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STUDY OF THE PROCESS OF MECHANICAL AND CHEMICAL ACTIVATION OF BROWN COAL OF THE ANGRENSK DEPOSIT AND PHOSPHORITES OF THE CENTRAL KYZYLKUM

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Abstract

One of the problems of agricultural production is associated with soil humus, which is the basis of the fertility of any soil. The irrigated soils of our region contain very little organic matter. In terms of the amount of humus, they are in the last place among other soils. One of the sources of organic matter replenishment in irrigated soils can be brown coals, coal-humic fertilizers based on them.

Introduction

Uzbekistan has proven reserves of 1.9 billion tons of coal, including lignite - 1853 million tons, stone - 47 million tons. Inferred resources amount to over 7 billion tons, of which 5718 million tons of coal. Currently, coal is mined at three deposits: Angrenskoye, Shargunskoye and Baysunskoye. The annual production volume is about 3 million tons.

The essence of the technology for producing organomineral fertilizers consists in the processing of oxidized in natural conditions, the so-called weathered coals, coals containing more than 45% of humic acids with alkalis and their subsequent mixing with superphosphate. However, Angren brown coal contains only 4.1% of humic acids. Therefore, it must be oxidized artificially and the content of humic acids in it must be increased to 50 percent or more. After that, you can get a component for creating highly effective organic mineral fertilizers that contribute to the accumulation of humus in the soil.

The work [1] shows the practical possibility of obtaining organomineral fertilizers by oxidizing brown coal of the Angren deposit with nitric acid and subsequent decomposition of phosphorites of Central Kyzyl Kum with coal nitric acid pulp.

And in work [2] brown coal was treated with 5 n nitric acid. Oxidized coal samples were mixed with ground phosphorite, aqueous ammonia, and urea. Oxidation of coal has led to a decrease in its carbon content. The hydrogen content changed slightly. The content of organically bound nitrogen increased from 1% in the starting material to 11-13% in fertilizers. The amount of humic acids and fulvic

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acids in coal has significantly increased. From the added phosphorite, due to the residual nitric acid and the formed organic acids, part of the phosphorus passed into the form assimilable for plants. In short-term growing experiments, even with the introduction of high amounts (2 t/ha), no phytotoxic effect was observed.

We have set ourselves the goal of developing technologies for the production of organomineral fertilizers based on brown coal from the Angren deposit and phosphorites of the Central Kyzylkum desert by mechanical destruction of coal in the presence of phosphorite, followed by their treatment with nitric acid.

It is known that the mechanical destruction of coal is accompanied by both disruption of intermolecular interaction and the rupture of chemical bonds in macromolecules of organic substances, changes in the configurations of molecular chains, interatomic distances, as well as distortion of bond angles. These phenomena are especially characteristic of hard vitreous organic substances. These changes are accompanied by a weakening of intermolecular bonds, an increase in free energy, an extension of high polymer chains, and an increase in interatomic distances, leading to bond rupture [3].

The leading factor in the formation of humic substances is considered to be high shear pressures leading to irreversible deformations of structures.

It should also be noted that mechanical action on phosphates leads to deformation of the crystal lattice and amorphization of the structure of phosphate minerals, which leads to an increase in their activity. As a result, the solubility of natural phosphates in weak solutions imitating humic acids sharply increases [4, 5]. The use of additives for mechanical activation is mainly due to an increase in the content of lemon-soluble forms of phosphate, which is the main characteristic of assimilable phosphorus for plants. Various salts are used as additives - sodium sulfate, ammonium sulfate and nitrate, potassium and ammonium chlorides, as well as zeolites and brown coals [6].

In this regard, mechanical activation of phosphate raw materials in the presence of brown coal is promising in order to increase the yield of humic acids in the latter.

In the work, a representative sample of BNSSSHH coal fines (brown, nut, small, seeds, shtyb) was used, having, after drying to an air-dry state and grinding in a ball mill to a particle size of 0.25 mm, the following composition (weight %): moisture 14, 1; ash 13.7; organic 72.2; humic acids 4.1% for organic matter. Nitric acid was taken from OJSC "Maksam-Chirchik" with a concentration of 59%. As a

phosphate raw material was taken phosphorite flour of the Central Kyzyl Kum and its waste - a pulverized fraction, the compositions of which are given in table.

Table 1 Composition (weight %) of the starting phosphate raw material

Types of phosphorites	P_2O_5	CaO	Al_2O_3	Fe_2O_3	MgO	F	CO_2	$\frac{CaO}{P_2O_5}$
Ordinary phosphate rock	18,80	46,71	1,24	1,05	1,75	2,0	15,19	2,48
Dust fraction	18,54	44,72	0,95	0,80	0,80	2,22	14,80	2,41

The experiments were carried out as follows. First, mixtures of brown coal with one part of the phosphate raw material were prepared, then they were abraded in a porcelain mortar, also to a particle size of less than 0.1 mm. The mixtures were prepared in the range of ratios Coal: FS = 1: 0.5 and 1: 0.7. Then, a 30% aqueous solution of nitric acid was poured into a glass reactor with a helical stirrer and a thermostatic water jacket. After heating to 40°C, a stirrer was turned on and a previously prepared powder mixture of coal and phosphate raw materials was gradually fed into the reactor to oxidize the coal and increase the content of humic acids in it. The weight ratio of the organic part of coal to nitric acid monohydrate varied from 1:1.2 to 1:2.0. Oxidation was carried out for 60 min. Further, the rest of the phosphate raw material was added to the obtained oxidation products. The total amount of phosphorites was calculated based on the amount of nitric acid initially taken for the oxidation of coal. The ratio of Coal: FS was 1:1.9-4.75. And the norm of nitric acid for the decomposition of phosphorites was taken by us in the amount of 40-60% of the stoichiometry for calcium oxide in the raw material.

The decomposition of phosphorite was carried out at a temperature of 40°C for one hour. Then the mass was ammoniated to a pH of 3.7-4.2, dried at 70-75°C to a moisture content in the product of 4-6% and analyzed. The analysis was carried out according to well-known methods [7, 8]. The assimilable form of P2O5 in the product was determined both by 2% citric acid and by 0.2 molar solution of Trilon B. The experimental results are shown in Table 2.

The picture is similar for the two types of phosphate raw materials. The higher the rate of nitric acid and the less phosphate raw material is taken, the less P2O5

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total in the product. But the greater is the relative content of the assimilable form of P2O5, the water-soluble form of CaO, nitrogen, organic matter, and humic acids.

Table 2 The composition of organomineral fertilizers obtained during mechanical and nitric acid processing of Angren coal and ordinary phosphate rock of Central Kyzyl Kum

	Coal ratio: FS	Coal: HNO_3 ratio	HNO_3 rate for CaO decomposition in raw materials, %	Coal: FS ratio	pulp	, %	2% lim. acid	0,2 M Tp.B.	$CaO_{total.}$, %	$CaO_{wat.}$, %	N, %	matter, %	acids, %
The ordinary phosphate rock based													
1	1 : 0,5	1,2	40	2,35	4,1	15,44	11,73	7,98	38,2	14,74	5,24	24,92	16,94
2	1 : 0,7	1,2	60	1,2	2,37	12,70	10,19	8,88	31,4	15,5	7,3	30,99	21,07
3	1 : 0,5	1,4	40	2,8	3,8	13,12	10,11	6,56	32,6	12,18	5,52	22,25	15,13
4	1 : 0,7	1,4	60	1,5	2,20	10,22	9,08	6,85	26,2	12,95	7,69	27,21	18,50
5	1 : 0,7	1,6	40	3,1	3,21	10,98	7,34	5,32	28,31	10,61	5,58	19,11	12,77
6	1 : 0,7	1,6	60	1,8	1,86	9,17	7,69	6,34	23,28	11,28	7,74	23,61	16,0
7	1 : 0,5	2	40	4,25	3,16	11,61	8,86	5,51	29,62	11,43	5,88	16,21	11,04
8	1 : 0,7	2	60	2,47	1,73	9,58	8,75	6,61	24,59	12,49	8,09	20,17	13,83
The pulverized fraction based													
1	1 : 0,5	1,2	40	2,49	4,23	15,52	11,19	7,68	37,3	13,5	5,14	23,82	15,24
2	1 : 0,7	1,2	60	1,35	2,48	12,83	9,89	8,53	30,6	14,2	7,2	29,89	20,01
3	1 : 0,5	1,4	40	2,96	3,92	13,21	9,91	6,28	31,3	11,2	5,42	21,23	14,19
4	1 : 0,7	1,4	60	1,65	2,42	10,32	8,79	6,41	25,0	11,78	7,55	26,18	17,56
5	1 : 0,7	1,6	40	3,26	3,33	11,01	7,23	5,12	27,21	9,12	5,47	18,15	11,19
6	1 : 0,7	1,6	60	1,91	2,1	9,23	7,42	6,11	22,24	10,1	7,62	22,51	15,2
7	1 : 0,5	2	40	4,47	3,4	11,76	8,68	5,28	28,50	10,33	5,44	15,18	10,12
8	1 : 0,7	2	60	2,61	2,1	9,64	8,55	6,14	23,42	11,6	8,1	19,16	12,77

When adding phosphorites to coal, it leads to a significant increase in both the oxidation state of the organic mass and an increase in the assimilable form of phosphorus in the phosphate raw material. That is, preliminary mechanical processing of brown coal in the presence of phosphate raw materials has a positive effect on the useful characteristics of the finished product.

Thus, the combination of mechanical and chemical methods of processing brown coal from the Angren deposit and the phosphorites of the Central Kyzyl Kum region makes it possible to obtain effective nitrogen-phosphorus-humic fertilizers

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