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N–HYDROXYETHYL–GLYCINE – A NEW ENVIRONMETALLY SOUND LIGAND

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Numerous chemists have already dealt with the study and development new compounds for use as special complexing agents in the previous years. Different oxygen– and nitrogen containing cyclic molecules and the polyaminopolyphosphonic– and carboxylic acids are well–known compounds from this respect. As regards their application the most important requirements for these complexing agents were the selectivity or/and the large stability constants of the metal complexes, but the environmental influence of these ligands were neglected. In the recent past, the environmental requirements have become increasingly important in the developed countries and on this basis chemists have to reinterpret the value of chelating agents utilised in many fields of chemical industry [1].

From the point of environmental safety, the biological stability of the different compounds is the most important aspect as concerns in the using of the molecules. This new requirement has changed the earlier situation: besides selectivity and a large stability constant, the biological stability is the third important factor currently in the using of the complexing agents. This new situation has resulted in a change in the thinking of chemists. Their aim now is to find new chelating agents, which can bind metal ions with appropriately large stability constants, but their biological stability should be low enough to satisfy the requirements of the environmental laws. This new situation has prompted chemists to prepare new compounds, which do justice to these new requirements.

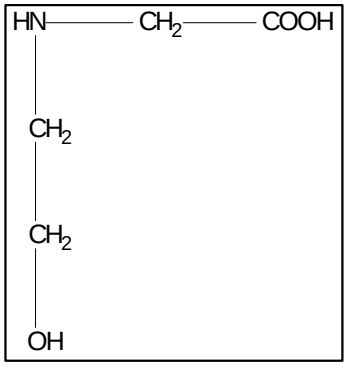

Figure 1. The structure of the N–hydroxyethyl–glycine

In our work an environmental sound ligand (N–hydroxyethyl–glycine, see in the Figure 1) were investigated in aqueous solution and in solid state. The good environmental properties (fast biodegradation) of this molecule are known but its metal binding abilities and properties in coordination

chemistry are unknown. The coordination chemical properties of this ligand were investigated in the presence of the following metal ions: Cu^{2+}, Ni^{2+}, Zn^{2+}, Co^{2+}, Al^{3+}, Fe^{2+}, Fe^{3+}, Ca^{2+}, Mg^{2+}, Mn^{2+}. The compound of the evolving complexes and their stability constants were calculated from pH–potentiometric titration data using the Psequad [2] computer package. The structure of the complex molecules of the ligand with Cu^{2+}, Ni^{2+}, Zn^{2+} and Co^{2+} ions were investigated by FT–IR spectroscopy in solid state.

It could be concluded that N–hydroxyethyl–glycine forms complexes with compositions ML, ML_2 and MLH_{-1}, MLH_{-2} (in the case of Al^{3+}) and these molecules have moderately large stability constants. The calculated stability constants of the evolved species are higher than in the case of the glycine [3]. This result indicates that the coordination of the hydroxyethyl group to the metal ions. This stability is enough large to bind practically the total amount of metal ion in solution, if the ligand is in excess. The distribution curves of different species are presented in Figure 2 for the case Zn^{2+} – N–hydroxyethyl–glycine system. It may be seen that practically all of the metal ion is bound to the ligand in the pH range 5–10.

The complexes of the ligand with Cu^{2+}, Zn^{2+}, Co^{2+} and Ni^{2+} ions were prepared and investigated in solid state by FT–IR spectroscopy. In these materials the metal ions were coordinated by two or/and three donor atoms of two ligands. On the basis of the results of FT–IR spectroscopic measurements the ligand coordinates to the metal ions through the following group: –NH, –COOH and –OH of the hydroxyethyl chain. Accordingly, the investigated ligand (N–hydroxyethyl–glycine) is a complexing agent which matches to the new environmental requirements and it may be suggested for industrial use.

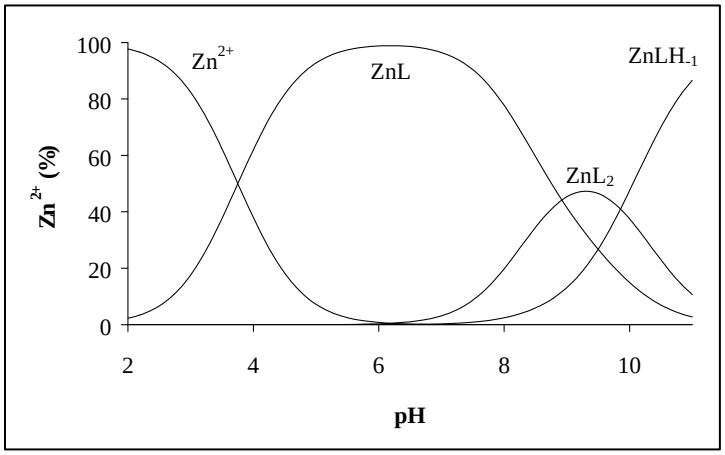

Figure 2. Zn(II) species distribution curves in the Zn^{2+} – N–hydroxyethyl–glycine (1:1) system

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