
Formation and Characterization of Clay Complexes with Bitumen from Athabasca Oil Sand

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Abstract: Montmorillonite, kaolinite, illite, and chlorite were found to adsorb bitumen and its pentane-soluble and pentane-insoluble fractions. The formation of clay-bitumen complexes is influenced by the nature of the exchangeable cation on the clay and by the solvent carrier which stabilizes the bituminous compounds. Ca-clays adsorb organic compounds more strongly than sodium forms except in the presence of nitrobenzene. Solvents of high dielectric constant, such as nitrobenzene, promote ionization so that the ion-exchange mechanism of adsorption is favored, whereas solvents of lower dielectric constant, such as chloroform, tend to solvate rather than to dissociate bitumens. The behavior of the montmorillonite-bitumen complex in variable relative humidity indicates that organic molecules adsorb primarily on external surfaces and cause the clay to become less hydrophilic than prior to treatment. Clay-organic complexes are sufficiently stable to resist powerful organic solvents. The clay-organic complex separated from the Athabasca oil sand behaves similarly during chemical treatment to complexes formed between bitumen and the four reference clay minerals.

Key Words: Bitumen • Clay-organic complex • Infrared • Montmorillonite • Oil sand • X-ray powder diffraction

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