SOLUBILITY OF COMPONENTS IN THE SYSTEM {84,3%∑[CA(CLO$_3$)$_2$+ MG(CLO$_3$)$_2$]+15,7%∑[CACL$_2$+MGCL$_2$]}-CH$_3$COOH·NH$_2$C$_2$H$_4$OH-H$_2$O

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Abstract: *studying the solubility of the system {84,3%∑[Ca(ClO$_3$)$_2$+Mg(ClO$_3$)$_2$]+15,7%∑[CaCl$_2$+MgCl$_2$]}-CH$_3$COOH·NH$_2$C$_2$H$_4$OH-H$_2$O from the freezing point -52,8 to -5,0°C. A polythermal solubility diagram is constructed, which delineates the ice crystallization fields, [Ca(ClO$_3$)$_2$·Mg(ClO$_3$)$_2$], [CaCl$_2$·MgCl$_2$], CH$_3$COOH, CH$_3$COOH·NH$_2$C$_2$H$_4$OH, and as a new phase, CaOHClO$_3$·2NH$_2$C$_2$H$_4$OH·2H$_2$O. Analysis of the radiograph of the initial components and the synthesized complex based on them shows that diffraction reflexes differ from each other, both in the value of interplane distances and in the intensity of diffraction lines. Thermal analysis also confirms the identity of the new compound.*
Keywords: *physiological active substances, polytherma, solubility, crystallization area, double and triple main points, calcium and magnesium chlorates and chlorides, defoliants.*

РАСТВОРИМОСТЬ КОМПОНЕНТОВ В СИСТЕМЕ {84,3%∑[CA(CLO$_3$)$_2$+ MG(CLO$_3$)$_2$]+15,7%∑[CACL$_2$+MGCL$_2$]}-CH$_3$COOH·NH$_2$C$_2$H$_4$OH-H$_2$O

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Аннотация: *изучена растворимость системы {84,3%∑[Ca(ClO$_3$)$_2$+ Mg(ClO$_3$)$_2$]+15,7%∑[CaCl$_2$+MgCl$_2$]}-CH$_3$COOH·NH$_2$C$_2$H$_4$OH-H$_2$O от температуры полного замерзания -52,8 до -5,0°C. Построена политермическая диаграмма растворимости, на которой разграничены поля кристаллизации льда, [Ca(ClO$_3$)$_2$·Mg(ClO$_3$)$_2$], [CaCl$_2$·MgCl$_2$], CH$_3$COOH, CH$_3$COOH·NH$_2$C$_2$H$_4$OH и в качестве новой фазы CaOHClO$_3$· 2NH$_2$C$_2$H$_4$OH·2H$_2$O. Анализ рентгенограммы исходных компонентов и синтезированного комплекса на их основе показывает, что дифракционные рефлексы отличаются друг от друга, как по значению межплоскостных расстояний, так и по интенсивностям дифракционных линий. Термический анализ также подтверждает индивидуальность нового соединения.*
Ключевые слова: *физиологически активные вещества, политерма,*

растворимость, поля кристаллизации, двойные и тройные узловые точки, хлораты и хлориды кальция и магния, дефолианты.

For the timely harvest of cotton, it is necessary to remove the cotton leaves. A big problem in cotton growing is the lack of domestic defoliants that meet all the requirements of agriculture. The existing chlorate-containing defoliants based on magnesium chlorate do not meet modern requirements for defoliants. It is known that the defoliating effect of chlorates is, to one degree or another, accompanied by a desiccation effect. In addition, they do not have a multifunctional effect. In the synthesis of new effective defoliants, the use of the monoethanolamine salt of acetic acid, which is a plant growth stimulator, is of considerable interest. It has biological activity, enhances redox processes, carbohydrate biosynthesis and enzymatic activity [1,2].

For the physicochemical substantiation of the process of obtaining an effective defoliant based on calcium-magnesium chlorate and monoethanolamine acetate, the solubility of the components in the system $\{84,3\%\sum[Ca(ClO_3)_2+Mg(ClO_3)_2]+15,7\%\sum[CaCl_2+MgCl_2]\}-CH_3COOH\cdot NH_2C_2H_4OH-H_2O$ in a wide temperature and concentration range.

Monoethanolamine acetate was synthesized on the basis of acetic acid and monoethanolamine taken at a molar ratio of 1:1.

We studied the solubility of the binary system $CH_3COOH\cdot NH_2C_2H_4OH-H_2O$ in the temperature range from -50,4 to 78,0°C. Its polythermal diagram of solubility is characterized by the presence of branches of ice crystallization, CH_3COOH and $CH_3COOH\cdot NH_2C_2H_4OH$, which intersect at two double points of coexistence of two solid phases. The first double point corresponds to the joint crystallization of ice and acetic acid at a temperature of -50,4°C and a concentration of 55,6%$NH_2C_2H_4OH\cdot CH_3COOH$ and 44,4% H_2O.

The second double point corresponds to the joint crystallization of acetic acid and monoethanolammonium acetate at a temperature of -26,0°C, the concentration of monoethanolammonium acetate is 78,0% and 22,0% of water (Fig.) [3].

The binary system magnesium chlorate - water has been previously studied. The data we obtained are in good agreement with the literature [4].

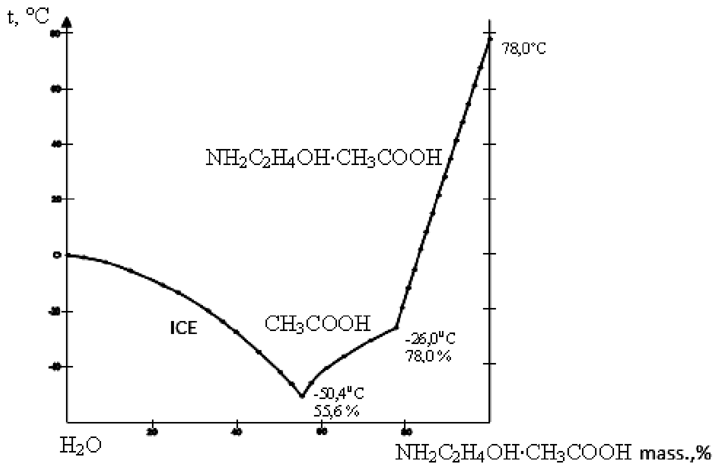

Fig. 1. Diagram of the solubility of the system $NH_2C_2H_4OH·CH_3COOH-H_2O$

The solubility of this system was studied using seven internal sections, on the basis of which a polythermal diagram of this system from -52,8 to -5,0°C was constructed. On the polythermal diagram of the solubility of the system, the fields of ice crystallization, $[Ca(ClO_3)_2·Mg(ClO_3)_2]$, $[CaCl_2·MgCl_2]$, CH_3COOH, $CH_3COOH·NH_2C_2H_4OH$ and a new compound of the composition $CaOHClO_3·2NH_2C_2H_4OH·2H_2O$ are distinguished. The above fields on the solubility diagram converge at one node of the invariant point. It is known that calcium chlorate actively forms complex compounds with a number of organic compounds containing a hydroxyl group [5,6,7,8], which is also observed in this system (table).

Table 1. Double and triple nodal points of the system $\{84,3\%\sum[Ca(ClO_3)_2+Mg(ClO_3)_2]+15,7\%\sum[CaCl_2+MgCl_2]\}$-$CH_3COOH·NH_2C_2H_4OH-H_2O$

Liquid phase,%			**t_{cr}, °C**	**Solid phase**
$\{84,3\%\sum[Ca(ClO_3)_2+Mg(ClO_3)_2]+15,7\%\sum[CaCl_2+MgCl_2]\}$	$CH_3COOH·NH_2C_2H_4OH$	H_2O		
44,8	6,0	49,2	-5,0	$Ca(ClO_3)_2·Mg(ClO_3)_2$+ $CaOHClO_3·2NH_2C_2H_4OH·2H_2O$
38,4	5,4	56,2	-45,8	$Ca(ClO_3)_2·Mg(ClO_3)_2$+ $CaCl_2·MgCl_2$+ $CaOHClO_3·2NH_2C_2H_4OH·2H_2O$
33,7	5,5	60,8	-52,0	Ice + $CaOHClO_3·2NH_2C_2H_4OH·2H_2O$
28,0	6,0	66,0	-34,0	same
25,0	7,9	67,1	-30,0	-//-
17,7	12,3	70,0	-23,0	-//-
7,4	27,9	64,7	-20,2	-//-
3,0	38,9	58,1	-24,0	-//-
1,7	57,0	41,3	-52,8	Ice + $CaOHClO_3·2NH_2C_2H_4OH·2H_2O$+ CH_3COOH
1,0	77,8	21,2	-30,4	$CaOHClO_3·2NH_2C_2H_4OH·2H_2O$+ CH_3COOH+$CH_3COOH·NH_2C_2H_4OH$
1,8	83,9	14,3	-27,4	$CaOHClO_3·2NH_2C_2H_4OH·2H_2O$+ $CH_3COOH·NH_2C_2H_4OH$
3,0	86,0	11,0	-26,8	same
3,9	87,3	8,8	-26,5	-//-

5,7	89,0	5,3	-26,3	-//-
-	78,0	22,0	-26,0	$CH_3COOH+CH_3COOH\cdot NH_2C_2H_4OH$
-	55,6	44,4	-50,4	Ice + CH_3COOH
42,2	-	57,8	-43,6	$Ca(ClO_3)_2\cdot Mg(ClO_3)_2+CaCl_2\cdot MgCl_2$
38,0	-	62,0	-46,0	Ice + $CaCl_2\cdot MgCl_2$

The resulting new compound of the composition $CaOHClO_3\cdot NH_2C_2H_4OH\cdot 2H_2O$ was identified by methods of chemical and physicochemical analysis.

Thus, the obtained data on the solubility of the components in the studied system by the visual polythermal method [22,52%$Ca(ClO_3)_2$+17,51%$Mg(ClO_3)_2$+ 4,33%$CaCl_2$+3,12%$MgCl_2$+52,52%H_2O]-$CaOHClO_3\cdot NH_2C_2H_4OH$-$H_2O$ can serve as a scientific basis for obtaining a new complex acting preparation based on calcium-magnesium chlorate defoliant and monoethanolammonium acetate. To maintain the physiological activity of the synthesized preparation during defoliation, the required interval of the initial components should not exceed 39,2 – 39,7% chlorate, 0,72 – 2,00% monoethanolammonium acetate.

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