
Adsorption and Spectroscopic Studies on the Interactions of Cobalt(III) Chelates with Clays

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Abstract: The interactions of the following three kinds of racemic and enantiomeric cobalt(III) chelates with montmorillonite and saponite are studied: $[\text{Co}(\text{en})_3]^{3+}$ (en = ethylenediamine), $[\text{Co}(\text{diNOsar})]^{3+}$ (diNOsar = (1,8-dinitro-3,6,10,13,16,19-hexaazabicyclo[6,6,6]-eicosane)cobalt(III)) and $[\text{Co}(\text{diAMsar})]^{3+}$ (diAMsar = (1,8-diamino-3,6,10,13,16,19-hexaazabicyclo[6,6,6]eicosane)-cobalt(III)). At neutral pH, these complexes are adsorbed as a trivalent cation up to 90%–100% of the cation exchange capacity of a clay. No difference is observed in the maximum adsorption amount between the racemic and enantiomeric isomers. The basal spacings of the clay-chelate adducts are determined by the X-ray diffraction measurements of non-oriented powder samples: 14.3 Å for $[\text{Co}(\text{en})_3]^{3+}$ montmorillonite, 16.5 Å for $[\text{Co}(\text{diNOsar})]^{3+}$ montmorillonite, and 16.9 Å for $[\text{Co}(\text{diAMsar})]^{3+}$ montmorillonite. The results imply that the chelates form a monolayer in the interlayer space. From the one-dimensional Fourier analyses of the diffraction pattern of $[\text{Co}(\text{diNOsar})]^{3+}$ montmorillonite, the chelate is concluded to be adsorbed with its three-fold symmetry axis in parallel with the layer surface. This is in contrast with the previous results of $[\text{Ru}(\text{phen})_3]^{2+}$ and $[\text{Ru}(\text{bpy})_3]^{2+}$, which are adsorbed with their three-fold symmetry axes perpendicular to the surface. The conclusion is consistent with the angular dependence of the infrared absorption spectrum of the film of the adduct.

Key Words: Clay-metal chelate interactions

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