



## MIXED AMIDE COMPLEXES OF MAGNESIUM NITRATE

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**Abstract:** The complex compounds of magnesium nitrate with formamide, acetamide and nitro carbamide were synthesized in this paper. The composition, individuality, ways of formamide molecule coordination, acetamide, nitro carbamide and nitrate fragment were found. Methods of organic ligands coordination by surround of central ion and thermic behaviour of synthesized compounds were proved by oscillation spectroscopy and thermic analyses.

**Keywords:** complex compounds, composition, synthesis, technique, IR-spectrum, adsorption, X-ray analyses, and thermolysis.

### I. INTRODUCTION

One of actual tasks of modern chemistry is synthesis of novel chemical compounds possessing effective properties for use in agriculture. Particular interest of these complexes is mixed ligand compounds of metals with vitamins that present by themselves novel class biological active compounds. Numerous studies on investigations of coordination compounds p, d, and f- metals with amide acids were devoted complexes with homogeneous ligands. In the beginning our researches there were no data on mixed ligand coordination compounds of metals nitrate. Some causes of competitive ligands, nitrate anion and water molecule of surround of central atoms were not presented. To solve these problems magnesium nitrate was elected by us as complex former. Since they can be judged for complexing on change of acids' anions nature.

### II. METHODS AND MATERIALS

Formamide, acetamide, nitro carbamide were used as organic ligands [1, 2]. For synthesis of coordination compounds mechanochemical technique was elected. As it does not require deficient organic solvents and allows to synthesis complexes various composition with large outlet for short time. The synthesis was conducted according to [3]. Analyses of synthesized compounds on magnesium content were determined by [4]. Nitrogen was defined by Dumas [5], carbon and hydrogen by burning in oxygen flow (table1). To establish individuality of synthesized compounds diffractograms were taken on device DRON-2.0 with Cu- anticathode [6]. IR-spectrum adsorption was recorded in a range 400-4000  $\text{cm}^{-1}$  on spectrometer IRTracer-100 (Shimadzu, Japan). Thermic analyses was carried out on derivative graph system F. Paulik- J.Paulik-L.Erdey [7] with speed 9  $^{\circ}\text{C}/\text{min}$ , and sample 0.102-0.143 g when sensitivity of galvanometer T-900, ТГ-200, ДТА, ДТГ-1/10. Recording was realized in atmospheric condition. Platinum crucible with diameter 10 mm was used as a holder and  $\text{Al}_2\text{O}_3$  was as etalon.

Complex  $\text{Mg}(\text{NO}_3)_2 \cdot \text{HCONH}_2 \cdot \text{CH}_3\text{CONH}_2 \cdot 2\text{H}_2\text{O}$  was synthesized by intensive mixing 1.28 g (0.005 mole)  $\text{Mg}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$  with 0.225 g (0.005 mole) formamide and 0.295 g (0.005 mole) acetamide in agate mortar in 3 hours. Yield constituted 96.54%. Compound  $\text{Mg}(\text{NO}_3)_2 \cdot \text{HCONH}_2 \cdot \text{H}_2\text{NCONHNO}_2 \cdot 1.5\text{H}_2\text{O}$  was synthesized intensive mixing 1.28 g (0.005 mole) magnesium nitrate with 0.225 g (0.005 mole) formamide and 0.525 g (0.005 mole) nitrate carbamide in agate mortar under room temperature in 3 hours. Product's outlet was 95.10%.

### III. RESULTS AND DISCUSSION

Comparison interplanar space and relative intensity of free molecules of formamide, acetamide, nitro carbamide, magnesium nitrate and coordination compounds  $Mg(NO_3)_2 \cdot HCONH_2 \cdot CH_3CONH_2 \cdot 2H_2O$ ,  $Mg(NO_3)_2 \cdot HCONH_2 \cdot H_2NCONHNO_2 \cdot 1.5H_2O$  shown that novel coordination compounds were differenced each other and on homothetic them initial compounds.

Therefore, synthesized complexes of magnesium nitrate have individual crystalline lattice (table 1). Comparison interplanar space and relative intensity of magnesium nitrate, acetamide, formamide, nitro carbamide and coordination compounds  $Mg(NO_3)_2 \cdot HCONH_2 \cdot CH_3CONH_2 \cdot 2H_2O$ ,

*Table 1 Results elemental analysis of complex compounds of magnesium nitrate with two amides*

№	Соединение	Chemical composition, %							
		Mg		N		C		H	
		Foun d	Calculate d	Foun d	Calculate d	Foun d	Calculate d	Foun d	Calculate d
1	$Mg(NO_3)_2 \cdot HCONH_2 \cdot CH_3CONH_2 \cdot 2H_2O$	6.18	6.25	14.38	14.42	9.32	9.27	3.16	3.11
2	$Mg(NO_3)_2 \cdot HCONH_2 \cdot H_2NCONHNO_2 \cdot 1.5H_2O$	7.54	7.47	25.78	22.85	7.42	7.39	2.84	2.79

$Mg(NO_3)_2 \cdot HCONH_2 \cdot H_2NCONHNO_2 \cdot 1.5H_2O$  presented that novel coordination compounds were differenced considerably each other and on homothetic them initial compounds. Therefore, synthesized complexes of magnesium nitrate have individual crystalline lattice (table 2).

*Table 2. Interplanar space and relative intensity lines of free molecules of formamide, acetamide, nitro carbamide and their complex compounds with magnesium nitrate*

Compounds	d, Å	I, %	D, Å	I, %	d, Å	I, %	d, Å	I, %	d, Å	I, %
1	2	3	4	5	6	7	8	9	10	13
$Mg(NO_3)_2 \cdot HCONH_2 \cdot CH_3CONH_2 \cdot 2H_2O$	15.92	20	5.26	11	2.99	13	2.03	13	1.595	13
	15.73	20	5.15	13	2.95	17	2.02	13	1.577	13
	13.35	37	4.99	13	2.88	13	1.990	13	1.571	13
	13.19	28	4.82	13	2.79	13	1.965	13	1.566	13
	11.91	31	4.67	19	2.76	13	1.952	13	1.554	13
	11.02	16	4.55	19	2.74	13	1.936	13	1.544	13
	10.50	12	4.35	9	2.71	15	1.917	13	1.519	13
	9.98	19	4.29	22	2.66	15	1.907	13	1.511	13
	9.80	19	4.19	17	2.61	13	1.872	13	1.506	13
	9.58	11	4.14	22	2.56	13	1.861	13	1.498	13
	9.22	13	4.06	22	2.50	16	1.856	13	1.481	13
	8.82	13	4.00	11	2.47	13	1.833	13	1.469	12
	8.65	17	3.92	10	2.44	13	1.824	13	1.455	15
	8.48	17	3.89	13	2.40	13	1.813	15	1.436	13
	8.14	17	3.84	13	2.37	13	1.805	15	1.431	13
7.45	100	3.78	13	2.36	13	1.785	13	1.428	13	

	7.35	9	3.70	13	2.33	13	1.741	15	1.420	13
	6.98	13	3.64	13	2.28	13	1.732	13	1.411	13
	6.70	13	3.56	19	2.25	13	1.719	13	1.393	13
	6.49	13	3.47	16	2.21	13	1.705	13	1.387	13
	6.22	13	3.40	16	2.19	16	1.694	15	1.379	13
	6.11	9	3.34	16	2.17	16	1.685	27	1.369	15
	5.88	9	3.27	16	2.15	16	1.665	15	1.364	13
	5.71	9	3.20	16	2.13	13	1.644	13	1.354	13
	5.64	9	3.16	16	2.11	13	1.637	13	1.343	13
$Mg(NO_3)_2 \cdot HCONH_2 \cdot H_2NCONHNO_2 \cdot 1.5H_2O$	15.66	4	5.82	7	3.06	42	2.15	5	1.676	2
	15.09	7	5.74	5	3.01	10	2.11	3	1.665	2
	14.12	7	5.68	5	2.93	17	2.07	2	1.641	4
	13.76	7	5.46	4	2.90	3	2.02	6	1.632	4
	12.59	7	5.20	6	2.83	24	1.991	2	1.611	2
	12.16	7	4.91	3	2.72	8	1.967	4	1.566	2
	11.02	4	4.78	3	2.63	2	1.926	9	1.556	3
	10.50	5	4.59	4	2.61	2	1.881	4	1.491	2
	8.82	4	4.43	77	2.51	20	1.854	6	1.459	2
	8.02	3	4.22	92	2.46	17	1.841	2	1.419	4
	7.85	3	3.92	8	2.41	11	1.816	3		
	7.48	3	3.77	100	2.35	2	1.774	5		
	7.35	3	3.46	31	2.30	8	1.760	8		
	7.01	3	3.37	4	2.27	7	1.753	5		
	6.44	6	3.24	4	2.21	2	1.695	2		
	5.97	5	3.11	33	2.18	12	1.687	3		

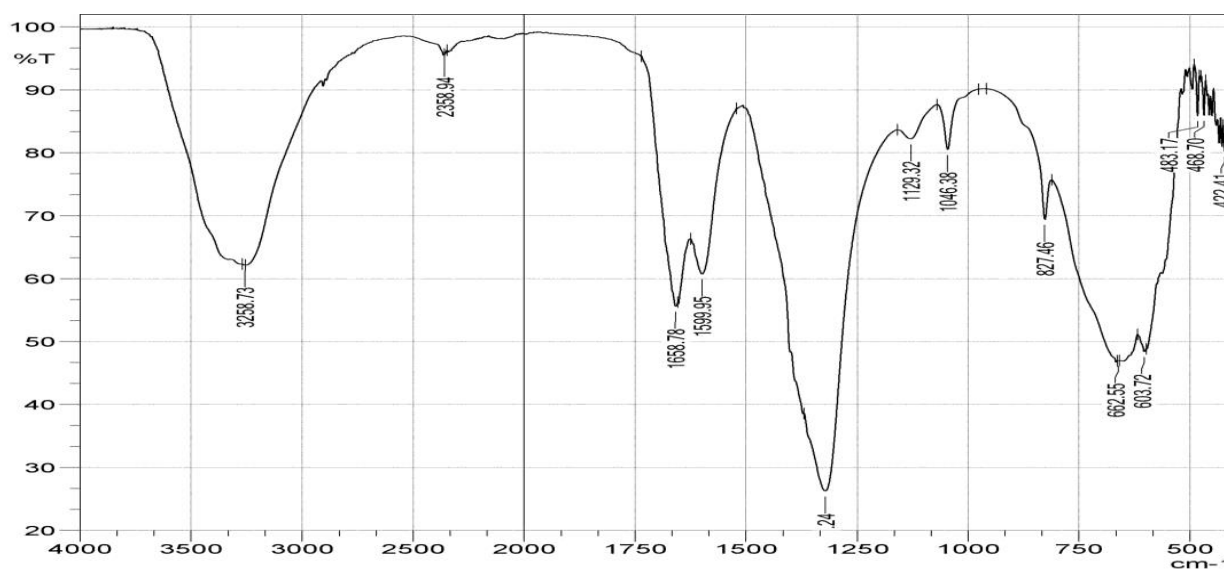
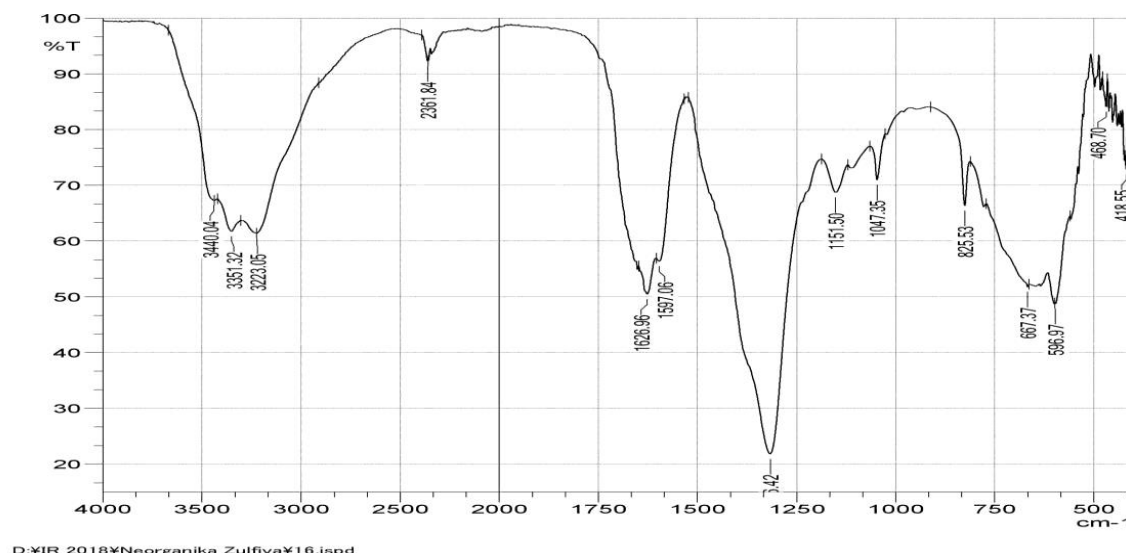


Fig.1. IR-spectrum adsorption of complex compound of magnesium nitrate with formamide and acetamide  $Mg(NO_3)_2 \cdot HCONH_2 \cdot CH_3CONH_2 \cdot 2H_2O$

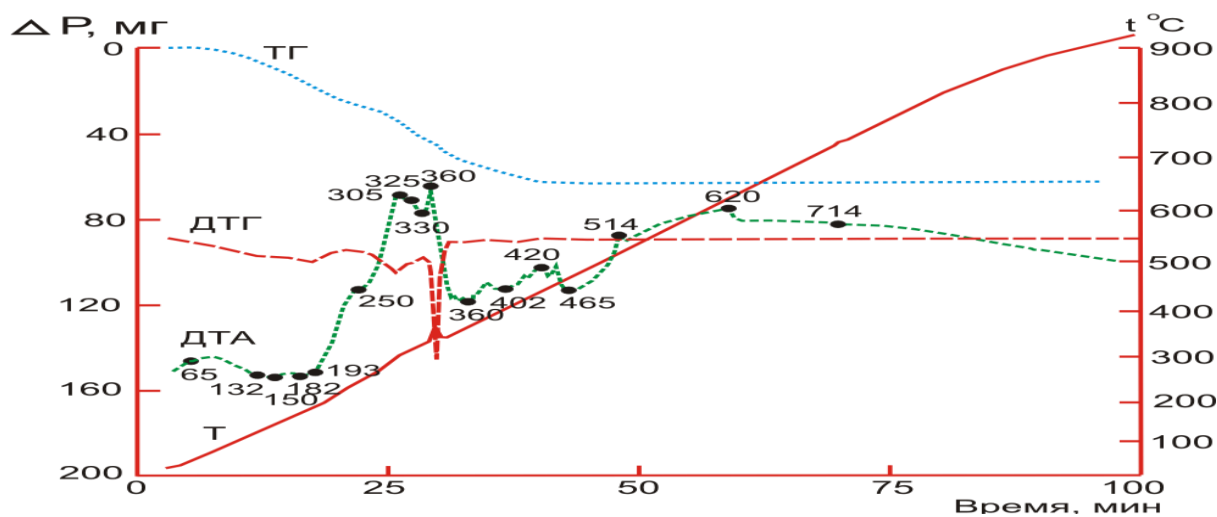


**Fig.2. IR-spectrum adsorption of complex compound of magnesium nitrate with formamide and nitro carbamide  $Mg(NO_3)_2 \cdot HCONH_2 \cdot CH_3CONH_2 \cdot 2H_2O$**

IR-spectrum adsorption of free molecules of ligands and synthesized compounds has been studied. A basis of the comparison of IR-spectrum adsorption of free molecules of ligands and complex compounds  $Mg(NO_3)_2 \cdot HCONH_2 \cdot CH_3CONH_2 \cdot 2H_2O$ , frequencies were found at 3258, 2358, 1658, 1599, 1129, 1046, 827, 662, 603  $cm^{-1}$ . For compounds  $Mg(NO_3)_2 \cdot HCONH_2 \cdot H_2NCONHNO_2 \cdot 1.5H_2O$  frequencies were found at 440, 3351, 3223, 2361, 1626, 1597, 1151, 1047, 825, 667, 596, 468  $cm^{-1}$ .

The presented complex compounds shown that all causes molecules of formamide, acetamide, nitro carbamide are coordinated through oxygen atoms of carbonyl group. At the same time water molecules are held due to hydrogen bonds. Anion of nitric acid is coordinated by magnesium ions.

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**Fig. 3. Derivative gram of  $Mg(NO_3)_2 \cdot HCONH_2 \cdot CH_3CONH_2 \cdot 2H_2O$  Time, min.**

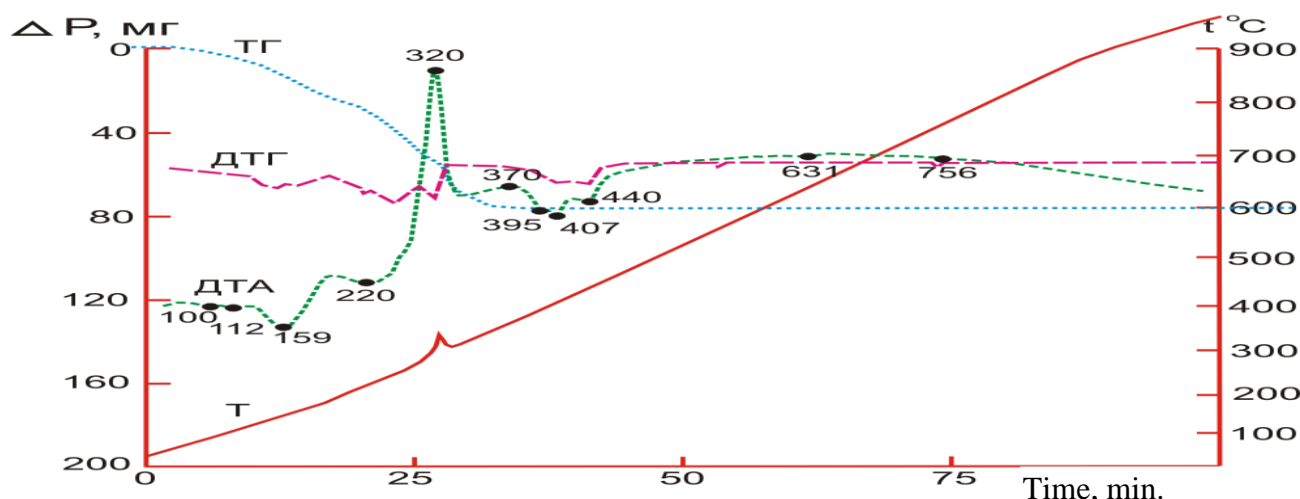


Fig. 4. Derivative gram of  $Mg(NO_3)_2 \cdot HCONH_2 \cdot NO_2NHCONH_2 \cdot 1,5H_2O$

#### IV. CONCLUSION

To sum up condition of synthesis was developed and complex compounds of magnesium nitrate with formamide, carbamide and thiocarbamide were recovered. Individuality, ways of formamide, carbamide, thiocarbamide, nitrate fragments molecules' coordination and thermic behaviour of synthesized compounds were proved by oscillation spectroscopy, derivative graph analysis. In addition, central ion was surrounded six atoms of oxygen and has geometric configuration of violent octahedron.

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