Orientation of Hexanediamine in Synthetic Fluorhectorite

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Abstract: Fourier-transform infrared (FTIR) spectroscopic studies were carried out on 1,6-hexanediamine hydrochloride (HDA)-treated synthetic fluorhectorite to determine the orientation of functional groups within the structure. Oriented crystal layers were prepared by flocculating the smectite slurry with glass fibers to obtain a 100-μm-thick paper. Orientations were determined by measuring integrated IR band intensities at various incident beam angles (<60 °), inasmuch as absorption occurred only if the oscillating dipole of the functional group interacted with the electric vector of the incident radiation. The H-N-H plane in amine groups was aligned parallel to the lamellar plane. The H-O-H plane of the small amount of sorbed water was inclined 45 ° or more to the interlamellar layer, and the OH groups were inclined 45 ° to this layer.

Even with the incorporation of HDA in the interlamellar structure, at high humidity, additional water sorbed. The sorbed water competed with and displaced amine groups from the surface, resulting in randomly oriented amine groups. Many of the amine groups were ionized, whereas the additional sorbed water showed little orientation.

This study demonstrated that the orientation of intercalated amines in fluorhectorite can be determined by following the intensity changes in infrared-active bands as a function of the incident beam angle. With intercalated HDA, the orientations were influenced by the presence of interlayer water.

Key Words: Adsorption • Fluorhectorite • Fourier-transform infrared spectroscopy • Functional group orientation • Hexanediamine • Infrared Spectroscopy

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