Self-Organized Inorganic-Organic Hybrids Induced by Silylating Agents with Phyllosilicate-Like Structure and the Influence of the Adsorption of Cations

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Abstract: Two analogous inorganic-organic hybrids with a phyllosilicate-like structure SILMg1 and SILMg2, containing 3-aminopropyl- and N-propylethylenediaminetrimethoxysilane were synthesized through a sol-gel process. These hybrids adsorbed divalent cations of cobalt, nickel, copper, and zinc from aqueous solution to give the effectiveness of adsorption capacities in the sequence $Cu^{2+} > Zn^{2+} > Ni^{2+} > Co^{2+}$. SILMg1 has a higher capacity of adsorption than SILMg2. Elemental analysis, X-ray diffractometry, thermal analysis, infrared and nuclear magnetic resonance spectroscopies, and energy dispersive system microscopy characterized all hybrids. The proposed adsorption mechanism involves dissolution of the precursor matrix, formation of a phyllosilicate around the adsorbed ion, and a complexation of the cation by the amino-pendant groups in the interlayer. These new phyllosilicates are more crystalline than the original hybrids. The adsorption of Co^{2+} increases the interlayer distance to maximum values of 1.81 and 2.24 Å for SILMg1 and SILMg2, respectively. Thermal analysis data showed a decrease of thermal stability with cation adsorption. Si-O-Si groups were detected by infrared spectroscopy in all hybrids and a band at 1384 cm^{-1} was assigned to the nitrate counter anion, which indicates the participation of this ion in the sphere of coordination of the interlayer complexes. The photomicrographs obtained by scanning electron microscopy showed the organized distribution of the sheet structure for these synthesized phyllosilicates.

Key Words: Adsorption • Aminated Surface • Complexes • Ion-Exchange • Modified Phyllosilicate

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