The Spectral, Structral and Thermal Characterizations of Dimethyl Sulphoxide, Pyridine, Ethanolamine and N-Methyl Formamide Intercalated Kaolinites

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The intercalation of dimethyl sulphoxide (DMSO), pyridine (Py), ethanolamine (Ea), and N-methyl formamide (NMF) molecules into the kaolinite interlayers led to an appreciable decrease of 3697 cm^{-1} of the hydroxyl band. The appearance of the peaks at 3662, 3541, and 3504 cm^{-1} proved that the DMSO species are intercalated between the kaolinite layers through forming H-bonds with internal-surface hydroxyl groups. The intensities of the 942 and 796 cm^{-1} bending peaks arising from inner-surface hydroxyls decreased and new vibrational features appeared due to the intercalation of the guest species. The d_{001} value of pure kaolinite was found at 7.18 Å, and the d_{001} values were seen at 11.26, 11.62, 10.77, and 10.67 Å for kaolinite-dimethyl sulphoxide (K-DMSO), kaolinite-pyridine (K-Py), kaolinite-ethanolamine (K-EA), and kaolinite-N-methyl formamide (K-NMF) composites, respectively. The endothermic differential thermal analysis (DTA) peaks at a temperature of 108 – 334 °C reflected the changes in the physicochemical properties of the intercalated species. The thermal stability increase followed the order of K-Py < K-NMF < K-Ea < K-DMSO. Based on the thermal analysis data, the intercalation ratios of the composites above were determined as 80.0, 40.0, 81.6, and 82.0 %, respectively. The specific surface areas are affected by the intercalation geometry of the composites within the gallery spacing. The surface areas of the K-DMSO, K-Py, and K-EA complexes increased whereas the surface area of K-NMF decreased with respect to that of untreated kaolinite.

Key words: Kaolinite; Intercalation; XRD; Thermal Analysis; Inner-Surface Hydroxyls.