# Coordination compounds of magnesium nicotinate with some acid amides
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# Координационные соединения никотината магния с некоторыми амидами кислот
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***Abstract:*** *Complexes of magnesium nicotinate with acid amides are synthesized aiming to vary the composition and the individual properties of the compounds obtained through coordination of the nicotinate group to acetamide, carbomide, thiocarbomide and nicotinamide. The coordination of the organic ligands, the environment of the central ion and thermal behavior of the synthesized compounds are elucidated by vibrational spectroscopy and thermal analysis.*

***Аннотация:*** *Синтезированы разноамидные комплексные соединения никотината магния с некоторыми амидами кислот. Установлены состав, индивидуальность, способы координации никотинатных групп, молекул ацетамида, карбамида, тиокарбамида, никотинамида. Методами колебательной спектроскопии и термического анализа доказаны способы координации органических лигандов, окружение центрального иона и термическое поведение синтезированных соединений.*

***Keywords:*** *coordination compounds, synthesis, IR spectroscopy, X-ray analysis, thermal behavior.*

***Ключевые слова:*** *координационные соединения, синтез, ИК-спектры поглощения, рентгенофазовый анализ, термическое поведение.*

The interest to nutrient chelates with organic ligands exhibiting various biological activities has currently increased. It is so because their metal complexes react with vitamins and amino acids to give a new class of biologically active compounds. The latter can find wide agricultural application as growth stimulators. For example, acetamide, carbomide, thiocarbimide, nicotinamide and nicotinic acid anion are bioorganic compounds whose transition to a coordinated state increases their biological activity. There are several studies aiming at the synthesis and the study of the properties of the mixed amid carboxlylate complexes of metals[1]. The aim of the current study is to synthesize some acid amide coordination compounds of magnesium nicotinate, to elucidate their identities, structures, and modes of coordination and to follow their thermal behavior.

Analytically and chemically pure $MgSO_4$, NaOH and nicotinic acid were used for the synthesis of the coordination compounds pointed above. Analytically pure acetamide ($CH_3CONH_2$) (AA), carbamide ($CO(NH_2)_2$) (C), thiocarbomide ($CS(NH_2)_2$) (TC), nicotinamide ($NC_5H_4CONH_2$) (NA) were used as ligands.

The synthesis was performed by mechanochemical (enzyme) method. The components required included nickel nicotinate, amid1 and amid 2. They were mixed in a ratio of 1: 2: 2 for 20 minutes at room temperature in 1 liter ball mill.

The metal content of the synthesized compounds was determined following the procedure described in [2], that of nitrogen was evaluated with the application of the Dumas micromethod, while that of carbon, hydrogen and sulfur was found through combustion in an oxygen stream. The identity of the synthesized complexes was established by on the ground of X-ray diffractograms. The latter were recorded using X-ray diffractometer DRON-2.0 with Cu-anticathode. Tables provided by [3,4] were used to calculate the interplanar distances and the relative intensity of the line $I/I_1$. IR absorption spectra were recorded in the range from 400 cm-1 to 4000 cm-1 on AVATAR-360 spectrometer from "Nicolet" using samples compressed with KBr. Thermal analysis was performed on a system derivatograph Paulik-Paulik-Erdei at 10°C min-1 and 0,1-linkage to the sensitivity of galvanometers T-900, TG-100,

*Table 1. Elemental analysis data referring to mixed-ligand coordination compounds of magnesium nicotinate*

| Compound | Me, % | | S, % | | N, % | | C, % | | H, % | |
|---|---|---|---|---|---|---|---|---|---|---|
| | found | count | found | count | found | count | found | count | found | count |
| $Mg(Нк\text{-}H)_2 \cdot 2AA \cdot 2C \cdot 4H_2O$ | 4,32 | 4,15 | - | - | 19,40 | 19,38 | 37,11 | 37,37 | 5,67 | 5,88 |
| $Mg(Нк\text{-}H)_2 \cdot 2AA \cdot 2TC \cdot 5H_2O$ | 3,15 | 3,82 | 10,23 | 10,19 | 18,45 | 17,83 | 34,96 | 34,39 | 5,53 | 5,73 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| $Mg(Нк\text{-}H)_2 \cdot 2AA \cdot 2NA \cdot 4H_2O$ | 3,60 | 3,42 | - | - | 15,61 | 15,95 | 47,80 | 47,86 | 5,30 | 5,41 |
| $Mg(Нк\text{-}H)_2 \cdot 2C \cdot 2TC \cdot H_2O$ | 4,30 | 4,30 | 11,53 | 11,47 | 25,17 | 25,09 | 34,57 | 34,41 | 4,37 | 4,66 |
| $Mg(Нк\text{-}H)_2 \cdot 2C \cdot 2NA \cdot H_2O$ | 3,70 | 3,69 | - | - | 21,32 | 21,54 | 48,43 | 48,00 | 4,16 | 4,62 |
| $Mg(Нк\text{-}H)_2 \cdot 2TC \cdot 2NA \cdot 2H_2O$ | 3,00 | 3,43 | 9,16 | 9,14 | 20,06 | 20,00 | 45,23 | 44,57 | 4,35 | 4,57 |

Mixed-ligand coordination compounds of magnesium nicotinate are synthesized with the application of the mechanochemical method. Individuality of the synthesized compounds proved by physico-chemical methods of analysis. Coordination centres and denticity acid residue proved by IR spectroscopy. The synthesized compounds are tested as stimulators of cotton growth.

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