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Study of Copper Sulfate System with Hexamethylenetetramine and Formalin

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ABSTRACT: Background of the problem one of the main directions of increasing crop yields is to provide agriculture with mineral fertilizers, plant growth stimulants and fungicides and pesticides. In this article, the physicochemical properties of the system based on hexamethylenetetraamine, formalin and copper sulfate were given.

KEY WORDS: hexamethylenetetramine, copper sulfate, formalin, fungicidal active substance.

I.INTRODUCTION

Cotton is one of the most important agricultural crops in Uzbekistan. In this regard, at present, an urgent task is the development and introduction into production of biologically active preparations obtained on the basis of local raw materials against the fight against gummosis, root rot and some insects that appear during the germination of cotton seeds. The search for the above protectants and the replacement of toxic protectants with safer and more effective preparations is of great scientific and practical interest. Hexamethylenetetramine, formalin copper sulfate, which are fungicidal preparations used for dressing seeds, are called protectants. During dressing, pesticides are applied to seeds in order to neutralize them from external and internal infections of plant origin, as well as to protect seedlings and seeds from pests and phytopathogenic microorganisms living in the soil [1].

In recent years, fungicides for seed treatment against a single disease have been replaced with drugs with a complex effect against several diseases. For a more rational use of fungicides and the prevention of resistance to them in pathogens, combined protectants are being developed based on components with a different nature, mechanism or spectrum of fungicidal action. Formalin is one of the most well-known seed disinfectants, produced in a solution of formaldehyde in water, contains 40% formaldehyde, a colorless transparent liquid with a sharp irritating odor. A big disadvantage is that during storage, especially at low temperatures, it becomes cloudy, thickens and loses the ability to dissolve in water [2, 3]. Formalin acts on pathogens only at the time of seed dressing and soaking, so it is necessary to ensure that the grain prepared for sowing is not again infected. Formalin is used in the absence of other disinfectants. Literature data indicate a rather large range of seed treatment agents [4, 5].

II. METHODS AND MATERIALS.

In quantitative chemical analysis, the content of nitrogen, carbon, sulfur, copper and metals and the resulting compounds were determined using (SEM-EDX).

The rotation speed of the electric motor was controlled by a rheostat and measured with a TM-300N tachometer and an RT-230U electronic relay. Based on the obtained results, the "composition-property" diagrams of the system under study were constructed [6].

X-ray diffraction patterns of new compounds were taken on a Shimadzu powder diffractometer (Japan). Crystallinity, sizes of nanoparticles, etc. have been determined. [7].

The pH of the solution medium was measured on a FE-20 METTLER TOLEDO pH meter [8].

Quantitative chemical analysis was carried out using a quantitative phase analysis by the Ritvelta method.

Thermal conductor for analysis - Thermo Scientific GC1310 combined Tsq 9000 TA Instilments STD 650 (USA).

IR spectroscopy was studied on - Perkin Elmer Spectrum Two (USA) [9].

Synthesized compounds $C_6H_{12}N_4 \cdot CuSO_4 \cdot 5H_2O$ and $CH_2O \cdot CuSO_4 \cdot 5H_2O$. It was shown that, in equimolar ratios, compounds are formed with a molar ratio of the components hexamethylenetetraammonium:copper sulfate and formalin:copper sulfate, equal to 1:1. Compounds were isolated in solid form and identified by chemical, IR-spectroscopic, X-ray phase and thermographic methods of analysis.

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III. RESULTS AND DISCUSSION

To substantiate the process of obtaining protectants of complex action, we studied the isothermal method [10] of the solubility of the system $C_6H_{12}N_4$–$CuSO_4·5H_2O$–H_2O and CH_2O–$CuSO_4·5H_2O$–H_2O. With the study of the system, it was found that the formation of a compound of the composition: $C_6H_{12}N_4·CuSO_4·5H_2O$ in crystalline form occurs. In this regard, we have studied the production of seed dressers of complex action, synthesized by hexamethylenetetrammonium: copper sulfate.

The synthesized compounds were in a crystalline state and were identified by scanning electron microscope, IR spectroscopic and thermogravimetric methods.

To substantiate and increase the reliability of the research results, the methods of scanning electron microscope energy dispersive analysis (SEM-EDX) were used, which, using the results of SEM analysis, can solve specific scientific and technological problems (Fig. 1.).

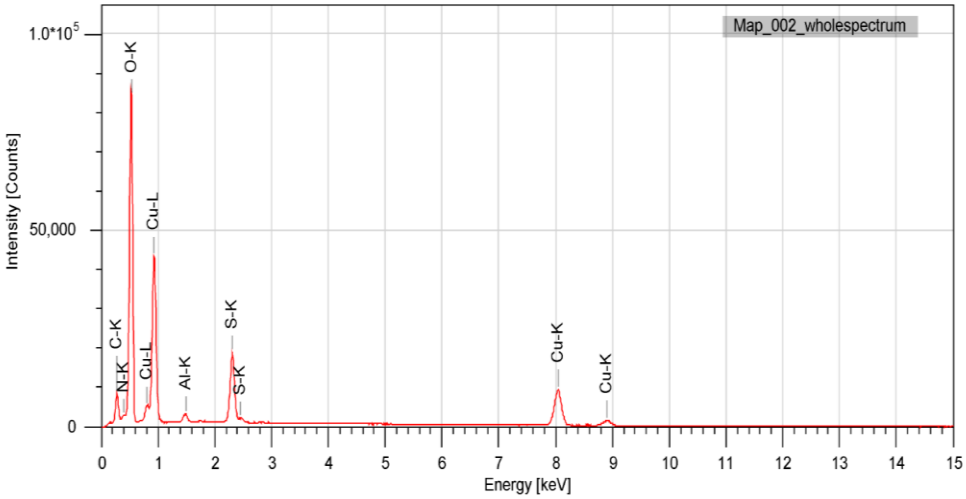

Fig 1. Microstructure of the compoundhexamethylenetetrammonium:copper sulfate

X-ray phase analysis showed that the resulting compound is characterized by its own values of interplanar distances, which confirms its individuality (Fig. 2).

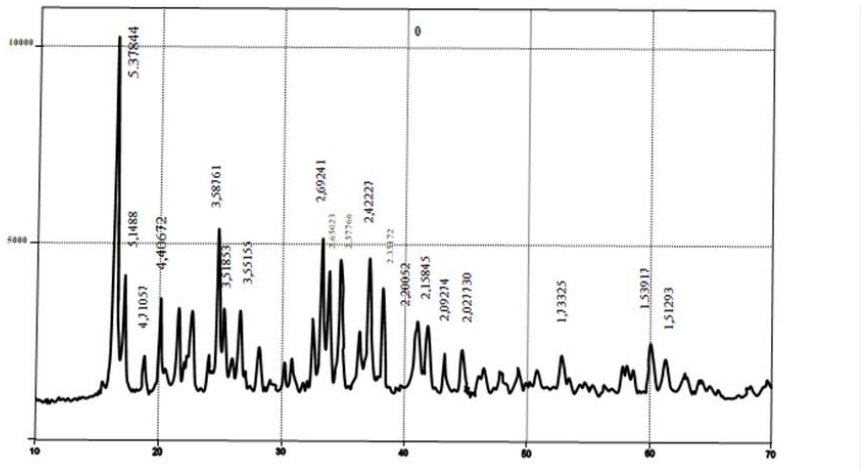

Fig 2. X-ray pattern of hexamethylenetetrammonium:copper sulfate

As shown, the results of experiments on the interaction of $C_6H_{12}N_4·CuSO_4·5H_2O$ in an aqueous medium in all studied pH ranges of the suspension are very sensitive to the amount of added copper sulfate (Fig. 4). Optimal

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technological parameters of the process, in particular, the amount of additive provides a suspension with a pH value of 7.5-8.5.

Heating of the hexamethylenetetraammonium:copper sulfate system is accompanied by weight loss, which at 60-1200C is 2.44%. This indicates that the thermal stability of hexamethylenetetraammonium decreases upon successive substitution of the reactive hydrogen atom of urotropine.

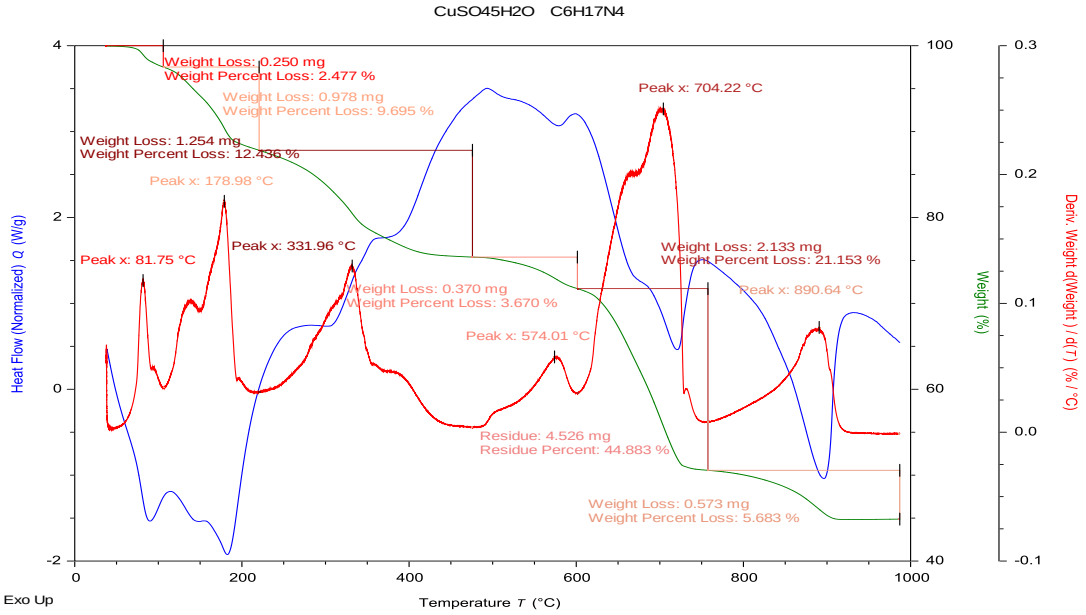

Figure 3.Derivatogram of the hexamethylenetetraammonium:copper sulfate system

Based on the data obtained, a derivatogram of the solubility of the hexamethylenetetraammonium:copper sulfate system was constructed (Fig. 3.).

On the heating curve of the derivatogram of the compound of the composition $CuSO_4 \cdot 5H_2O \cdot C_6H_{12}N_4$ of the obtained compound, two endothermic effects are observed at 81.75; 174°C and four exotherms at 332; 574; 704; and 891°C.

The first two endo-effects are due to dehydration of the compound, with a weight loss of 2.477%. The following thermal effects correspond to the decomposition of the substance with a mass loss of 9.695% at a temperature range of 120-230°C. The nature of subsequent exo-effects at 332; 574; 704; 891°C are associated with the decomposition of urotrapine by the combustion of thermolysis products, the decomposition of copper sulfate to copper oxide.

To establish the identity and structure of the new compound, the IR spectrum of the resulting complex was studied. A comparative analysis of the IR spectrum of the complex shows that significant changes in the IR spectra occur during the formation of the complex.

The IR spectrum of hexamethylenetetraammonium:copper sulfate is characterized by strong absorption of the reflection band of the complex at 779 cm^{-1}, 1079 cm^{-1} and between 2700-3200 cm^{-1} associated with C-O stretching, C=O stretching, O-H symmetric and asymmetric stretching vibration of $CuSO_4 \cdot 5H_2O$ On the other hand, the reflection band of the complex at 600 cm^{-1} and 492 cm^{-1} is explained by C–N stretching, the vibration of methenamine.

IV. CONCLUSION

Thus, in order to develop a process for obtaining seed dressing agents, the system of formalin-copper sulfate-water, urotropine-copper sulfate-water at 250C was studied by the isothermal method. Analysis of the solubility diagram shows that a new compound of composition takes place in the system: $C_6H_{12}N_4 \cdot CuSO_4 \cdot 5H_2O$ which is identified by a scanning electron microscope (SEM-EDX), IR spectroscopic, thermogravimetric methods of physicochemical analysis.

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