Spectrum Journal of Innovation, Reforms and Development
Volume 10, Dec., 2022 | ISSN (E): 2751-1731
Website: www.sjird.journalspark.org

STUDY OF THE SOLUBILITY ISOTERM OF MANGANESE SULFATE - MONOETHANOLAMINE - WATER

Isabayev Z.
Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan, Uzbekistan, Tashkent
zikrilla_i@mail.ru

Zhumanova M. O.
Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan, Uzbekistan, Tashkent
jumanova@mail.ru

Isabaev D. Z.
Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan, Uzbekistan, Tashkent
davroni84@mail.ru

Zhumadullaeva S.K.
Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan, Uzbekistan, Tashkent
jumadullaevas@mail.ru

Isroilov E.T.
Institute of General and Inorganic Chemistry of the Academy of Sciences of the Republic of Uzbekistan, Uzbekistan, Tashkent

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 plant growth and development, improve the uptake of basic nutrition elements, 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 to obtain new types of highly effective environmentally friendly plant growth and development stimulants are of great theoretical and practical interest.

Our earlier studies and the results obtained have already proved to be beneficial for agricultural production and, therefore, further development of the theory and practice of obtaining and application of physiologically active substances based on ethanolamines seems to us promising [1-3].

Methods

Monoethanolamine was determined by titration with 0.1 n sulfuric acid solution in the presence of methyl orange. SO_4^{-2} content was determined by precipitation followed by conversion to metal sulfate. [4-5].

Nitrogen was determined by Keldahl method [6].

Main part

Solubility and interactions in the system manganese sulfate - monoethanolamine - water were studied at 10ºC. It was shown that true equilibrium in the system was established within 7 hours. Recrystallized salt - manganese sulfate "ch" and monoethanolamine "ch" distilled were used as a starting substance. Solubility isotherm 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 manganese sulfate penta-water, and the second corresponds to the new compound composition: $NH_2C_2H_4OH{\cdot}MnSO_4{\cdot}3H_2O$. The resulting compound dissolves in water congruently (Fig. 1, Table 1).

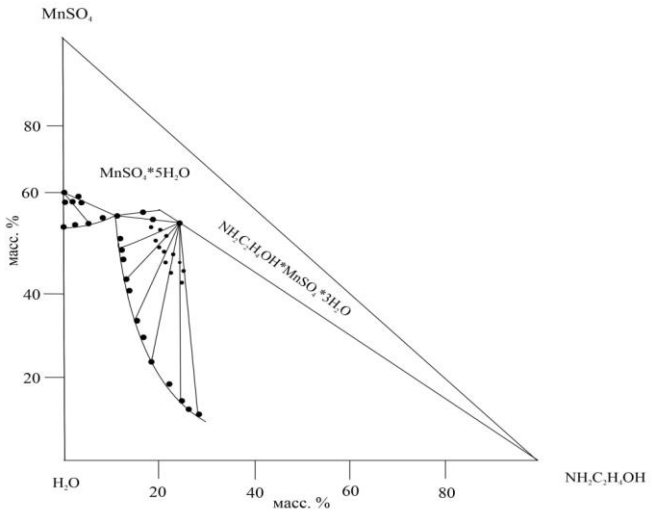

Figure 1. Solubility isotherm of the system manganese sulfate - monoethanolamine - water.

Concentration limits of the new compound occupy a large area in 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 in a wide range of concentrations of the initial components.

The new compound was isolated in crystalline form and identified by chemical, graphical, X-ray and thermal analyses.

Table 1 Solubility data for manganese sulfate - monoethanolamine - water at 10°C

№	**Composition of liquid phase, mass %**		**Composition of solid "residue", mass %**		**Crystallizing phase**
	MEA	$MnSO_4$	MEA	$MnSO_4$	
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	--//--

Chemical analysis of $NH_2C_2H_4OH \cdot MnSO_4 \cdot 3H_2O$:

Calculated,% :
$NH_2C_2H_4OH$ – 22,93;
$MnSO_4$ – 56,77;
H_2O - 20,30.

Found,, % :
$NH_2C_2H_4OH$ – 22,56;
$MnSO_4$ – 56,98;
H_2O - 20,35.

X-ray pictures of the initial and synthesized new compound were taken on a Dron-3 diffractometer at filtered copper radiation, 25 kV, 8 mÅ current strength, with a counter speed of 2 deg/min [7].

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

Table 2 Interplanar distances $MnSO_4 \cdot 5H_2O$, $NH_2C_2H_4OH \cdot MnSO_4 \cdot 3H_2O$

№	$MnSO_4 \cdot 5H_2O$				$NH_2C_2H_4OH \cdot MnSO_4 \cdot 3H_2O$			
	1	2	3	4	5	6	7	8
	d, Å	J/J_o	d, Å	J/J_o	d, Å	J/J_o	d, Å	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 interplanar distances of manganese sulfate five-water have values 4.91; 3.50; 3.14; 2.58; 2.25 Å with intensities 61, 100, 62, 48, 20, respectively. For NH2C2H4OH - MnSO4 - 3H2O, the following diffraction lines are characteristic: 11.30; 6.02; 4.54; 3.70; 3.06 Å with intensities of 79; 52; 48; 59; 100, respectively [8].

Conclusions

The conducted physico-chemical investigations on interaction and solubility of monoethanolamine with salts of microelements, synthesis of new compounds on their basis and revealing their efficiency in agricultural production as growth and development stimulators of plants have formed the basis for development of the technology of getting new generation growth stimulators of polyfunctional action.

Thus, the solubility in the system manganese sulfate - monoethanolamine - water at 10oC was studied. The formation of a new compound NH2C2H4ON-MnSO4-3H2O was established, which was identified by chemical, graphic and X-ray phase analysis methods. Preliminary agrochemical tests have shown that it increases the yield of cotton and grain crops by 3-7 c/ha and improves the product quality.

BIBLIOGRAPHY

1. Leopold A. Plant growth and development. Moscow: The World, 1968. 99c.
2. Isabaev Z., Saibova M.T. System monoammonium phosphate - monoethanolamine - water at 50°C. Journal of Inorganic Chemistry T.32, № 8, 1987, p.2035-2037
3. Isabayev Z, Zokirov B.S., Isabayev D.Z. Solubility isotherm of the system cobalt sulfate - ethanolamine phosphate - water at 25°C, Chemical journal of Kazakhstan. 2007. №3. C. 114-118.
4. Klimova V.A. Basic micromethods of analysis of organic compounds. Moscow. "Chemistry," 1975. 207c.
5. Blagrov R. J., Oruen Z.C. Mikrochimica. Asta. №4, 1971. 639c.
6. GOST 20851.1-75 - GOST 20851. 4-75 Fertilizers mineral. Methods of the analysis. Moscow. Reissue. August 1986. C. 10.
7. Zevin L.S., Zavyalova L.L. Quantitative X-ray phase analysis. Moscow. Nedra, 1974. C. 184.
8. Efimov A.I. et al. Properties of Inorganic Compounds. Reference Book. - L.: Chemistry, 1983, 392 p.