Sorption of Benzene, Toluene, Ethylbenzene, and Xylene (BTEX) Compounds by Hectorite Clays Exchanged with Aromatic Organic Cations

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Abstract: Adsorptive-type organoclays, where hydrocarbons adsorb directly to the siloxane surfaces, were studied to find new organic cations and to determine the parameters that produce effective sorbents. Organoclays were prepared from hectorite by cation exchange with small, aromatic organic cation salt solutions. Trimethylphenylammonium (TMPA) chloride was obtained and iodide salts of commercially-unavailable aromatic cations were synthesized and used to prepare organoclays. An aqueous mixture of benzene, toluene, ethylbenzene, and xylenes (BTEX) consistent with the composition of unleaded gasoline was used in sorption isotherms to compare the sorptive properties of the organoclays. Only the TMPA, methylphenylpyridinium (MPPyr), and trimethylammonium indan (Indan) organoclays were effective BTEX sorbents. Organoclays prepared from methylpyridinium (MPyr), trimethylammonium biphenyl (Biphenyl), and trimethylammonium fluorene (Fluorene) were poor sorbents. The MPPyr and TMPA organoclays preferentially sorbed ethylbenzene, whereas the Indan organoclay preferentially sorbed benzene and toluene. Langmuir-type sorption isotherms for the TMPA, MPPyr, and Indan organoclays implied surface adsorption, whereas linear isotherms suggested that partitioning was the sorptive mechanism for the MPyr, Biphenyl, and Fluorene organoclays. Water hydrating the small MPyr cation and the larger bulk of the Biphenyl and Fluorene cations may have blocked BTEX access to the interlayer siloxane surfaces. Although the rather bulky MPPyr and Indan cations produced effective organoclays, compact size and low hydration are organic cation properties that typically yield effective adsorptive-type organoclays.

Key Words: Adsorptive Organoclays • Aromatic Cations • BTEX • Hectorite • Natural Clays • Organophilic Organoclays • Smectite • Sorption • Unleaded Gasoline • X-Ray

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