EXTRACTION TECHNOLOGY OF AMMONIUM PHOSPHATE FROM PHOSPHATE ACID

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Abstract: *Evaporation of local phosphorite - up to 45% of EFK obtained from Central Kyzylkum phosphorites in simple and vacuum conditions leads to a change in its temperature, and the technology of obtaining ammophos by ammonization without separation of the resulting precipitate is shown.*

Key words: *phosphorite, extractable phosphoric acid (EFK), concentration, thermal phosphoric acid (TFK), evaporation, concentrated acid, vacuum, heating, ammonization, fluorine, magnesium, economy.*

The development of the society is determined by the growth of the population, which is followed by an increase in the needs of the population. The most basic and important aspect of this is the development of the agrarian industry in order to provide the population with food products, which is the main factor of the development of the society. Because the most important part of food security is the quantity of food. In order to increase productivity, it is necessary to increase the substances and elements absorbed by the plant in the soil. For this, it is necessary to develop the mineral fertilizer production industry due to the lack of natural organic mineral fertilizers. That is why these issues are included in the main plan of our country.

The problem of fertilizers is in the first place in the development of agriculture. In order to solve these problems, breeding of their main types and development of new technologies are among the main tasks facing the chemical scientists of our republic.

Mineral fertilizer production industry is widely developed in our country. However, it is necessary to continue scientific work in order to increase the level of absorption by the plant, to use the used raw materials economically, and to ensure the quality of the fertilizer.

Currently, there are organic, mineral and organomineral types of fertilizers used in agriculture. However, phosphorus mineral fertilizers are being prepared to increase the amount of the main absorbable phosphorus. The most basic of these, besides, ammophos, simple and double superphosphate production is widely established due to the ease of production .

Central Kyzylkum phosphorites used for the production of phosphorous fertilizers are local, which is convenient for production. However, 14-16% P_2O_5 of phosphorus in its content is used to enrich this phosphorite by reducing excess substances through additional processing.

In addition to the enrichment of phosphorites in the production processes of phosphorous fertilizers, extractable phosphoric acid (EFK) is also obtained in a low concentration in the production process. In order to prepare high-quality, that is, mineral fertilizers containing plant-absorbable phosphates, it is planned to increase the concentration of these EFCs by reducing the amount of water in them. For this, the process of evaporation of EFCs is widely used in the chemical industry.

Another property of mineral fertilizers is that the level of absorption by plants is very low after they are applied to the ground and after irrigation. In particular, the rate of use of nitrogen fertilizers is based on the easy evaporation and solubility of nitrogen in water, the rate of evaporation of nitrogen in their content, phosphorus contained in phosphoric fertilizer, and the addition of leachate and perob water are high. In order to eliminate these shortcomings, it is necessary to use gradually dissolving types of fertilizers, that is, types in the form of polyforms.

In order to form phosphorus in the form of polyphosphate in phosphorus fertilizer, its concentration is increased through the process of evaporation of Extractive Phosphoric Acid (EFK), which is intended for mineral fertilizer. It is known that the use of thermal phosphoric acid (TPA) is convenient for making high-concentration phosphoric acid easily absorbable in mineral fertilizers. However, due to the high cost of this, such TFK is not produced in Uzbekistan, and EFK is used instead.

In order to obtain quality ammonium phosphates from EFK, it is necessary to carry out the process of cleaning them from heavy metals, arsenic, calcium, magnesium and fluorine. This needs to be done in a cost-effective way. Such methods are divided into evaporation, deposition, use of organic solvents, ion exchange, and crystallization. One of the convenient methods currently implemented is evaporation, which reduces the amount of water contained in the initial EFF.

Chemical and physicochemical analysis showed that the composition of the original EFK was entirely orthophosphoric acid. In order to increase the amount of phosphorus pentaoxide P_2O_5 in the phosphorus fertilizer, it is necessary to evaporate the initial EFK obtained from phosphorites.

The laboratory work was carried out in a laboratory device with a simple glass reactor, a water cooler against evaporation of water as a result of the reaction, and an electromotive stirrer, by gradually adding sulfuric acid to phosphorite of the specified standard. Thermal concentrate of Central Kyzylkum phosphorite for laboratory use (composition: P_2O_5 – 25,68%; CaO – 53,28%; CO_2 – 2,68%; MgO – 1,22%; F – 2,76, R_2O_3 – 3,58%; SO_3 – 5,01%) and 93% sulfuric acid was obtained. The stoichiometric rate of sulfuric acid was set at 100% according to the amount required for the decomposition of calcium in phosphorite and brought to an aqueous solution of the appropriate concentration.

When it reacts with sulfuric acid H_2SO_4 - phosphorite - $Ca_5F(PO_4)_3$ taken for the reaction, the following process is observed:

$Ca_5F(PO_4)_3 + 5H_2SO_4 = 3H_3PO_4 + 5CaSO_4 + HF$.

It is known that calcium dihydro- and hydrophosphates are formed in addition to the main phosphoric acid H_3PO_4 formed during the acid decomposition of phosphorites:

$2Ca_5F(PO_4)_3 + 7H_2SO_4 = 3Ca(H_2PO_4)_2 + 7CaSO_4 + 2HF$,

$2Ca_5F(PO_4)_3 + 4H_2SO_4 = 6CaHPO_4 + 4CaSO_4 + 2HF$.

he process was continued for 4 hours and EFK was isolated by filtration. Repeating this process 3 times, the chemical composition of the obtained EFKs was determined by the analytical method according to the established procedure:

Chemical composition of EFK obtained from phosphorite

Table 1

№	P_2O_5	H_2SO_4	CaO	MgO	Al_2O_3	Fe_2O_3	F
Each EFK received is separate							
1	27,64	0,18	0,51	1,24	1,92	1,45	2,23
2	27,53	0,23	0,53	1,19	1,99	1,38	2,28
3	27,87	0,26	0,48	1,17	1,91	1,42	2,25
With mixed EFCs							
4	27,67	0,24	0,51	1,2	1,94	1,42	2,26

It is known that this obtained EFK is used in the process of obtaining double superphosphate or ammonium phosphates. If we take into account the requirements of the present time, the abundance of additional substances and elements in its composition, especially the excess of fluorine, will have a negative effect on the quality of the obtained fertilizer. Taking this into account, the EFK concentration process is carried out at a high temperature, which gives a positive result.

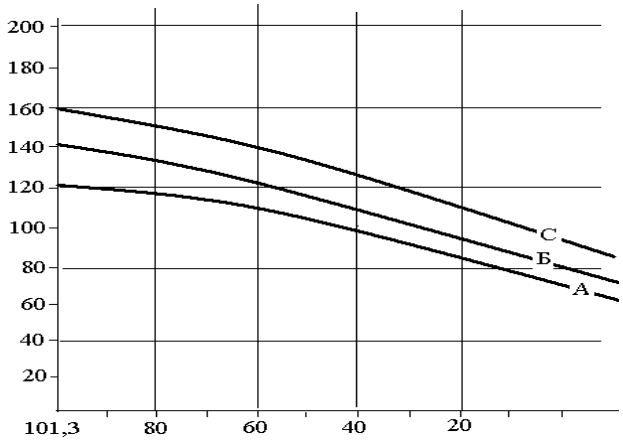

Fig. 1: Variation of boiling temperature during vacuum evaporation of EFC: A-45, B- 50, S- 55% for EFCs with P_2O_5 concentration of.

During the evaporation process of EFC, as its concentration increases, the boiling point increases accordingly. When the EFC concentration reaches 45% P_2O_5, the boiling point reaches 120 °C, 140 °C at 50 %, and 160 °C at 55 % (Figure 1).

Modern industrial production requires the use of energy-efficient technologies. Correspondingly, as shown in Figure 1, under reduced pressure conditions, boiling temperatures are reduced and energy savings are observed.

It is known that the presence of substances and elements in EFK and its amount depends on the content of phosphorite used. Phosphorite contains fluorine, magnesium, and similar additives that are transferred to EFK during the extraction process. One of the properties of magnesium is that it causes its condensation when the concentration of the evaporating EFC reaches 40÷45%. Therefore, the first stage of the high-quality evaporation process is up to 40÷45%, and after reaching this concentration, EFK is cleaned from the magnesium precipitate. Ammonium phosphate fertilizer was obtained by neutralizing the EFK with ammonia by taking the experiment without the precipitate being cleaned. Chemical and physico-chemical analysis of the resulting fertilizer proved to be ammonium phosphate with magnesium content, which is necessary for agriculture.

In order to concentrate EFK, two methods - evaporation under normal conditions and under vacuum conditions - were carried out. During evaporation under normal conditions, that is, when P_0=101,3 kPa, the boiling temperature increased to 120^{o}C when the P_2O_5 content of EFK reached 45%, and to 167^{o}C during the subsequent ammonification period. The main point of this is that the amount of fluorine in the mixture is reduced to an average of 0.52% at the end of neutralization, from 2.26% in the initial EFK content. Comparing this to the EFK two-stage evaporation process, almost the same performance was achieved.

It can be said that depending on the amount of magnesium in EFK, the boiling point changes. For example, 0.54% is 110^{o}C and 1.50 is 154 degrees. The main reason why evaporation can be continued until the initial stage of the evaporation process is 45% when the content of magnesium in the EFC being evaporated is 0.54% is based on its high fluidity at high temperature. Correspondingly, when it is MgO 1.24%, it was determined in the experiment that it is forced to separate from the precipitate when the concentration of EFC reaches 40%. By starting the ammonization process without separating the precipitate, the further increase in temperature is the basis for the fluorine to fly out. Due to the industrial production of the phosphorus mineral fertilizer obtained in this way, the cost reduction is achieved.

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