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PHOSPHORUS FERTILIZER TECHNOLOGY ACTIVATED FROM PHOSPHORUS POWDER AND MINERALIZED MASS

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Abstract: The article presents the results of obtaining activated phosphorous fertilizer (APF) using phosphoric acid extraction (PAE) from phosphorite powder (PP), which is formed during the washing processes of Central Kyzylkum (CK) phosphorites at high temperature enrichment. Phosphoric acid containing 18.0-21.0% P2O5 and its standards of 110-120% were found to be acceptable sizes for experiments. The main components of APF received in these sizes are as follows: Total P2O5. 30.75-31.53%; P2O5 - 16.28-18.30%; P2O5s.w.- 4.46-5.30%; CaO comm.– 22.33-22.79%; CaO assim. – 12.20-13.18% (when using PP) and total P2O5.-32.58-33.15%; P2O5 - 17.26-19.23%; P2O5s.w.- 4.49-5.39%; CaOcomm.-29.13-29.31%; CaOassim.-15.67-17.22% (when using MM).

Keywords: phosphorite powder, extractable phosphoric acid, calcium hydroxide, acid concentration, activated phosphorus fertilizer.

Introduction. It is known that in our republic, the main phosphate raw material for the production of simple phosphorus and phosphorus-containing complex fertilizers is Central Kyzylkum (CK) phosphorites. The amount of phosphorus contained in these phosphorites is very small and belongs to the type of low-grade phosphorites, and these phosphorites contain an average of 16.2% P_2O_5. However, the reserve of these phosphorites is very large (10 billion tons). Today, these phosphorites are used through high-temperature enrichment, direct acid and processing with various reagents, etc. Recently, a widely used method for enrichment of CK phosphorites is the high-temperature enrichment method. This enrichment method consists of the following stages: separation of mined phosphate raw materials into rich fractions, washing of rich fraction phosphorites from chlorine and burning of the resulting phosphorite raw materials at high temperature. It is known that this thermal enrichment technology has a number of disadvantages: during the separation of phosphorites into rich fractions, the formation of phosphate waste, the so-called mineralized mass (MM), which is larger than 5 mm in size and contains 12-14% P2O5 and its amount is one third of minable phosphate raw materials; during chlorine washing of phosphate raw materials, 15-25% of the total P2O5 goes to waste in the form of phosphorite powder (slurry). 42% of P_2O_5 in phosphate raw material goes to waste in the form of mineralized mass and PP. Recently, a number of scientists of our country (Namazov Sh.S., Erkaev A.U., Mirzaqulov Kh.Ch., Reymov A.M., Sherkuziev D.Sh) have recently worked on the nitric acid processing of CK phosphorites and their waste MM . and others) and a lot of scientific research is being done by their followers. Scientists of our country (Sh.S.Namazov, Kh.Ch.Mirzakulov, A.R. Seytnazarov and others) chemically activated Karatog (Kazakhstan) and Central Kyzylkum phosphorites to obtain various fertilizers. studies have been conducted [1]. Acceptable conditions for phosphoric acid activation of CK phosphate raw materials were determined, technologies for obtaining phosphorous and ammophosphate fertilizers containing a large amount of absorbable and water-soluble P_2O_5 were created, new information was obtained on the solubility properties of ammonium salts in relation to tricalcium phosphate, and The scientific basis of chemical and mechanochemical activation of CK phosphorites was created, methods of pressing and intensive mixing with moisture were developed for granulation of fertilizers. Research method. Processes of obtaining simple phosphorus fertilizers based on hydrochloric acid from Central Kyzylkum phosphorites by various methods are studied in detail in [2-4]. Samples of various phosphate raw materials (MM, ordinary phosphorite flour (OPF), washed and dried phosphorite powder(WDPP) and washed and burned phosphorite powder (WBPP)) were used to obtain ordinary phosphorus fertilizer. The main composition of phosphorus fertilizers obtained in acceptable sizes is as follows depending on the type of PRM (wt., %): P_2O_5comm. 23.63-26.98%; CaO comm. 26.97-29.27%; P_2O_5 assim. 21.09-22.73%; CaOassim. 24.14-25.59%; P_2O_5s.w.1.01-1.28%; CaOs.w.1.05-1.32%; Cl 0.96-1.10%; It is shown that the degree of precipitation is in the range of 94.01-98.05%. However, in the above and other scientific researches, there is no information on obtaining simple phosphorus fertilizers by activating MM and PP with the EPA acid. That's why we have conducted a scientific research on processing PP with nitric acid and obtaining ordinary activated phosphorus fertilizers containing phosphorus [5-7].

Results. As mentioned above, the production of activated simple phosphorus fertilizer mainly includes the following stages: finely divided PP or MM are treated with a 50.0-58.78% concentrated solution of nitric acid in the required amount to convert P_2O_5 into $CaHPO_4$; calcium nitrate solution with a concentration of 10.0-15.0% is added to the interaction product and the calcium hydroxide suspension is neutralized; simple phosphorus fertilizer fertilizer suspension resulting from neutralization is filtered; the wet product is washed with water and the resulting wet activated fertilizer is dried. In this case, dusty-gaseous substances formed during nitric acid decomposition and mixing are sent to the absorption system. As a result of the reaction of phosphate raw materials with nitric acid, the following chemical reactions occur:

$Ca_5(PO_4)_3F + 10HNO_3 = 3H_3PO_4 + 5Ca(NO_3)_2 + HF\uparrow$ (1)
$2Ca_5(PO_4)_3F + 14HNO_3 = 3Ca(H_2PO_4)_2 + 7Ca(NO_3)_2 + 2HF\uparrow$ (2)
$Ca_5(PO_4)_3F + 4HNO_3 = 3CaHPO_4 + 2Ca(NO_3)_2 + HF\uparrow$ (3)
$Ca_5(PO_4)_3F + 10HNO_3 = 5Ca(NO_3)_2 + 3H_3PO_4 + HF\uparrow$ (4)
$CaCO_3 + 2HNO_3 = Ca(NO_3)_2 + CO_2\uparrow + H_2O$ (5)
$MgCO_3 + 2HNO_3 = Mg(NO_3)_2 + CO_2\uparrow + H_2O$ (6)
$2SiO_2 + 10HF = SiF_4\uparrow + H_2SiF_6 + 4H_2O$ (7)
$R_2O_3 + 6HNO_3 = 2R(NO_3)_3 + 3H_2O$, бу ерда R=Al, Fe (8)

When calcium nitrate and phosphoric acid suspension is neutralized with calcium hydroxide, the following reactions occur:

$Ca(H_2PO_4)_2 + Ca(OH)_2 + 2H_2O = \downarrow 2CaHPO_4 \cdot 2H_2O$ (9)
$H_3PO_4 + Ca(OH)_2 = \downarrow CaHPO_4 \cdot 2H_2O$ (10)

Products are created.

According to the technological scheme (Fig. 1), exposure of phosphate waste (PP and MM) with nitric acid is carried out in a screw reactor (location 6) driven by an electric motor (location 7). From the hopper, PW-PP or MM (location 4) is continuously fed to the screw reactor through a weighing adder scale (location 5). From the acid storage volume (location 1) with the acid pump (location 2), the acid is sent to the nitric acid screw reactor through the flow meter (location 3). The slurry formed after the treatment of local phosphate wastes-PP and MM with nitric acid flows from the screw reactor to the mixer reactor (location 10) and to it location) is sent, in addition, water is added there. Here, the unneutralized activated phosphorus fertilizer suspension is mixed through a mixer (position 8) and neutralized with $Ca(OH)_2$. The resulting activated phosphorus fertilizer suspension is sent from the mixing reactor (position 9) through a submersible pump (position 10) to a belt vacuum filter (position 11), where the wet activated phosphorus fertilizer is filtered by washing with water once. The primary and secondary filtrates are collected respectively (location 12) in a common container (location 13). The wet activated phosphorus fertilizer separated from the belt vacuum filter is sent to the drum granulator (location 14) where it is granulated and the finished product is packaged.

Figure 2 shows the scheme of the simplified technology of obtaining PFA on the basis of waste phosphorites - PP and MM and EPA. According to this technological scheme, exposure of phosphate waste (PP and MM) with EPA is carried out in a stirred reactor (location 6) through mixers (location 7). From the hopper FPW-PP or MM (location 1) is continuously fed to the stirred tank reactor (location 6) through a weighing feeder scale (location 2).

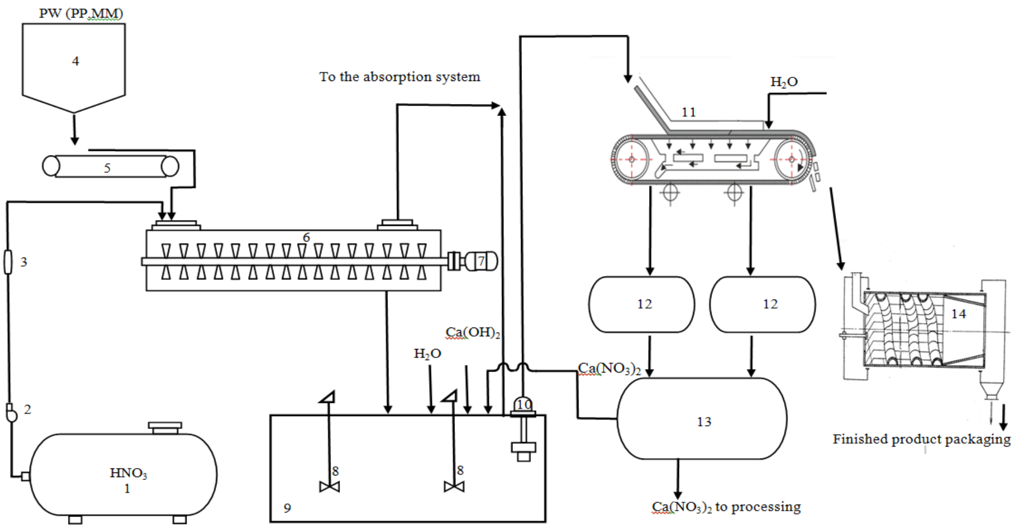

Figure 1. The principle technological scheme of production of activated phosphorus fertilizers based on local phosphate waste and nitric acid. 1- Acid storage volume capacity; 2-acid pump; 3-acid flow meter; 4-hopper for raw materials; 5- weight adding scale; 6- screw reactor; 7- electric motor; 8- mixers; 9- mixing reactor; 10-submersible pump; 11-tape vacuum filter; 12- capacities for the main and additional filters; 13- total capacity; 14-drum granulator.

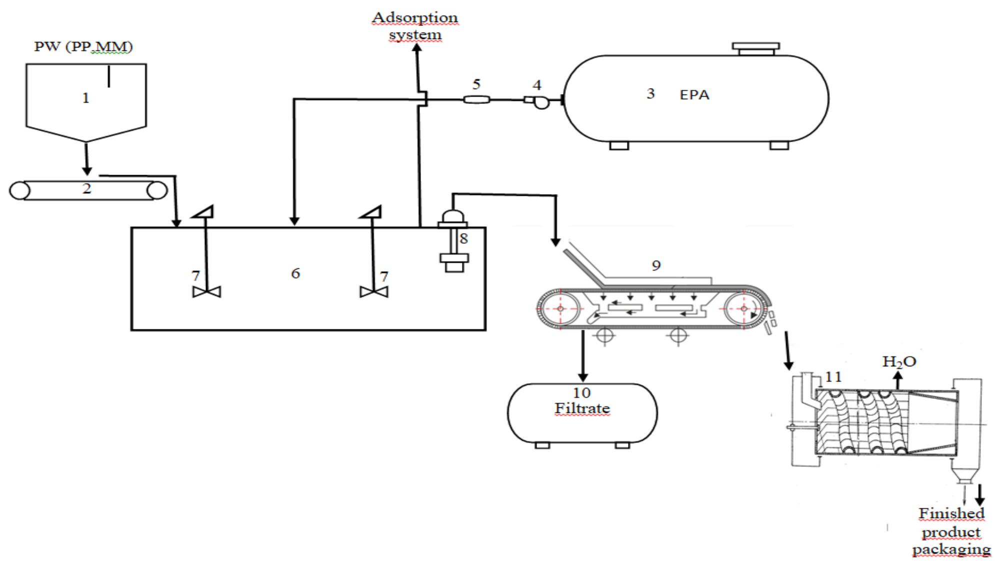

Figure 2. A simplified technological scheme for obtaining activated phosphorus fertilizers based on local phosphate waste and EPA. 1st raw material bunker; 2-weighing scale; 6- screw reactor; 3- acid storage capacity; 4-acid pump; 5-acid flow meter; 6-mixing reactor; 7- mixers; 8- submersible pump; 9-tape vacuum filter; 10-capacity for filtrate; 11-drum granulator.

The acid is sent from the storage volume tank (location 3) to the EPA stirrer reactor through the acid flow meter (location 5) with the acid pump (location 4). The suspension of activated phosphorus fertilizer formed after exposure to local phosphate waste-PP and MM EPA is sent by a submersible pump (location 8) to a belt vacuum filter (location 9) and filtered there. The resulting filtrate is sent to the drum granulator (location 11) where the wet activated phosphorus fertilizer separated from the belt vacuum filter is granulated and the finished product is packaged.

The main composition of APF obtained in these sizes is as follows: P_2O_5comm. 30.75-31.53%; P_2O_5 - 16.28-18.30%; P_2O_5s.w.- 4.46-5.30%; CaOcomm. – 22.33-22.79%; CaOassim.. – 12.20-13.18% (when using PP) and total P2O5.-32.58-33.15%; P2O5 - 17.26-19.23%; P_2O_5s.e.- 4.49-5.39%; CaOcomm.-29.13-29.31%; CaOassim.-15.67-17.22% (when using MM).

Conclusions. The basic rules for obtaining FPW using PP and MM are the same for both PRM. The quantity values of Total P_2O_5 in EFA samples obtained are different.

Processes of production of activated phosphorus fertilizers were investigated in laboratory model equipment. It was found that the general results obtained in acceptable sizes are very close to the results in laboratory conditions. In addition, it was decided not to use water for washing in the process of obtaining EFA from FPW using phosphoric acid, because such fertilizers do not contain any hygroscopic substances. Material flows of EFA using nitric and phosphoric acids from PP and MM were calculated and simplified technological schemes were developed.

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