Polarity Effect on Dichlorobenzene Sorption by Hexadecyltrimethylammonium-Exchanged Clays

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Abstract: Sorptive properties of organoclays may be greatly influenced by the physicochemical properties of organic sorbates. Hexadecyltrimethylammonium(HDTMA) clays were prepared using a high-charge smectite (HDTMA-SAz-1), a low-charge smectite (HDTMA-SWy-2), and an illite (HDTMA-ILL). The resultant organoclays were used to sorb aqueous phase 1,2-dichlorobenzene (*o*-DCB), 1,3-dichlorobenzene (*m*-DCB), and 1,4-dichlorobenzene (*p*-DCB). Sorptive characteristics of these compounds were determined by their molecular polarities (*o*-DCB > *m*-DCB > *p*-DCB) and the HDTMA-clay interlayer distance. HDTMA-ILL was used for comparison to HDTMA-SAz-1 and HDTMA-SWy-2. All dichlorobenzene isomers were directly intercalated in the interlayers of HDTMA-SAz-1, causing interlayer expansion, *o*-DCB and *m*-DCB were not intercalated in the interlayers of HDTMA-SWy-2 at low concentrations, but intercalation occurred at higher concentrations, which caused interlayer expansion. The concentration needed to produce interlayer expansion depended on the solute molecular polarity, hence a higher concentration of *m*-DCB than *o*-DCB was required, *p*-DCB was sorbed primarily by the HDTMA phase on the external surfaces of HDTMA-SWy-2. In the presence of chlorobenzene (CB), *p*-DCB sorption by HDTMA-SWy-2 is greatly enhanced, owing to the interlayer expansion by CB and a cosolvent effect. Sorption of *o*-DCB resulted from both direct solvation-type interactions with HDTMA and partitioning into HDTMA. Such sorption results in double-sigmoid isotherms. *m*-DCB weakly solvates the HDTMA and partitions into the HDTMA, displaying either a double-sigmoid or a type-III isotherm depending on clay type. *p*-DCB lacks ability to solvate HDTMA and partitions into HDTMA as its sole mechanism, producing type-III isotherms. HDTMA-clays are potentially effective for treating dichlorobenzene-contaminated wastewater.

Key Words: CMS Clay SAz-1 • CMS Clay SWy-2 • Dichlorobenzene • HDTMA • Organoclay • Polarity • Sorption

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