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STUDY OF THE POLYTHERMIC SOLUBITY SYSTEMS OF UREA IN AQUEOUS SOLUTIONS WITH OXALATE ACID AND OXALATE MONOETHANOLAMMONIUM

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ABSTRACT:

In this work, polythermal solubility diagram of Urea in aqueous solution with oxalic acid and monoethanolammonium oxalate was constructed. The $H_2C_2O_4 \cdot 2H_2O$ - $CO(NH_2)_2$ - H_2O *system was studied in the temperature range from -11.2 to 92 °C using binary systems and internal cross-sections, while the* $CO(NH_2)_2$ - $HOOC\text{-}COOH \cdot NH_2C_2H_4OH$ - H_2O *polythermal solubility diagrams were constructed in the temperature range from 0 to 61 °C. Crystallization areas of ice, urea, dihydrate oxalic acid, oxalate urea, oxalate monoethanolammonium, and oxalateurea monoethanolammonium were separated in the diagrams. In both systems, the crystallization fields intersect at two ternary points.*

INTRODUCTION. Usually, agricultural plants are treated with various stimulators in order to accelerate the growth and development of the crop, and in order to fight against insects, substances with insecticidal activity are widely used [1-4]. As a result of carrying out the above two agrochemical measures separately, they increase the sensitivity of plants and cause a state of stress in them [5,6]. As a result, there is a decrease in plant productivity and a weakening of their ability to resist pests [7,8]. Taking into account the above, obtaining effective, new drugs with both stimulant and insecticidal properties, studying their synthesis conditions and mechanisms of action, remains one of the urgent problems of agriculture.

Urea has been used in agriculture as an effective fertilizer for many years. Urea contains a large amount of nitrogen, is well soluble in water, and is one of the important substances that can be used for plant leaf nutrition [9,10]. Urea is quickly absorbed on the surface of the leaf and shows its effect when it is applied through the plant leaf by spraying [11].

Ethanolamines perform a number of important functions in plants, such as growth and development, stimulation, effective synergism [12]. Under the influence of ethanolamine salts, ethylene is released in the plant and accumulates in the plant band, as a result of which the plant leaves fall prematurely [13].

Ethylene and other plant growth regulators are important chemicals in agricultural production. Plant growth regulators are now used worldwide on a variety of crops every year. The plant hormone ethylene strongly affects almost all developmental stages of plant growth, from germination to fruit ripening and senescence. In addition, its decisive role in the post-harvest physiology of agricultural products has been well studied [14].

Taking into account the above, it was interesting to study the effect of urea with oxalic acid and monoethanolammonium oxalate in an aqueous solution using a polythermal method.

The polythermal solubility diagram of the **$H_2C_2O_4 \cdot 2H_2O$ - $CO(NH_2)_2$ - H_2O** system was constructed in the temperature range from -11.2 to 92 °C using binary systems and internal sections, and the properties of the components of the system were studied (Fig. 1).

The $CO(NH_2)_2$ - $H_2C_2O_4 \cdot 2H_2O$ - H_2O system was studied by conducting ten internal sections. Sections I-V were constructed from them by transferring $H_2C_2O_4 \cdot 2H_2O$ - H_2O to the end of $CO(NH_2)_2$, sections VI-X by $CO(NH_2)_2$ to the end of $H_2C_2O_4 \cdot 2H_2O$ -H_2O. The diagram shows the formation of crystallization ares of ice, urea, oxalic acid dihydrate and the new compound oxalate urea. These crystallization fields intersect at two ternary points.

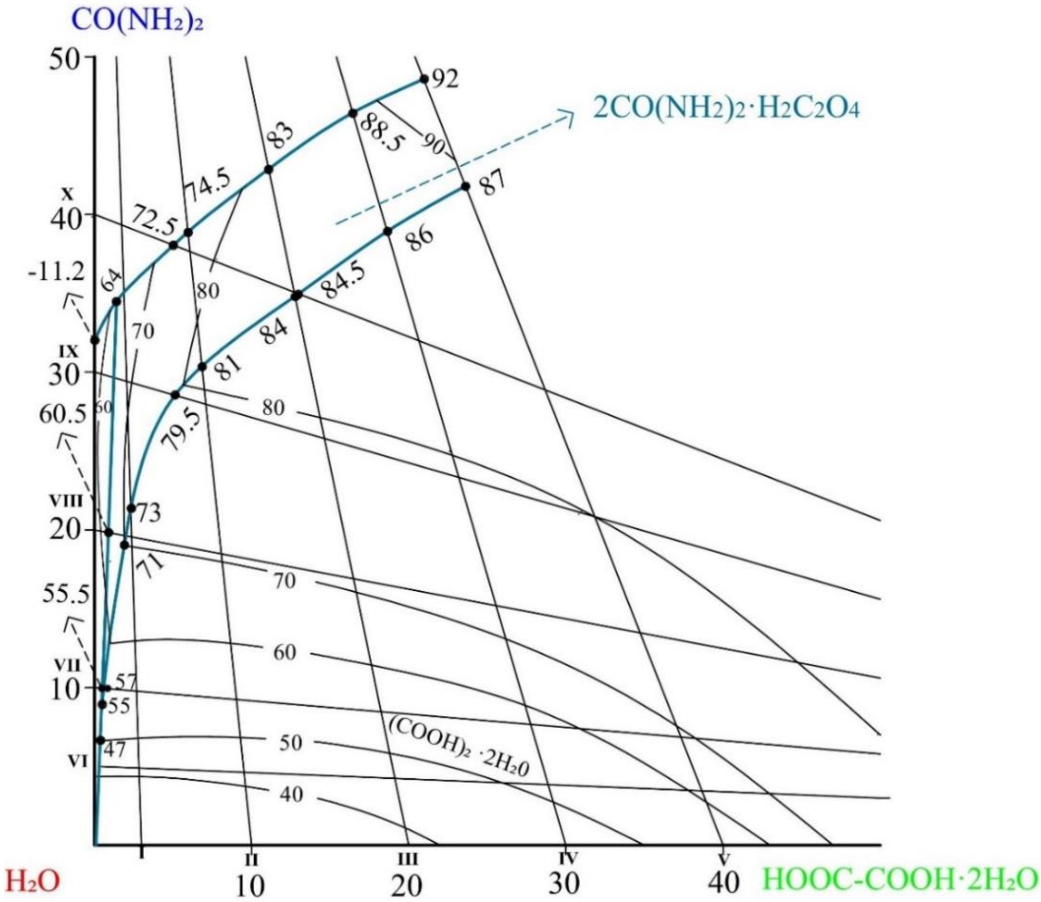

Figure 1. Polythermal solubility diagram of the $CO(NH_2)_2$ - $H_2C_2O_4 \cdot 2H_2O$ - H_2O system

The first triple point in the diagram corresponds to 9% urea and 0.5% oxalic acid dihydrate at 55 °C, and at this ternary point ice, urea oxalate, and oxalic acid dihydrate crystallize in the solid phase.

The second triple point corresponds to 34.8% urea and 1.4% dihydrate oxalic acid at 64 °C, where urea, urea oxalate, and ice crystals are present. The studied system serves as a scientific basis for obtaining a physiologically active substance.

The polythermal solubility diagram of **$CO(NH_2)_2$ - HOOC-COOH · $NH_2C_2H_4OH$ - H_2O** system in the range from -11.2 to 61 °C was studied and constructed using binary systems (Fig. 2). First, by reacting $H_2C_2O_4$ and $NH_2C_2H_4OH$ in a 1:1 mol ratio, a compound containing HOOC-COOH · $NH_2C_2H_4OH$ was synthesized, and the interaction of the obtained compound with urea in an aqueous solution was studied by visual polythermal method.

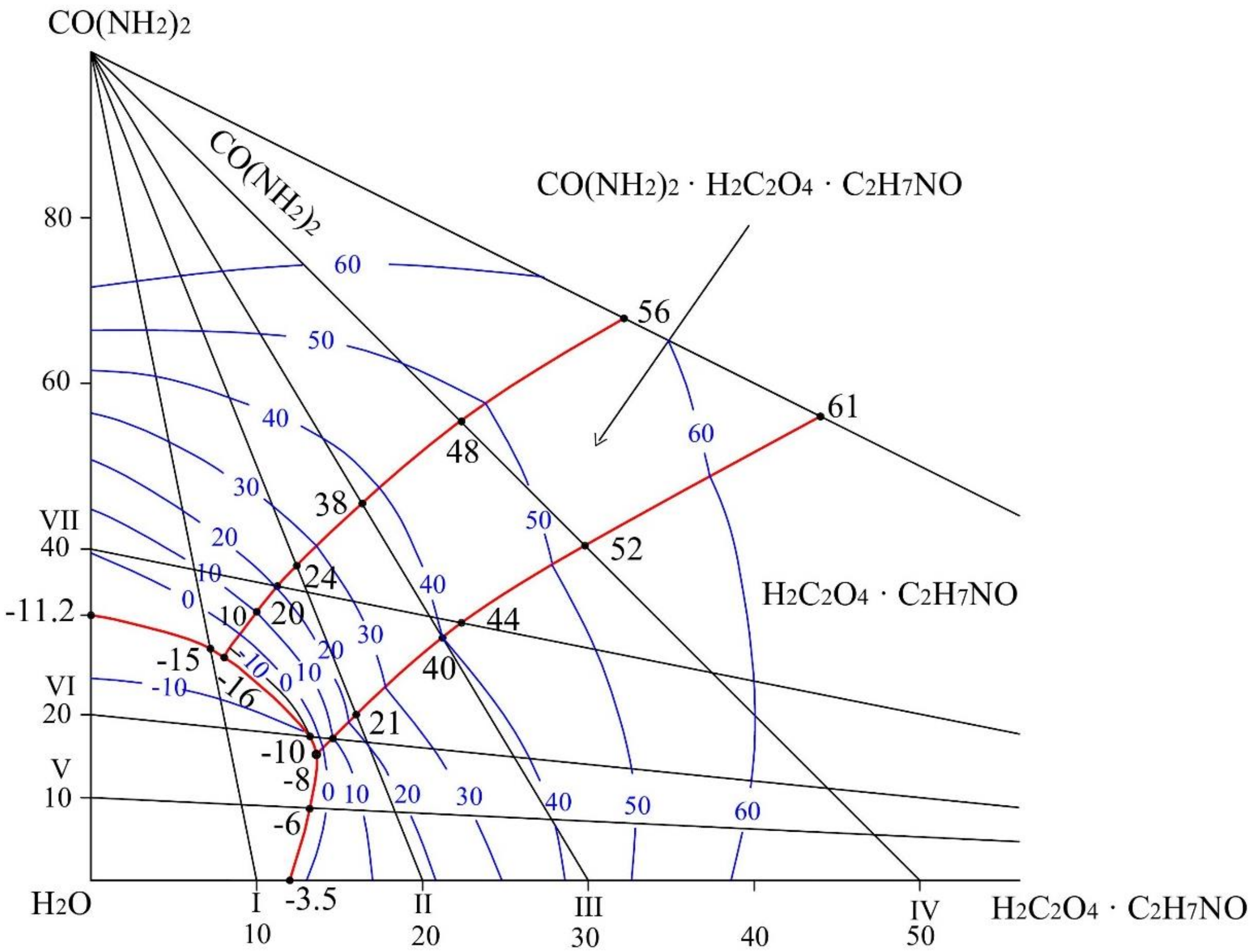

Figure 2. Polythermal solubility diagram of the $CO(NH_2)_2$ - HOOC-COOH · $NH_2C_2H_4OH$ - H_2O system

The diagram was studied by seven internal sections. From them, sections I-IV were drawn by HOOC-COOH·$NH_2C_2H_4OH$ to $CO(NH_2)_2$, sections V-VII were drawn by $CO(NH_2)_2$ to HOOC-COOH·$NH_2C_2H_4OH$.

The phase boundaries of ice, urea, monoethanolammonium oxalate, and the new compound ureamonoethanolammonium oxalate were identified in the system diagram.

In the diagram, all phases are connected at two triple points. In this case, the first triple point corresponds to the temperature of -16.0 °C and corresponds to 16% monoethanolammonium oxalate, 26% urea and 58% water according to the composition of the liquid phase, and this point is limited by the crystallization areas of urea, urea monoethanolammonium oxalate and water.

The next triple point consists of monoethanolammonium oxalate, carbamide monoethanolammonium oxalate, and water according to the composition of the solid phase corresponding to 13.4% monoethanolammonium oxalate, 14.6% urea, and 82% water at a temperature of -8 (Table 1).

Table 1

Classification of binary and triple points of the system 1-jadval HOOC

Liquid phase composition, %			Crys. T °C	Solid phase
HOOC-COOH $\cdot NH_2C_2H_4OH$	$CO(NH_2)_2$	H_2O		
32.4	67.6	-	56.0	$CO(NH_2)_2 + CO(NH_2)_2 \cdot H_2C_2O_4 \cdot NH_2C_2H_4OH$
22.4	55.2	22.4	48.0	»
16.4	45.6	38.0	38.0	»
12.4	38.0	49.6	24.0	»
11.4	35.6	53.0	20.0	»
16.0	26.0	58.0	-16.0	$CO(NH_2)_2 + CO(NH_2)_2 \cdot H_2C_2O_4 \cdot NH_2C_2H_4OH$+muz
7.40	26.8	65.8	-15.0	$CO(NH_2)_2$ + muz
-	32	68.0	-11.2	»
13.0	17.6	69.4	-10.0	$CO(NH_2)_2 \cdot H_2C_2O_4 \cdot NH_2C_2H_4OH$+muz
44.0	56.0	-	61.0	$CO(NH_2)_2 \cdot H_2C_2O_4 \cdot NH_2C_2H_4OH + H_2C_2O_4 \cdot NH_2C_2H_4OH$

29.6	40.8	29.6	52.0	»
23.2	31.2	45.6	44.0	»
21.4	29.2	49.4	40.0	»
16.0	20,0	64	21.0	»
13.4	14.6	82	-8.00	$H_2C_2O_4\cdot NH_2C_2H_4OH + CO(NH_2)_2\cdot H_2C_2O_4\cdot NH_2C_2H_4OH$+muz
13.2	8.80	78.0	-6.00	HOOC-COOH $\cdot NH_2C_2H_4OH$ + muz
12.0	-	88.0	-3.50	-»

The polythermal solubility system $CO(NH_2)_2$ - HOOC-COOH · $NH_2C_2H_4OH$ - H_2O was studied for the first time and a solubility diagram was constructed. The phase boundaries of the components were determined in the diagram and the composition of the new phase oxalate urea monoethanolammonium was analyzed by chemical and physicochemical methods.

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