International Journal of Progressive Sciences and Technologies (IJPSAT)
ISSN: 2509-0119.

http://ijpsat.ijsht-journals.org
Vol. 24 No. 2 January 2021, pp. 375-380

Research Of Mutual Effect Of Components In A Water System Including Calcium Nitrate And Monoethanolammonium Acetate

Askarova M.K., Makhammatova G.A.,Zakirov B.S., Eshpulatova M.B., Kucharov B.Kh.

Abstract – This article presents the results of a study of the mutual influence of components in an aqueous system, including calcium nitrate, and a physiologically active substance, monoethanolammonium acetate. By constructing a polythermal solubility diagram. It has been established that the $Ca(NO_3)_2$-$CH_3COOH \cdot NH_2C_2H_4OH$-$H_2O$ system belongs to a complex type. Its solubility diagram revealed crystallization fields: ice, tetra-, tri- and dihydrous calcium nitrate, acetic acid, monoethanolammonium acetate and, as a new phase, the compound
$Ca(NO_3)_2 \cdot NH_2C_2H_4OH$. The formation of $Ca(NO_3)_2 \cdot NH_2C_2H_4OH$ in this system is confirmed by the methods of chemical and X-ray phase analysis.
The results obtained serve as a scientific basis for the action on the basis of the product when obtaining a liquid fertilizer for the complex nitric acid decomposition of dolomite and a physiologically active substance.

Keywords – Liquid Fertilizers, Product Of Nitric Acid Decomposition Of Dolomite, Solution Of Calcium And Magnesium Nitrates, Physiologically Active Substances, Solubility, Binary Systems, Internal Sections, Polythermal Diagram Of Solubility, System Projections, Crystallization Fields.

I. Introduction

In recent years, intensively developing agricultural production requires a wider range of fertilizers containing several nutrients. On the agrochemical market, liquid fertilizers are of great interest, the use of which is effective by foliar feeding, as well as by drip irrigation. The production of liquid fertilizers leads to a reduction in the number of processes and, compared to solid fertilizers, to a significant reduction in costs. Of particular interest is the study of the combined use of liquid fertilizers with physiologically active substances that contribute to the acceleration of growth, development of plants and obtaining high yields.

Physiologically active substances (PAS) are plant growth regulators capable of causing various changes in the process of plant growth and development in small quantities [1-3]. In [4], we presented the optimal conditions for obtaining liquid fertilizer by nitric acid decomposition of dolomite to obtain, after separation of the insoluble residue, a solution of calcium and magnesium nitrates, followed by enrichment of the latter with ammonium and potassium nitrates.

For the physicochemical substantiation of the process of obtaining a liquid complex fertilizer containing in its composition a physiologically active substance, monoethanolammonium acetate, it is necessary to know the solubility of salts in systems that include the initial components. For this purpose, the mutual influence of one of the main components of liquid fertilizer, i.e. calcium nitrate and monoethanolammonium acetate, in the system: $Ca(NO_3)_2$-$CH_3COOH \cdot NH_2C_2H_4OH$-$H_2O$

II. Methods and materials

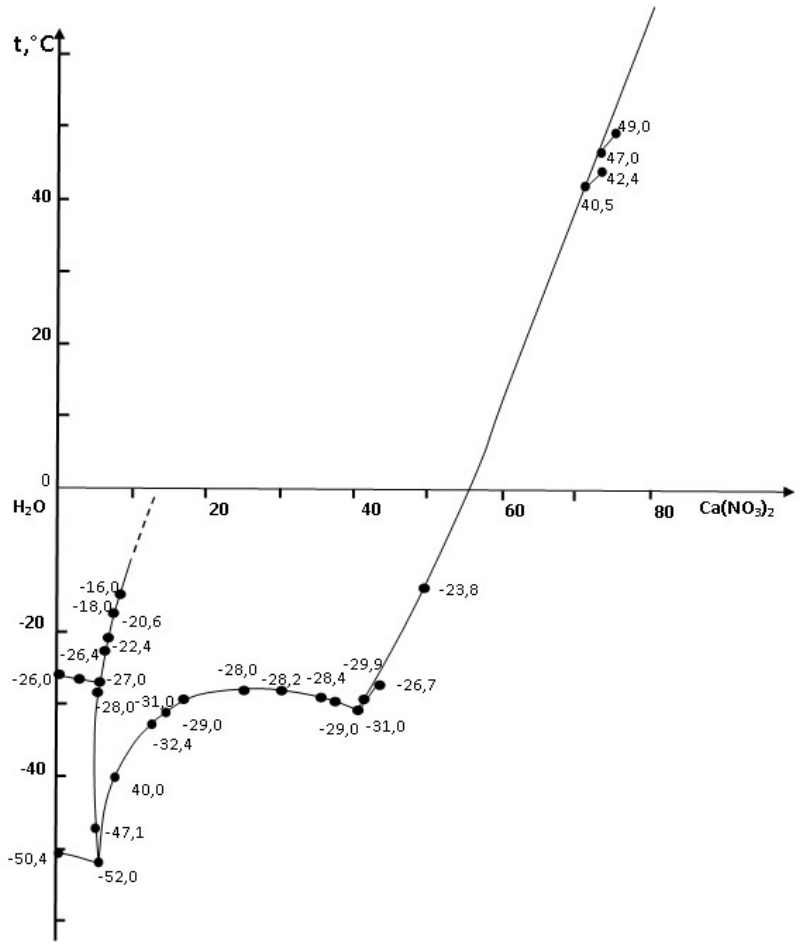
For the research, calcium nitrate recrystallized from an aqueous solution, grade "pure", was used as the initial components. Monoethanolammonium acetate is synthesized by the interaction of monoethanolamine with acetic acid, taken at a molar ratio of 1: 1 [5,6]. Study of the solubility of the components in the conductivity system by the visual polythermal method in a wide range of temperatures and concentrations [7].

In the quantitative chemical analysis of liquid and solid phases isolated from the systems, well-known methods of analytical chemistry were used, in particular: the calcium content was determined by the volumetric complexometric method [8], the content of elemental nitrogen, carbon, hydrogen was carried out according to the method [9]. X-ray phase analysis of the initial components and the new separated solid phase was carried out on a Dron-3.0 diffractometer with filtered copper radiation at a voltage of 40 kV, a current of 20 mA, and a counter disk speed of 2 deg / min. The values of the interplanar distances were found from the handbook according to the angle of reflection [10, 11], and the intensity of the diffraction lines was estimated using a hundred-point scale.

III. RESULTS AND DISCUSSION

The solubility of the components in the system calcium nitrate-acetate monoethanolammonium-water was studied in a wide range of temperatures and concentrations using ten internal sections. Sections I-V are drawn from the side of $CH_3COOH \cdot NH_2C_2H_4OH$-$H_2O$ to the top of $Ca(NO_3)_2$, and VI-X from the side of $Ca(NO_3)_2$-H_2O to the top of $CH_3COOH \cdot NH_2C_2H_4OH$. The binary system $Ca(NO_3)_2$-H_2O was studied by a number of the author [12]. The data obtained by us on the position of the eutectic and the regions of existence of crystalline hydrates of calcium nitrate are consistent with the literature. The polytherm of the binary system $CH_3COOH \cdot NH_2C_2H_4OH$-$H_2O$ has three branches of crystallization: ice, CH_3COOH and $CH_3COOH \cdot NH_2C_2H_4OH$, the eutectic freezing point corresponds to -50.40C at 55.6% content of $CH_3COOH \cdot NH_2C_2H_4OH$. The results obtained are in good agreement with the data of the authors [6,13]. Based on the data on the solubility of binary systems and internal sections, projections were built on the corresponding lateral sides of Ca (NO3) 2-H_2O, $CH_3COOH \cdot NH_2C_2H_4OH$-$H_2O$ and the polythermal diagram of the solubility of the system (Fig. 1, 2).

On the diagram of this system, crystallization fields are distinguished: ice, tetra-, tri-, and dihydrous calcium nitrate, acetic acid, monoethanolammonium acetate and, as a new phase, compounds $Ca(NO_3)_2 \cdot NH_2C_2H_4OH$. The indicated fields converge at five triple nodal points, the characteristics of which are given in Table 1. Analysis of the polythermal diagram of the solubility of the system shows that the bulk of it is occupied by the crystallization field $Ca(NO_3)_2 \cdot NH_2C_2H_4OH$, which



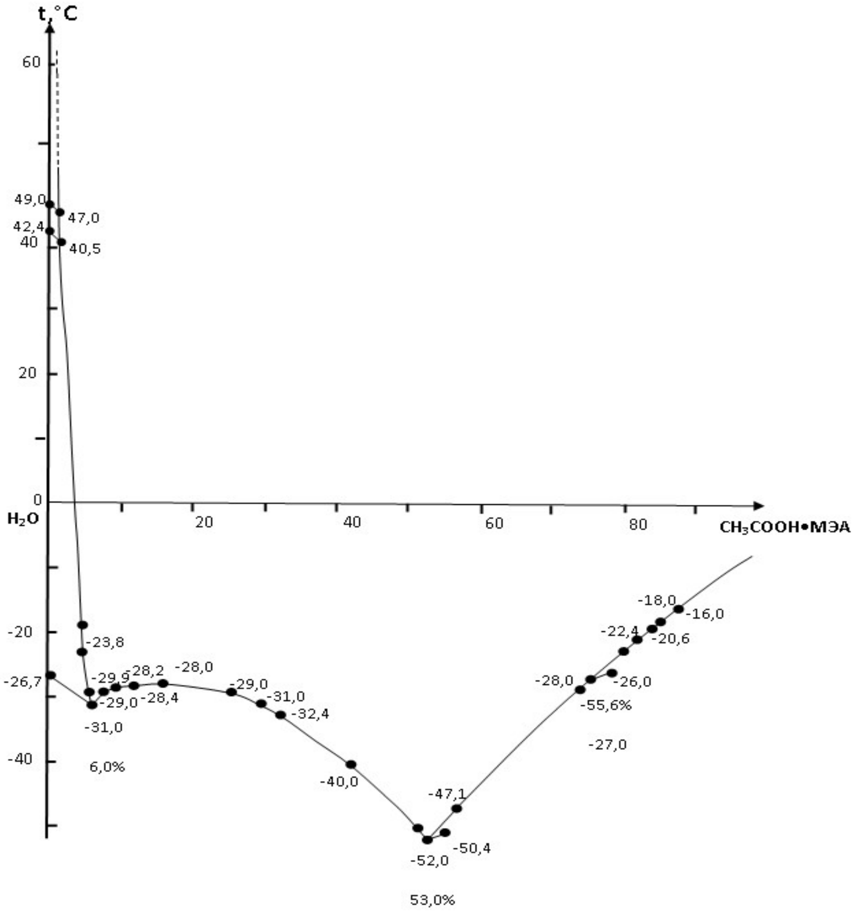


Fig 1. Projections of the calcium nitrate-monoethanolammonium acetate-water system.

Table 1. Triple inflection points of the Ca $(NO_3)_2$-$CH_3COOH \cdot NH_2C_2H_4OH$-$H_2O$ system

Liquid phase composition,%			$t_{кр}$.^{0}C	Solid phase
$Ca(NO_3)_2$	$CH_3COOH \cdot NH_2C_2H_4OH$	H_2O		
73,0	1,9	25,1	47,0	$Ca(NO_3)_2{\cdot}3H_2O$+$Ca(NO_3)_2{\cdot}2H_2O$+ $Ca(NO_3)_2{\cdot}NH_2C_2H_4OH$
70,0	2,1	27,9	40,5	$Ca(NO_3)_2{\cdot}4H_2O$ + $Ca(NO_3)_2{\cdot}3H_2O$+ $Ca(NO_3)_2{\cdot}NH_2C_2H_4OH$
41,0	6,4	52,6	-31,0	Ice +$Ca(NO_3)_2{\cdot}4H_2O$+ $Ca(NO_3)_2{\cdot}NH_2C_2H_4OH$
5,7	52,0	44,4	-52,0	Ice+ $Ca(NO_3)_2{\cdot}NH_2C_2H_4OH$+ CH_3COOH
6,1	75,2	20,2	-27,0	CH_3COOH+ $Ca(NO_3)_2{\cdot}NH_2C_2H_4OH$+ $CH_3COOH{\cdot}NH_2C_2H_4OH$
6,0	80,0	11,7	-22,4	$CH_3COOH{\cdot}$ $NH_2C_2H_4OH$+ CH_3COOH

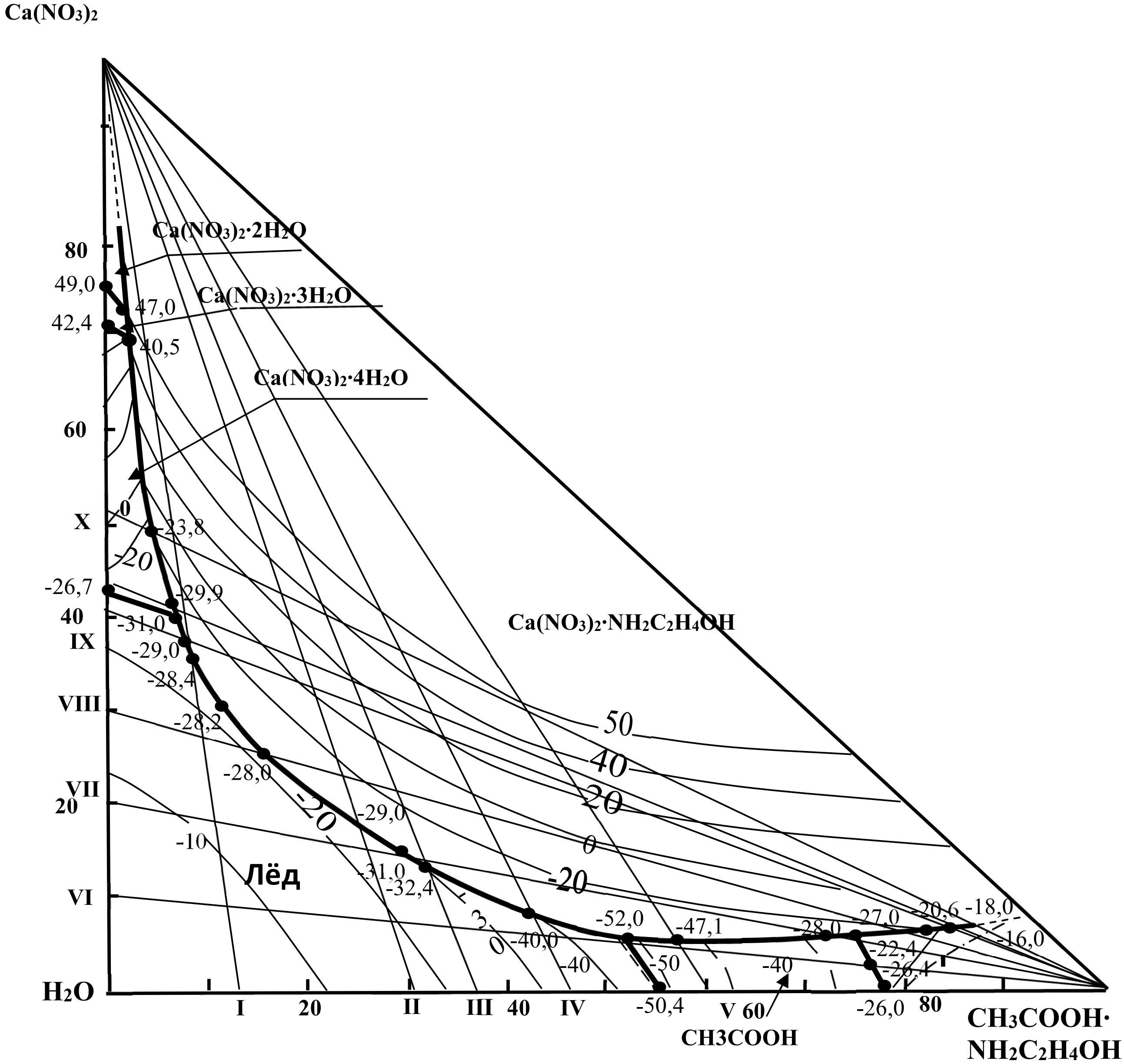


Fig 2 Polythermal diagram of the solubility of the system Ca (NO3) 2-CH3COOH · NH2C2H4OH-H2O

indicates the low solubility of the latter in comparison with other components of the system. According to the polythermal diagram of the solubility of the system calcium nitrate-acetate monoethanolammonium-water, the formation of the compound Ca $(NO_3)_2$ · $NH_2C_2H_4OH$ is observed within the concentration range: 3.1 ÷ 73.0% Ca $(NO_3)_2$; 1.9 ÷ 87.4% CH_3COOH · $NH_2C_2H_4OH$. With an increase in the concentration of the initial components, the crystallization field of monoethanolamine calcium nitrate increases. A new phase formed in the studied system was isolated in crystalline form and identified by methods of chemical and physicochemical analysis [8, 9].

Chemical analysis gave the following results: found,%: Ca + 2 = 17.7; H = 3.09; O = 49.80 N = 18.74; C = 11.05 For Ca (NO_3) 2 · $NH_2C_2H_4OH$ calculated,%: Ca + 2 = 17.77; N = 18.66; H = 3.11; C = 10.66; O = 49.77 The formation of the Ca $(NO_3)_2$ · $NH_2C_2H_4OH$ compound was confirmed by the X-ray phase analysis data (Fig. 3).

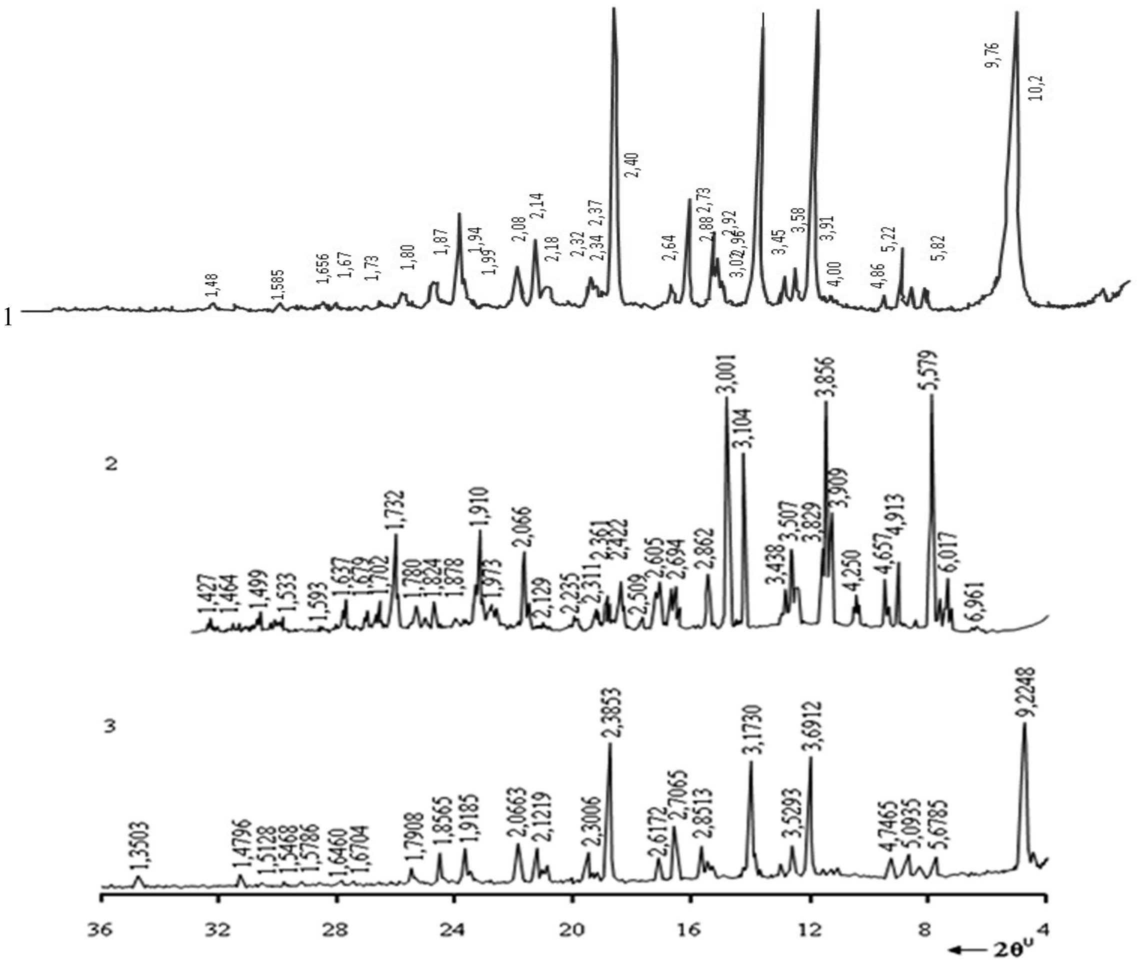


Fig 3. X-ray diffraction patterns of 1-$Ca(NO_3)_2 \cdot NH_2C_2H_4OH$; 2-$CH_3COOH \cdot NH_2C_2H_4OH$; 3-$Ca(NO_3) \cdot 4H_2O$ X-ray phase analysis of the initial components of calcium nitrate, monoethanolammonium acetate, and the compound Ca $(NO_3)_2 \cdot NH_2C_2H_4OH$ indicates that all diffraction patterns differ from each other and are characterized by intrinsic angles of reflection, a set of interplanar distances and intensities of diffraction lines. That is, this compound is individual [10,11]

IV. Conclusion

As a result of studying the mutual influence of components in an aqueous system consisting of calcium nitrate and monoethanolammonium acetate, it was found that in the system in the studied temperature range, the formation of a new phase of the compound Ca $(NO_3)_2 \cdot NH_2C_2H_4OH$ is observed. The compound formed in the system is a nitrogen fertilizer with growth activity. The nitrogen content in it is 18.66% (versus 11.86% in calcium nitrate tetrahydrate). That is, this circumstance indicates the possibility of joint use of calcium nitrate with monoethanolammonium acetate. Thus, the results obtained make it possible to jointly use calcium nitrate with mono-ethanolammonium acetate and serve as a scientific basis in the process of obtaining a liquid fertilizer based on the product of nitric acid decomposition of dolomite and FAS.

References

[1] Muromtsev GS, Chkanikov DI, Kulaeva ON. Fundamentals of chemical regulation of plant growth and productivity. M.: Agropromizdat, 1987.-387 p.

[2] 2.Nickell L.J. Plant growth regulators. Application in agriculture, translated from English, 1984.

[3] Saibova M.T. Complex of nitrogen and nitrogen-phosphorus fertilizers with physiologically active substances // Doctoral Dissertation in Chemistry. Tvshkent, 1989.-351s.

[4] Askarova M.K., Isabaev Z., Eshpulatova M.B., Makhamatova G.A., Ergashev D.A., Isabaev D.Z. Investigation of systems that substantiate the process of obtaining a liquid fertilizer of complex action // International research journal "Eurasian Union of Scientists" (ESU) №5 (62). 2019.1 Part. -S.25-30.

[5]

5. Zh. S. Shukurov., Askarova M. K., S. Tukhtaev. Solubility in systems comprising sodium dicarbamidochlorate, vonoethanolamine acetate, ethanol and acetamprid // Russian Journal of Inorganic Chemistry, -Moscow, 2018, Vol. 63, no. 2 pp. 260-264 (Springer, IF-0.787).

[6] 6. Abdullaeva MT Obtaining liquid nitrogen fertilizers based on carbamide and ammonium nitrate with physiologically active substances. // Authorfe ... diss. (PhD) Ph.D. in tech. sciences. -Tashkent. -2018. –S.53.

[7] 7. Trunin A.S. Petrova D.G. Visual-polythermal method / Kuibyshev Polytechnic. Ins-t-Kuibyshev .: 1977, 94 p. Dep. in VINITI No. 584-78.

[8] 8. Kalyukova E.N. Conviction and complexometric titration: Methodological guidelines for laboratory work in analytical chemistry. Ulyanovsk: Ul - GTU, 2003.28 p.

[9] 9.Klimova V.A. Basic micromethods for the analysis of organic compounds. M .: Chemistry, 1975.224s.

[10] 10. Giller Ya.L. Interplanar spacing tables. -M.: Nedra, 1966. - T. 2. -330 p. 11. Nedoma I. Decoding of powder X-ray diffraction patterns. - M .: metallurgy, 1975, -423 p.

[11] 12. Kirgintsev A.N., Trushnikova L.N., Lavrent'eva V.G. Solubility of inorganic substances in water. Directory. Publishing house "Chemistry", fol. 1972, pp. 152-154.

[12] 13. Zh.S. Shukurov, S. S. Ishankhodzhaev, Askarova M. K., S. Tukhtaev. Study of the Solubility of Components in the NaClO3 · 2CO (NH2) 2-NH2C2H4OH • CH3COOH-H2O System // Russian Journal of Inorganic Chemistry, 2011, Vol.56, No.3, pp.463-466.