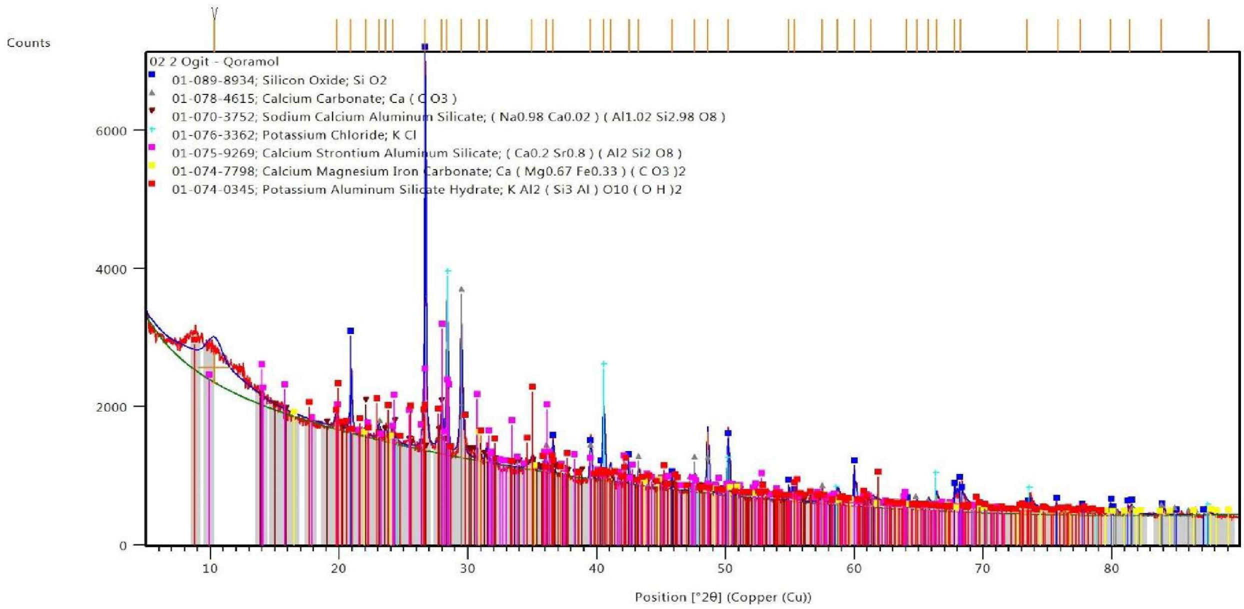

Fig. 2. X-ray analysis of a sample of organomineral fertilizer with CD:B:PF:NFM =100:5:5:4

As can be seen from these results. the organomineral fertilizer obtained in the ratio CD:B:PF:NFM=100:5:5:4 contains 26% SiO_2. 5% potassium chloride. 12% sodium calcium aluminum silicate. 26% potassium aluminum hydrosilicate. 21% contains calcium strontium aluminum silicate. 8% calcium carbonate and 1% calcium magnesium iron carbonates.

Conclusions. Laboratory experiments on the production of organomineral fertilizers based on nitrogen-fixing microorganisms. cattle dung and bentonite were carried out and their optimal ratios were determined: depending on the change of the CD:B:NFM ratio. it is in the range of 0.336-0.35%. and in the case after 60 days it is 1.138-1.513%. It can be seen that the amount of nitrogen in the obtained fertilizer samples increases 3.4-4.6 times.

The processes of obtaining organomineral fertilizers based on nitrogen-fixing microorganisms. cattle dung. bentonite and phosphorite flour were studied. The optimal quantities of this type of organomineral fertilizers were determined: when the ratio of CD:B:PF:NFM was 100:5:5:0.5 and after 60 days. the value of the relative absorbable form of phosphorus in the compost was 68.31%. and the amount of nitrogen was 1.415%. is equal. the ratio of CD:B:PF:NFM is 100:5:5:4.0. and it is 73.17 and 1.913%. According to the results of the conducted research. some physico-chemical and commodity properties of 2 new types of organomineral fertilizer samples were studied. The dispersion of organomineral fertilizer samples is equal to 7.8 and 8.05 points. respectively. and has good dispersion. The natural slope angles of the above organomineral fertilizer samples are 40.7° 41.8°. The bulk weight of these 2 kinds of organomineral fertilizer samples is 0.621. 0.611 g/sm^3. respectively. which fully meets the general requirements of production plants.

The hygroscopic points of these samples were as follows: sample 1 – 76%. sample 2 – 74%. As can be seen from these values. the obtained samples of organomineral fertilizers correspond to average atmospheric humidity. but it is recommended to store and transport them in polypropylene bags during storage in the autumn-winter and winter-spring periods. when the relative humidity is very high.

The new type of organomineral fertilizer samples were analyzed using modern physico-chemical methods and their elemental and mineral contents were studied. CD:B:PF:NFM =100:5:4 ratios of organomineral fertilizer contains 55% SiO_2. 4% dolomite. 3% potassium chloride. 2% sodium aluminum silicate. 20% potassium aluminum hydrosilicate. 10% calcium strontium silicate. 6% calcium carbonate and calcium magnesium iron. carbonates are present. CD: B:PF:NFM=100:5:5:4 ratios of organomineral fertilizer contains 26% SiO_2. 5% potassium chloride. 12% sodium calcium aluminum silicate. 26% potassium aluminum hydrosilicate. 21% calcium strontium aluminum silicate. 8% calcium carbonate and 1 % calcium magnesium iron carbonates.

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STUDYING THE STRUCTURE AND PROPERTIES OF POLYPROPYLENE FILLED WITH NITROGEN, PHOSPHORUS, METAL-CONTAINING OLIGOMERS

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Abstract: The synthesis of refractory oligomers to protect polymeric materials and structures from fire and various aggressive environments is an urgent task of modern chemistry of high molecular weight compounds. In this regard, the presented article has studied the receipt of heat-resistant and mechanically

CONTENTS