

## STUDY OF THE PROCESS OF OBTAINING LIQUID FERTILIZER WITH PHYSIOLOGICAL ACTIVITY

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### ABSTRACT

In work to substantiate the process of obtaining liquid fertilizers based on solutions of potassium sulfate, ammonium nitrate, carbamide, copper sulfates and monoethanolammonium. The dependence of the change in the physicochemical properties of solutions on the composition of the components has been studied. On the basis of the data obtained, the “composition-properties” diagrams were constructed.

**Keywords:** solution, urea, diagram, system, ammonium nitrate, potassium sulfate, fertilizers, properties, composition, ratios.

### INTRODUCTION

For normal growth, development and creation of high yields of plants, along with nitrogen-phosphorus fertilizers, potash fertilizers are needed, which contribute to the normal course of vital processes in the plant organism. The lack of mobile forms of potassium in the soil will reduce productivity, impair the assimilation of nitrogen and phosphorus fertilizers.

### MATERIALS AND METHODS

The range of manufactured potash fertilizers includes potassium chloride and potassium sulfate, as well as mixed potassium salts. However, the systematic introduction of chloride forms of potassium leads to the accumulation of chlorine

ions in the soil, which adversely affect the yield and quality of many industrial crops. Its use is especially unfavorable in the conditions of Central Asia, where most of the soils are of the serozem type, prone to chloride salinization.

Among the chlorine-free forms of potash fertilizers, potassium sulfate, which feeds plants with potassium and sulfur, has the greatest prospects for production and use. Potassium sulfate is a valuable chlorine-free fertilizer. Potassium sulfate has a much more effective effect on the size of the crop and its quality if it is used in combination with nitrogen and phosphorus fertilizers. After the use of potassium sulfate in grown fruits, vegetables and berries, the content of sugars and vitamins increases noticeably, the resistance of plants to various diseases increases, and the percentage of damage to finished products by heart and gray rot decreases. Potassium sulfate as a fertilizer must be used to provide perennial plants with a successful winter. By feeding fruit trees and shrubs with potassium sulfate in autumn, one can expect that they will survive even the most severe frosts with insignificant losses [1]. One of the most effective methods for the production of mineral fertilizers is to obtain them in liquid form. The production of such fertilizers leads to a reduction in the number of processes and, in comparison with solid fertilizers, to a significant reduction in costs.

Today, one of the important tasks is the development and improvement of technologies for obtaining new complex fertilizers based on local raw materials. To solve this problem, it is relevant to use potassium sulfate as a feedstock, produced at JSC "Maksam-Chirchik", followed by enrichment of the potassium sulfate solution with components of nitrogen fertilizers, physiologically active substances and microelements.

## RESULTS AND ITS DISCUSSION

To substantiate the process of obtaining a liquid fertilizer based on a solution of potassium sulfate and ammonium nitrate, the dependence of the change in the physicochemical properties of solutions on the composition of the components in the system  $[10\% \text{K}_2\text{SO}_4 + 90\% \text{H}_2\text{O}] + \text{NH}_4\text{NO}_3$  was studied.

In order to clarify the mutual influence of the components on the physicochemical properties of solutions of this system, the change in the crystallization temperature, pH of the medium, the density and viscosity of solutions from the composition of the components was determined [2-4]. On the basis of the data obtained, the diagram "composition-properties" of the system was constructed (Fig. 1).

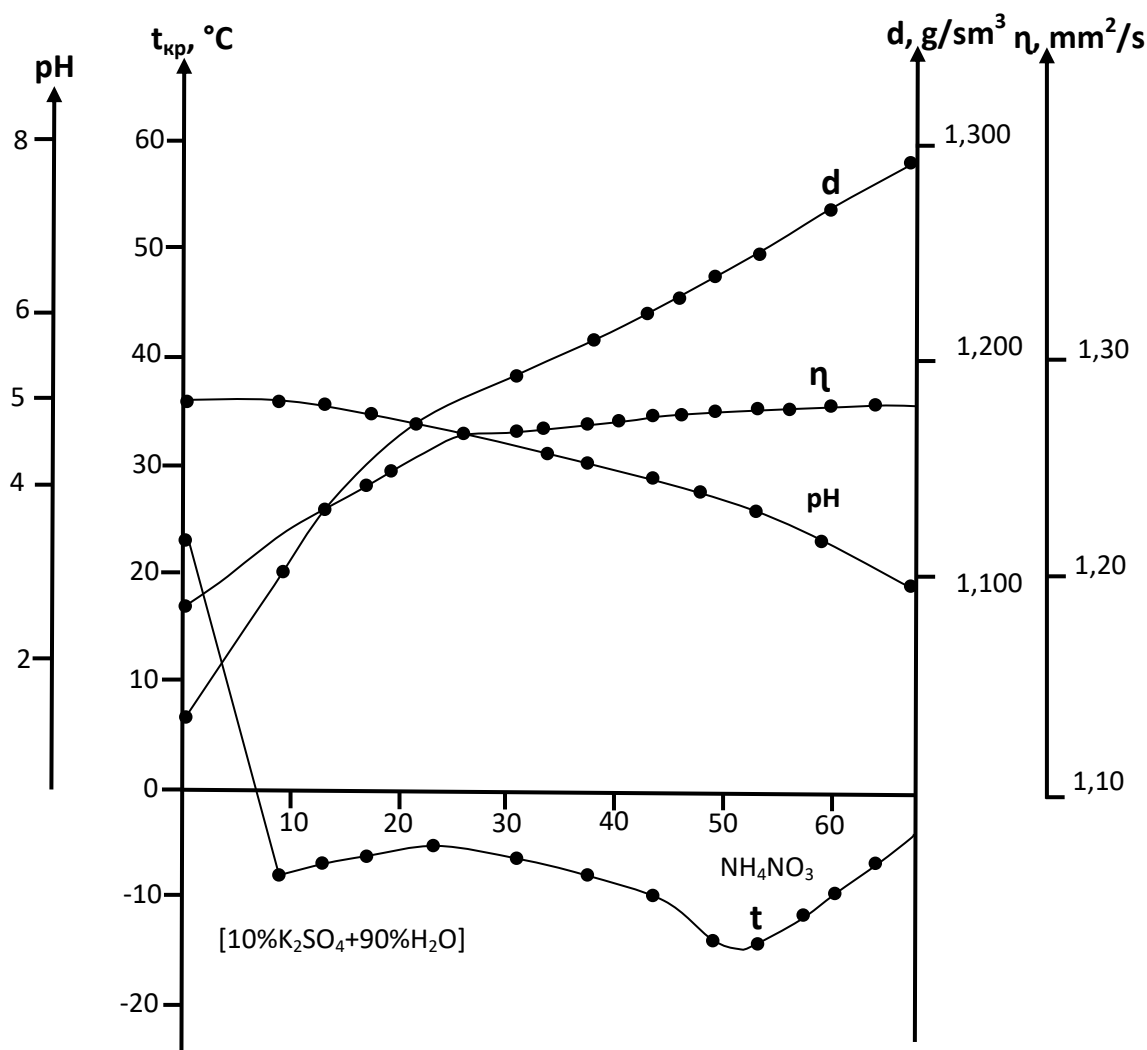


Fig.1 Diagram "composition-properties" of the system  
 [10% K<sub>2</sub>SO<sub>4</sub> + 90% H<sub>2</sub>O] -NH<sub>4</sub>NO<sub>3</sub>

According to the data obtained, the composition-crystallization temperature diagram is characterized by the presence of three crystallization branches with obvious breaks in the solubility curve. The first branch corresponds to the crystallization of K<sub>2</sub>SO<sub>4</sub> and continues up to 9.4% ammonium nitrate content. In the range of ammonium nitrate concentrations of 9.4 ÷ 50.0%, K<sub>2</sub>SO<sub>4</sub> and NH<sub>4</sub>NO<sub>3</sub> crystallize in the system. Infatuated with nitrate content ammonium more than 50% in the system is crystallized by NH<sub>4</sub>NO<sub>3</sub>, which was confirmed by the results of chemical and X-ray phase analysis.

Analysis of the "composition-properties" diagram of the studied system shows that as ammonium nitrate is added to the initial potassium sulfate solution, the pH values of the newly formed solutions gradually decrease. The values of the density

and viscosity of the solutions of the system gradually increase, respectively:  $d$  from 1.086 to 1.29 g / cm<sup>3</sup> and  $\eta$  from 1.134 to 1.282 mm<sup>2</sup> / s.

With this ratio of components, a solution is formed with satisfactory physicochemical properties: crystallization temperature -9.0 ° C, density 1.22 g / cm<sup>3</sup>, viscosity 1.268 mm<sup>2</sup> / s and pH 4.24.

It is known that physiologically active substances are widely used to obtain high yields with good qualities.

(auxins, kinins, gibberellins and others) possessing high activity and the ability to influence the intensity of all processes occurring in the plant organism [5,6]. They can enhance cell growth, stimulate cell division, and promote protein and nucleic acid synthesis.

Physiologically active substances have a beneficial effect on the growth, development and fruiting of plants, significantly increase resistance to various diseases and improve the absorption of basic nutrients by plants, increase productivity, reduce its ripening period and improve product quality [7,8].

The most effective, economically and agrochemically expedient method of using physiologically active substances is their combined use with basic fertilizers. At the same time, additional costs for the introduction of each drug are eliminated, their uniform distribution in the soil is achieved and the efficiency of fertilizers increases [9-12].

Thus, the combined use of physiologically active substances with fertilizers improves the use of all elements of mineral nutrition and increases the efficiency of fertilizers. Therefore, research on obtaining more effective forms of fertilizers, which, along with the main elements of nutrition, contain physiologically active substances, are relevant.

To obtain a liquid fertilizer containing such nutrients as K<sub>2</sub>O, S, N, as well as FAS-monoethanolammonium sulfate, the physicochemical properties of solutions were studied in the system {60% [10% K<sub>2</sub>SO<sub>4</sub> + 90% H<sub>2</sub>O] + 40% NH<sub>4</sub>NO<sub>3</sub>} - H<sub>2</sub>SO<sub>4</sub> · NH<sub>2</sub>C<sub>2</sub>H<sub>4</sub>OH.

On the basis of the data obtained, the diagram "composition-properties" of the system was constructed (Fig. 2).

Analysis of the diagram shows that as monoethanolammonium sulfate is added to the initial solution of the composition {60% [10% K<sub>2</sub>SO<sub>4</sub> + 90% H<sub>2</sub>O] + 40% NH<sub>4</sub>NO<sub>3</sub>}, the crystallization temperatures of the newly formed solutions gradually decrease  $t_{cr}$  from -9.0 ° C to -12, 5 ° C. The values of density, viscosity and pH of solutions gradually increase. Rani carried out agrochemical tests it was found that the optimal rate of monoethanolammonium sulfate as PAS is 0.2 ÷ 0.3%. The obtained results of the study of this system and the results of agrochemical tests indicate the

possibility of obtaining a liquid fertilizer containing PAS by dissolving monoethanolammonium sulfate in an initial solution based on potassium sulfate and ammonium nitrate at a mass ratio of 1.0: 0.002 ÷ 0.003. The resulting solution has a crystallization temperature of  $-11.0 \div 11.5$  °C, a density of  $1.2244 \div 1.2252$  g / cm<sup>3</sup>, a viscosity of  $1.283 \div 1.287$  mm<sup>2</sup> / s and a pH of  $5.0 \div 5.1$ .

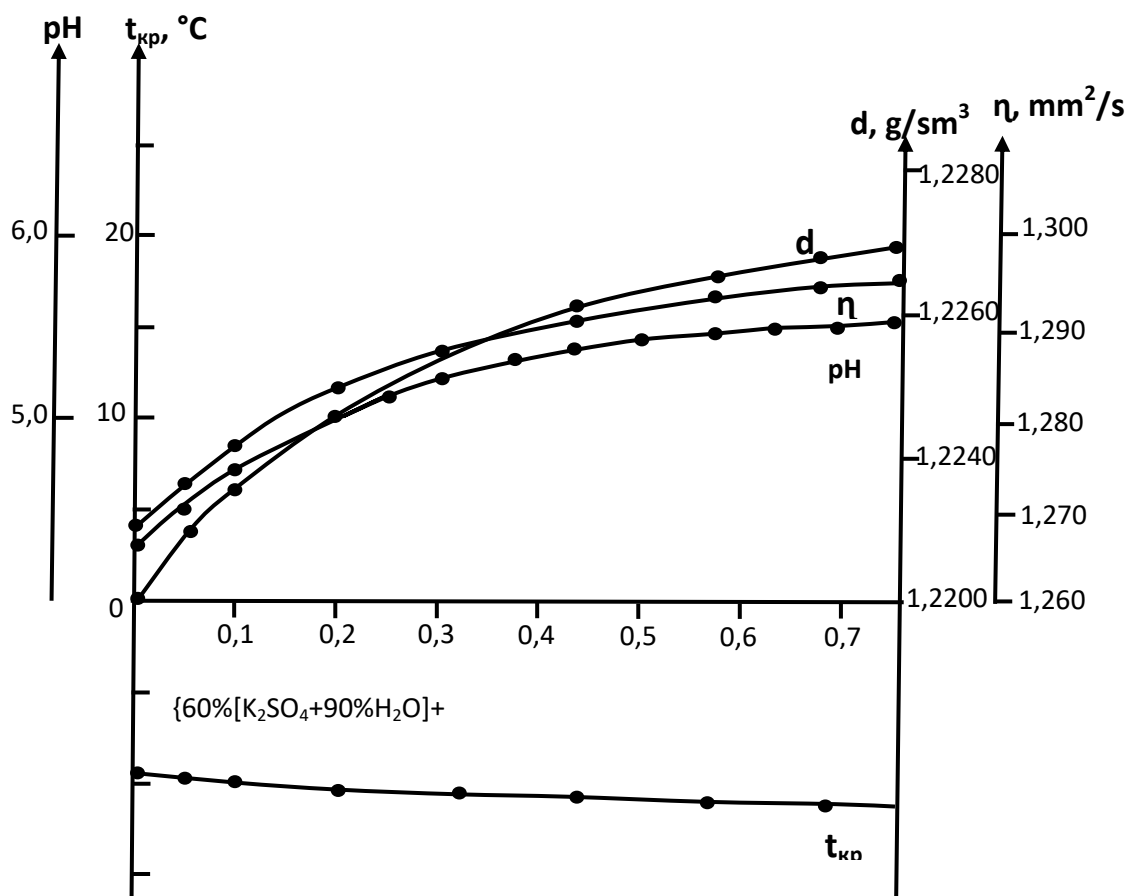


fig.2 Diagram "composition-properties" of the system {60% [10% K<sub>2</sub>SO<sub>4</sub> + 90% H<sub>2</sub>O] + 40% NH<sub>4</sub>NO<sub>3</sub>} - H<sub>2</sub>SO<sub>4</sub> · NH<sub>2</sub>C<sub>2</sub>H<sub>4</sub>OH

An indissoluble component of measures to increase the productivity of agricultural crops is the use of microelements, since the use of only mineral and organomineral fertilizers is not enough for the normal development of plants. The role of trace elements in plant nutrition is multifaceted.

Trace elements increase the activity of many enzymes and enzyme systems in the plant organism and improve the use of macrofertilizers and other nutrients from the soil by plants [13].

With the aim of introducing a microelement into the composition of the resulting fertilizer, the dependence of the change in the rheological properties of solutions in the system {59.7% [10% K<sub>2</sub>SO<sub>4</sub> + 90% H<sub>2</sub>O] + 40% NH<sub>4</sub>NO<sub>3</sub> + 0.3%

$H_2SO_4 \cdot NH_2C_2H_4OH$  } - $CuSO_4 \cdot 5H_2O$  by measuring the crystallization temperature, density, viscosity and pH of the solution medium. On the basis of the data obtained, the diagram "composition-properties" of the system was constructed (Fig. 3).

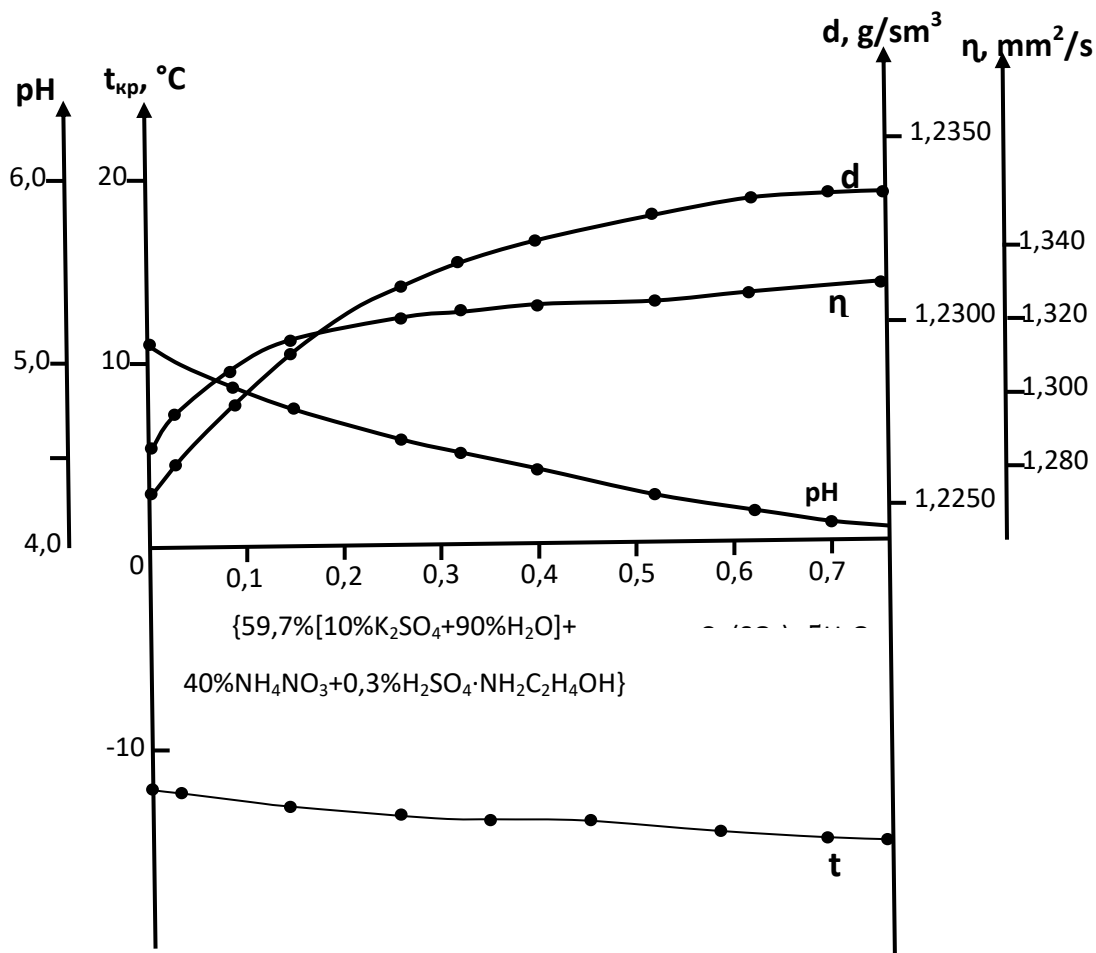


Fig.3 Diagram "composition-properties" of the system {59.7% [10% K<sub>2</sub>SO<sub>4</sub> + 90% H<sub>2</sub>O] + 40% NH<sub>4</sub>NO<sub>3</sub> + 0.3% H<sub>2</sub>SO<sub>4</sub> · NH<sub>2</sub>C<sub>2</sub>H<sub>4</sub>ON} -CuSO<sub>4</sub> · 5H<sub>2</sub>O

Analysis of the diagram shows that no breaks are observed on the curves of composition - crystallization temperature, density, viscosity and pH of this system, that is, within the studied concentration limits, changes in the crystallizing solid phases do not occur in the system and the components retain their individuality, and therefore physiological activity.

## CONCLUSION

Thus, based on the results of the studied systems and preliminary agrochemical tests of various compositions, it follows that to obtain a liquid fertilizer of complex action containing a trace element (Cu), it is necessary to dissolve copper sulfate at a

mass ratio in the initial solution based on potassium sulfate, ammonium nitrate, monoethanolammonium sulfate 1.0: 0.001 ÷ 0.002.

The resulting fertilizer solution has the following physicochemical properties: blue solution,  $t_{cr} = -12^{\circ}C$ ,  $d = 1.2300 \text{ g/cm}^3$ ,  $\eta = 1.317 \text{ mm}^2/\text{s}$ ,  $pH = 4.58$  and contains wt%: N = 14.07; K<sub>2</sub>O = 3.21; S = 1.84; FAV = 0.3; Cu = 0.02.

## REFERENCES

1. <https://udobreniya.info/promyshlennye/sulfat-kaliya/>
2. Frolov Yu.G. Colloid chemistry course // Surface phenomenon and dispersed systems. –M.: 1982. –S. 117-124.
3. Zdanovsky A.B. Hallurgy. -L.: Chemistry. 1972.-572 s.
4. Gorbachev S.V. Physical chemistry workshop. –M.: Higher school, 1974. -310s.
5. Verzilov V.F. Growth regulators and their use in crop production. -M.: Nauka, 1971 -144 p.
6. Durdyev N., Agakishiev D. The influence of some regulators on the growth, development and yield of cotton with different water supply. - Publishing house. AN Turkm. SSR, Ser. Biological Sciences, 1970, No. 3. S.23-27.
7. Blagoveshchenskiy AA, Rakhmanov RR Biochemical nature of increasing yields with succinic acid. -M.: Publishing house of Moscow State University, 1970.-62 p.
8. Babaev D., Agakishiev D. The influence of growth stimulants on the change in the content of natural physiologically active substances in cotton. –Izv-to AN Turkm. SSR, Ser. Biological Sciences, 1968, No. 3. pp. 12-20.
9. Tukhtaev Saydiahral. Physicochemical bases for obtaining complex fertilizers containing trace elements, physiologically active substances and defoliant. // Autoref. diss.... doct. chem. Sciences. - Tashkent, 1983. - p.62.
10. Saibova Marena Tashmetovna. Chemistry of complex nitrogen and nitrogen-phosphorus fertilizers with physiologically active substances. // Autoref. diss.... Doctor of Chem. Sciences. - Tashkent, 1989. - p. 60.
11. Abdullaev M.T. Obtaining liquid nitrogen fertilizers based on urea and ammonium nitrate with physiologically active substances. // Abstract of thesis ... diss. (PhD) Doctor of Philosophy in tech. naukam.-Tashkent. 2018. –C.53.
12. Azimov S. Kh. Technology of obtaining liquid nitrogen fertilizers modified with monoethanolammonium salts of carboxylic acids. // Abstract of thesis ... diss. (PhD) Doctor of Philosophy in tech. naukam.-Tashkent. 2019. –P.45.
13. Bulygin S.Yu., Demishev L.F., Doronin V.A., Zarishnyak A.S., Pashchenko Ya.V., Turovsky Yu.E., Fateev A.I., Yakovenko M.M., A.I. Kordin Trace elements in agriculture. Dnepropetrovsk, 2007. –S. 100.