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TECHNOLOGY OF AMMOPHOS MODIFIED WITH PHYSIOLOGICALLY ACTIVE SUBSTANCES

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Abstract: This article presents the results of a study on modified ammophos technology. Physiologically active substances—IVIN and TPN—were used for modification. A technology for producing ammophos containing IVIN and TPN, based on phosphate raw materials from Karatau, was developed.
Key words : complex fertilizer, physiologically active substances, ammophos, melt, modification, solubility, system, concentration, evaporation, pulp, scheme.
Abstract: The article presents the results of the study of the technology of modified ammophos . Physiologically active substances were used for modification - IVIN, TPN. A technology has been developed for the production of ammophos containing IVIN and TPN based on Karatau phosphate raw materials.
Key words: complex fertilizer, physiologically active substances, ammophos , melt, modification, solubility, system, concentration, residue, pulp, scheme .

Introduction

One of the ways to solve the problem of chemicalization of agriculture is the creation of complex fertilizers containing physiologically active substances (F AB), stimulants of plant growth and development.
There are a huge number of biologically active compounds, but many of them are due to insufficient efficiency, toxic effects on warm-blooded animals, the ability to accumulate in the external environment, the inaccessibility of raw materials and semi-finished products for their synthesis, and high cost.
Solid-phase method of production polymer complexes containing physiologically active substances [1-3].
The possibility of obtaining mineral fertilizers containing physiologically active substances has been demonstrated [4].
Promising in this regard are pyridine derivatives [5, 6], in particular, IVIN, derivatives of benzimidazole structural analogs of purine and pyrimidine bases [7-10], among which drugs with a wide spectrum of growth-regulating and pesticidal activity have been found (rosalin , uzgen , olgin , BION, 5- KHBION, etc.). and furan compounds, in particular, TPN [11,12], which are finding ever wider application in various areas of the national economy.
Currently, growth factors are used to treat seeds or spray growing plants with aqueous solutions of a certain concentration. The combined application of fertilizers with physiologically active substances is both agrochemically and economically advantageous.
One of the used FAS is β- (2-tetrahydrofuryl) propionitrile (TPN) - tetranyl - a derivative of furan, a mobile liquid from yellow to light brown color with a specific odor; molecular weight - 125 c.u. n_D^{20} = 1.4468; viscosity at 20 ^{0}C - 2.7 siz; pH = 7; boiling point 92-94 ^{0}C with / 8 mm Hg; fire and explosion proof .
Empirical formula: $C_7H_{11}NO$. Structural formula:

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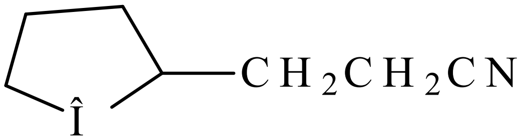

Tetranil does not have corrosive properties, is stable in aqueous solutions, and slightly oxidizes under the influence of sunlight , so it can be stored in a sun-protective container for more than 5 years at a temperature of 25-45°C.
TPN is highly soluble in water, chloroform, acetone, alcohol, poorly soluble in methanol, insoluble in hexane , acetonitrile , nitrile acetate .
The physicochemical characteristics of tetranyl - IR, UV, PMR spectra are presented in [12].
Tetranil was first obtained at the Institute of Chemistry of Plant Substances of the Academy of Sciences of the Republic of Uzbekistan [13] .

The use of fertilizers with physiologically active substances allows for the improvement of growth, development, and yield of plants, increased resistance to diseases, full use of the main elements of mineral nutrition, and eliminates unnecessary costs for their individual application to the crop [13-16].
As a rule, the introduction of physiologically active substances, despite their relatively high cost, gives a positive effect at their low concentrations (from 0.03 to 0.05 wt %) in complex fertilizers. The production of fertilizers containing FAB is not associated with significant specific capital investments in the reconstruction of existing process flow charts; however, it is necessary to solve a number of technological problems associated with the organization of dosing units. FAS, mixing FAS with a large fertilizer flow, and analytical quality control of the finished product. ***In*** this regard, this chapter examines the issues and conducts research on the development of methods for introducing *FAS into fertilizers and producing ammophos and urea modified with FAS. Data on solubility and fusibility in* the systems we studied, presented below, were used to solve a number of process problems .
$C_7H_9NO - NH_4H_2PO_4 - H_2O$, $C_7H_9NO - (NH_4)_2HPO_4 - H_2O$, C_7H_9NO - [90% $NH_4H_2PO_4$+10% $(NH_4)_2HPO_4$] - H_2O, $C_7H_6N_2O - H_3PO_4 - H_2O$, $C_7H_6N_2O - NH_3 - H_2O$, $C_7H_5N_2OCl - H_3PO_4 - H_2O$,

2. Research methodology

To study the solubility of phases in water-salt systems, a visual- polythermal analysis method developed by A.G. Bergman was used [17-19].
The essence of the visual- polythermal method is to determine the crystallization temperature by visual observation of the temperature of the appearance of the first crystals, which are released during slow cooling and vigorous stirring of the solution, and the temperature of disappearance of the last crystals during heating, after which a composition-crystallization temperature diagram is constructed.
When conducting the studies, recrystallized salts of the " analytical grade " and " chemically pure " grades and laboratory-synthesized IVIN, TPN [20-24] were used.
The analyses for phosphorus content were carried out using known methods [25]

2.The main part

The bottleneck in the production of ammophos modified with FAS is the unit for introducing FAS into the acid or pulp. Since the optimal concentration of FAS in ammophos, according to agrochemical and toxicological studies, is 0.15-0.05%, the hourly consumption of the physiologically active additive in the EFA or ammophos pulp for existing process lines with a capacity of 120,000 tons of P_2O_5 per year for those working with phosphate raw materials . The

output of ammophos pulp will be 4.5-15 kg/h. The mass ratio of ammophos pulp:FAS is 14,500:4,500:1 and ammophos pulp:FAS = 11,000-3,500:1.
Uniform distribution of the additive with such a mass ratio of components presents significant difficulty.

It is advisable to remove part of the acid or pulp , dissolve a physiologically active additive in this volume and mix it with the main flow of acid or pulp.
As studies of systems based on IVIN, TPN and ammophos components have shown, it is advisable to introduce FAS into neutralized ammophos pulp, since their decomposition is possible when mixed with phosphoric acid.

Analysis of phase diagrams of solubility of the systems C_7H_9NO -$(NH_4)_2HPO_4$, $NH_4H_2PO_4$, [90% $NH_4H_2PO_4$+10% $(NH_4)_2HPO_4$]- H_2O showed that the physiologically active additive dissolves well in aqueous solutions of ammonium dihydroorthophosphates and ammonium hydroorthophosphates .

When mixed with solutions of high concentration ammonium dihydroorthophosphates and ammonium hydrogen orthophosphates, TPN is poorly soluble, so it was not possible to construct complete polythermal diagrams including TPN and ammonium phosphate components .
Therefore, when IVIN is introduced into ammophos pulp at a temperature above 60° C , according to the solubility diagram, it will dissolve to a content of *5 %* by weight . This concentration is optimal, since it takes *1-2* minutes for the IVIN to dissolve and be uniformly mixed . The ammophos pulp after the high-speed ammoniator -evaporator (SAE) with a salt solution mass of 50-55 - % has a temperature of -80-85 °C. Dissolving IVIN does not present any particular difficulty.
The ammophos pulp obtained in this way , containing *5* wt .% IVINA is mixed with such a quantity of ammophos pulp that the concentration of FAS in the finished product is 0.03-0.05 wt .%.
In connection with the above, we have proposed a technological scheme for obtaining ammophos containing F AB (Fig. 1).
Part of the pulp flow entering the evaporation unit from the SAI apparatus 7 is diverted to the mixer reactor 10, heated through a jacket with heating steam. The calculated amount of FAS is also introduced there from the bin 8 by means of a weigh batcher 9. The residence time of the reagents at a temperature of 70-80°C is 3 min. The concentration of IVIN in the pulp is maintained at a level of *5* wt .%. Then, the IVIN-containing source of the ammophos pulp is mixed with the main flow directly in the evaporator 12 with a remote heating chamber due to the circulation provided by pump 6. The ratio of the main and IVIN- containing flows of the ammophos pulp is 330-200:1 and ensures a concentration of the physiologically active substance in the finished product of 0.03-0.05 wt .%.
The ammophos pulp after the evaporator 12 is fed to the granulation system 15, where granulation and drying take place. After cooling and pouring the product into the pea mill (18), the fine fraction (particles less than 1 mm in size) is returned to the granulation system as external recycle . The coarse fraction is sent to the crusher (17), and The goods are cooled in a refrigerator (19) and sent to the finished goods warehouse (20).
The production of ammophos containing IVIN and TPN, based on phosphate raw materials from Karatau, is carried out using SAI units for ammonization of EPA, and BGS units for granulation and drying. The process parameters are given for a standard process line with a capacity of 120 thousand tons of P_2O_5 . per year.

Table 1.

Indicators of the technological mode of production of ammophos containing IVIN and TPN

Neutralization of EPA:		
Concentration of EPA , wt .% P_2O_5		20.0:21.0
Molar ratio $NH_3 : H_3PO_4$		1.00:1.1
pH of ammophos pulp		4.9:4.5
Pulp temperature, °C		90:95
Ammonization time in the SAI apparatus, min		1:2
Dissolution of IVIN or TPN in ammonium pulp:		
The ratio of pulp flow diverted to dissolution stage to the main flow		1 :250 :300
Dissolution time, min		3:4
Temperature, °C		85:90
Concentration of FAS (IVIN or TPN) in the pulp, wt .%		4.5:5.0
Mixing ammophos pulp with FAB- containing pulp **:**		
The ratio of flows of FAB- containing pulp and ammophos pulp		1 :250 :300
Mixing time, min		1 :1.5
Additive concentration in pulp, wt .%		0.818 * 8.08
Pulp density, kg/ ^{m3}		1280:1300
Pulp moisture content, %		50:55
Pulp evaporation:		
Pulp moisture content, % wt .	before evaporation	50:55
	after evaporation	20:40
Density of pulp after evaporation, kg/ ^{m3}		1400:1500
Pulp temperature after evaporation, °C		90:95
Drying and granulation in BGS		
Flue gas temperature , °C	at the entrance to BG C	550:650
	exhaust gases	100:110
Product temperature, °C	in a layer	80:90
	at the exit of the BGS	75:80
Output of commercial fraction with size		
granules 1-4 mm, %		90
Composition of ammophos containing physiologically active substances		
Mass fraction of digestible phosphates, %		45:47
Mass fraction of total nitrogen, %		10 ± 1
Mass fraction of FAV **(** IVIN or TPN), **%**		0.03:0.05
Mass fraction of moisture, %, not more than		1.5
Granulometric composition:		
mass fraction of granules with size, mm1-4		90:95
less than 1 mm		5

Granule strength, MPa, not less than	3
Friability, %	100

Conclusions

A technology for producing ammophos containing IVIN and TPN has been developed using phosphate raw materials from Karatau. The ammophos-containing FAS does not cake, and its hygroscopic point is close to that of pure ammophos. The fertilizer technology is implemented using existing ammophos production equipment with the installation of an additional reactor for dissolving physiologically active additives and mixing ammophos pulp flows, as well as storage units and FAS dosing units *in* a reactor-mixer.

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