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# Vibrational Probe Studies of Water Interactions with Montmorillonite

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**Abstract:** Interaction of water with montmorillonite exchanged with Na<sup>+</sup>, K<sup>+</sup>, Co<sup>2+</sup>, and Cu<sup>2+</sup> cations as a function of water content was examined using an FTIR/gravimetric cell designed to collect spectroscopic and sorption data simultaneously. Correlation of water desorption isotherms with infrared spectra of the clay-water complex showed that the position of the HOH bending band of water decreased as a function of water content. The largest decreases in frequency were observed for Cu<sup>2+</sup> and Co<sup>2+</sup>; smaller decreases were found for Na<sup>+</sup> and K<sup>+</sup>. In addition, the molar absorptivity of sorbed water increased upon decreasing the water content. The decrease in frequency and the concomitant increase in molar absorptivity were attributed to polarization effects on the sorbed water molecules by exchangeable cations. The interference fringes of a self supporting clay film permitted d-spacings to be determined optically and, therefore, changes in frequency, molar absorptivity, and water sorption behavior to be related directly to changes in interlayer spacing. The d-spacings obtained from the interference fringes were consistently larger by approximately 0.5 Å than those determined using powder XRD.

**Key Words:** Cation exchange • Desorption isotherm • FTIR • Gravimetric • Montmorillonite • Physisorption • Water

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