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An Overview on Polymer Complexes

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Polymer complexes have been attracting interest in many scientific and technological fields in recent years. Polymer complexes have found wide applications in bioinorganic industry, wastewater treatment, pollution control, hydrometallurgy, pre concentration, anionic polyelectrolyte hydrogels, cation-exchange resins, etc. Moreover, they recently showed potential applications in material science as catalytic, conductive, luminescent, magnetic, porous, chiral or non-linear optical materials. Although various extensive investigations on polymer complexes have been reported, most of these complexes are too complicated to be discussed quantitatively due to the non-uniformity of their structure. These compounds include not only “complexes of macromolecules” but also the structurally labile “metal complex”. Before detailed information can be obtained about the properties of polymer complexes, in particular about the reactivity and the catalytic activity, their structure must be elucidated. A polymer complex possessing a uniform structure may be defined as follows:

The structure within the coordination sphere is uniform, i.e. the species and the composition of the ligand and its configuration are identical in any complex unit existing in the polymer complex;

- The primary structure of the polymer ligand is known;
- If the structure within the coordination sphere is identical in a polymer and in a monomeric complex, their reactivity ought to be the same even though the complex is bound to a polymer chain. However, it is clear that the reactivity is sometimes strongly affected by the polymer ligand that exists outside the coordination sphere surrounding the metal complex. The effect of polymer ligands can be explained in terms of two factors;
- The steric effect, which is determined by the conformation and density of the polymer ligand chain;
- The special environment constituted by a polymer ligand domain.

Hence, it is possible to prepare polymer complexes having different use and applications by varying the polymer chain, the nature of the ligand and the metal ion. Our research group interests for the synthesis and characterization of polymer complexes structure by using elemental analyses, electronic spectra, magnetic susceptibilities, FT-IR, IR, ¹H-NMR, ESR and TGA analyses. The metal complexes of 8-quinolyl acrylate, acrylamido-4-aminoantipyrinyl, 2-acrylamidophenol, bis(2,6-diaminopyridine sulphoxide), 5-vinyl salicylaldehyde, 2-acrylamidobenzoic acid, 5-vinylsalicylidene anthranilic acid, 5-vinylsalicylidene aniline, 5-vinylsalicylidene-2-aminophenol, 5-vinylsalicylidene semicarbazone, 5-vinylsalicylidene-2-aminomethyl pyridine, cinnamaldehyde-2-anthranilic acid, 5-vinylsalicylidene-2-aminopyridine and etc. in the polymeric form were prepared in DMF and adding 0.1 (w/v%) 2,2'-azobisisobutyronitrile as initiator.

The determination of equilibrium constants is an important process for many branches of chemistry and can be determined from potentiometric and/or spectrophotometric data. Many more programs have been published to use microcomputers for the computations of equilibrium constants from experimental data. Potentiometry generally used for the measurements of formation constants of metal complexes is based on pH-metric titration of the ligand in absence and presence of metal ions. The formation constants derived by least squares analysis of potentiometric data can describe completely the solution equilibria. The measurements are usually carried out in the monomeric and polymeric form at a constant ionic strength higher than the metal ion concentration and in the absence and presence of 2,2'-azobisisobutyronitrile as initiator, respectively. Generally, the stability constants of polymer complexes are higher than monomer complexes. This is quite reasonable because the ligand in polymeric forms are better complexing agent. Also, the measurements are usually carried out at different temperatures to calculate the thermodynamic parameters. In most cases the formation of the metal polymer complexes have been found to be spontaneous, endothermic and entropically favourable.

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