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SOLUBILITY ISOTHERM OF MANGANESE SULFATE - MONOETHANOLAMINE - WATER AT 10ºC

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Abstract:
Solubility isotherm of the system manganese sulfate - monoethanolamine - water at 10ºC consists of two branches of crystallization of the initial components. The first branch corresponds to crystallization in the solid phase of manganese sulfate penta-water, and the second corresponds to the new compound composition: NH2C2H4OH -MnSO4- 3H2O. The new compound was isolated in crystalline form and identified by methods of chemical, graphic and X-ray phase analysis. Preliminary agrochemical tests have shown that it increases the yield of cotton and grain crops by 3-7 c/ha and improves the quality of products.

Keywords: Isotherm, system, manganese sulfate, monoethanolamine, solubility, X-ray phase analysis, stimulant.

INTRODUCTION

Preparations based on ethanolamines, with components of mineral fertilizers and trace elements favorably affect the growth and development of plants, improve the absorption of the main elements of nutrition, increase yields and accelerate the maturation of various crops.

In this regard, the study of the interaction of ethanolamines and their derivatives with sulfates of trace elements with the production of new types of highly effective environmentally harmless stimulants of plant growth and development are of great theoretical and practical interest.

The research carried out by us and the results obtained have already proven themselves in agricultural production on the positive side, and therefore the further development of the theory and practice of obtaining and using physiologically active substances based on ethanolamines seems promising to us [1-3].

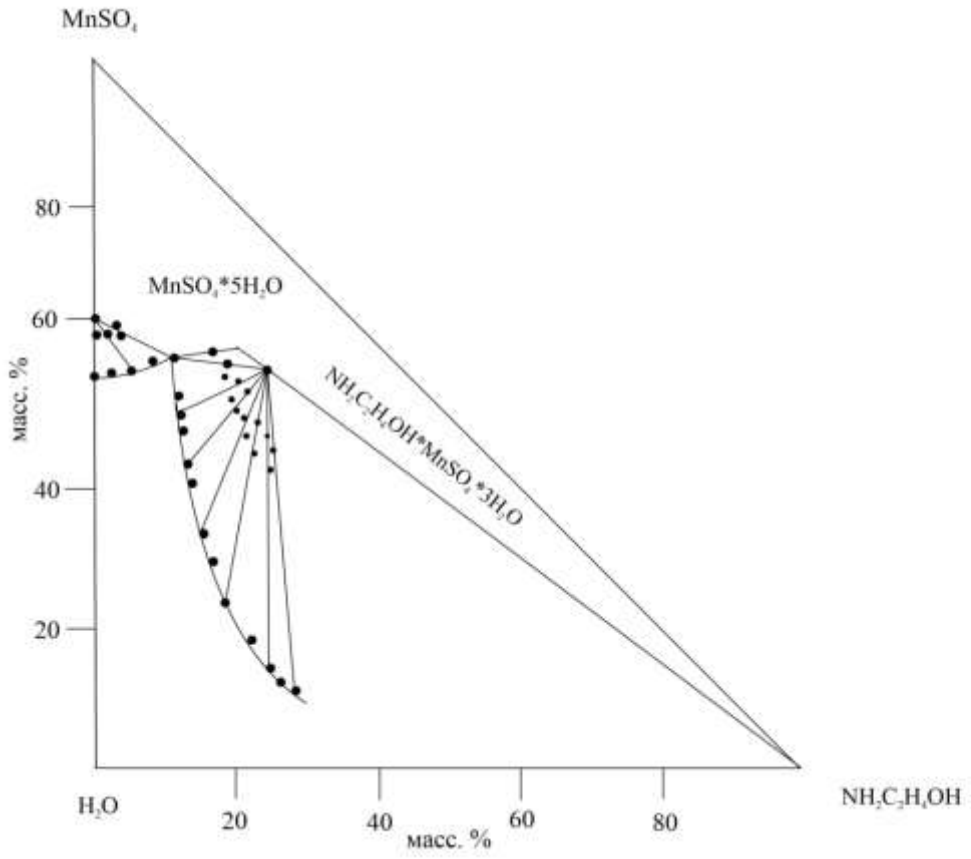
METHOD

Monoethanolamine was determined by titration of 0.1 n with a solution of sulfuric acid in the presence of methyl-orange. The content of SO^{4-2} was determined by precipitation followed by conversion to metal sulfate. [4-5].

Nitrogen was determined by the Keldahl method [6].

BODY

The solubility and interactions in the system of manganese sulfate - monoethanolamine - water at a temperature of 10 º C showed that the true equilibrium in the system was established within 7 hours. As a starting material, a recrystallized salt was used - manganese sulfate of the grade "hch" and monoethanolamine "h" distilled. Isotherm of solubility of the system manganese sulfate – monoethanolamine – water consists of two branches of crystallization of the initial components. The first branch corresponds to crystallization in the solid phase of five-water manganese sulfate, and the second corresponds to a new compound of composition: $NH_2C_2H_4OH \cdot MnSO_4 \cdot 3H_2O$. The resulting compound dissolves congruently in water (Fig. 1, Table 1).



Rice. 1. Andzotherm solubility system manganese sulfate - monoэtanolamine - water at 10ºC.

The concentration limits of the existence of a new compound occupy a large area on the diagram and are between 12.69-28.50% monoethanolamine and 8.72-59.86 manganese sulfate, respectively. This makes it possible to synthesize the compound within a wide range of concentrations of the initial components.

The new compound is isolated in crystalline form and identified by the methods of chemical, graphic, X-ray phase and thermal analysis.

Table 1 Resource requirements by component Data on the solubility of the manganese sulfate system – monoэtanolamine – water at 10 °C

№	Composition liquid phases, masses. %		Composition of the solid "residue", masses. %		Crystallizuyusaya phase
	IEA	$MnSO_4$	IEA	$MnSO_4$	
1	-	57,64	-	62,80	$MnSO_4 \cdot 5H_2O$
2	2,87	58,10	1,14	59,54	--//--
3	5,53	58,36	2,62	61,12	--//--
4	8,40	58,62	4,25	61,46	--//--
5	12,54	59,58	3,16	62,78	--//--
6	12,63	59,70	16,92	60,14	$MnSO_4 \cdot 5H_2O + NH_2C_2H_4OH$ $MnSO_4 \cdot 3H_2O$
7	12,69	59,86	19,18	57,89	$NH_2C_2H_4OH \cdot MnSO_4 \cdot 3H_2O$
8	12,58	55,42	18,20	56,41	--//--

9	12,51	51,82	19,90	55,33	--//--
10	12,75	48,81	19,29	53,58	--//--
11	13,10	43,56	20,45	53,54	--//--
12	15,21	39,90	20,16	51,60	--//--
13	16,39	34,33	20,94	50,22	--//--
14	18,30	30,11	21,12	47,49	--//--
15	19,26	24,80	22,08	50,77	--//--
16	22,32	20,39	22,36	45,44	--//--
17	24,10	15,23	23,29	47,63	--//--
18	26,41	12,18	24,48	41,52	--//--
19	28,50	8,72	24,60	45,80	--//--

Химический анализ $NH_2C_2H_4OH\cdot NSO_4\ 3H_2O$:
Discarded, % :Found, % :
$NH_2C_2H_4OH$ – 22.9 3; NH $_2C_2H_4OH$ – 22.5 6;
$MnSO_4$ – 56.7 7; $MnSO_4$ – 56.98;
H_2O - 20.30. H $_2O$ - 20.35.

Radiographs of the original and synthesized new compound were taken on the Dron-3 diffractometer at filtered copper radiation, voltage of 25 kV, current strength of 8 mÅ, with a counter speed of 2 degrees / min [7].

X-ray phase analysis shows that the new compound is a crystalline substance with an individual set of interplane distances and line intensities (Table 2).

Table 2 Resource requirements by component
Межплоскостные расстояния $MnSO_4\cdot 5H_2O$, $NH_2C_2H_4OH\cdot MnSO_4\cdot 3H_2O$

№	$MnSO_4\cdot 5H_2O$				$NH_2C_2H_4OH\cdot NSO_4\ 3H_2O$			
	1	2	3	4	5	6	7	8
	d, Z	J/J$_o$	d, Z	J/J$_o$	d, Z	J/J$_o$	d, Z	J/J$_o$
1	7,66	10,96	1,634	15,85	11,30	79,331	1,854	27,59
2	4,91	60,98	1,616	18,29	7,35	31,03	1,833	34,48
3	3,82	14,63	1,598	9,76	6,02	51,72	1,799	34,48
4	3,50	100	1,577	8,54	4,91	34,48	1,774	37,93
5	3,37	42,68	1,537	8,54	4,37	31,03	1,701	34,48
6	3,14	62,195	1,482	12,195	4,54	48,28	1,674	37,93
7	2,58	47,56	1,424	6,097	3,79	37,93	1,659	41,38
8	2,42	9,76	1,301	10,96	3,70	58,62	1,571	41,38
9	2,36	18,29			3,06	100	1,537	41,38
10	2,25	23,17			3,00	89,66	1,463	27,59
11	2,14	15,85			2,82	41,38	1,344	27,59
12	2,10	17,07			2,60	27,59		
13	2,02	17,07			2,51	51,72		
14	1,972	9,76			2,42	44,83		
15	1,871	10,96			2,10	34,48		
16	1,747	9,76			2,01	34,48		
17	1,717	19,51			1,988	27,59		
18	1,675	9,76			1,967	27,59		

The main interplane distances of five-water manganese sulfate have values of 4.91; 3,50; 3,14; 2,58; 2.25 Å with an intensity of 61, 100, 62, 48, 20 respectively. For $NH_2C_2H_4OH \cdot MnSO_4 \cdot 3H_2O$ are characteristic of the following diffraction lines: 11.30; 6.02; 4.54; 3.70; 3.06 Å with an intensity of 79; 52; 48; 59; 100 respectively [8-9].

FINDINGS

The conducted physical and chemical studies to study the interaction and solubility of monoethanolamine with microelement salts, the synthesis of new compounds based on them and the identification of their effectiveness in agricultural production as stimulants of plant growth and development served as the basis for the development of technology for obtaining growth stimulants of a new generation of multifunctional action.

Thus, the solubility in the system of manganese sulfate - monoethanolamine - water at 10 ° C. The formation of a new compound $NH_2C\ 2\ H_4OH \cdot MnSO_4 \cdot 3H_2O$, which is identified by methods of chemical, graphic and X-ray phase analysis. Preliminary agrochemical tests have shown that they increase the yield of cotton and grain crops by 3-7 c / ha and improve the quality of products.

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