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Ryoto Kobayashi

Ryoto Kobayashi[1)], Tomohiko Okada[1)]
1) Graduate School of Science and Technology, Shinshu University
E-mail: 24w1018k@shinshu-u.ac.jp (Ryoto Kobayashi), tomohiko@shinshu-u.ac.jp (Tomohiko Okada)

Adsorption of oleic acid on a quaternary long-chain alkylammonium modified smectite

Hydrophobic smectites, prepared via cation exchange reactions between interlayer hydrated cations and quaternary alkylammonium, have been widely used as adsorbents and dye supports. “Hydrophobic interactions” have been regarded as an essential driving force for the adsorption of hydrophobic molecules, however, discussion on the adsorption mechanism would be insufficient because several issues should be concerned. We have performed fundamental study on adsorption characteristics of a hydrophobic smectite using oleic acid as a model hydrophobic molecule. Oleic acid is a hydrolyzed product of sebum originated from resident skin flora, causing body odor.

Dimethyldistearyl ammonium ($2C_{18}$) and stearyltrimethylammonium (C_{18}) bromides were used as the quaternary alkylammonium salts for the cation exchange reactions of a natural montmorillonite (Kunipia-F, abbreviated as KF hereafter). Oleic acid was impregnated into the cation-exchanged KFs in ethanolic solutions at the molar oleic acid/$2C_{18}$ or C_{18} ratios (r) ranging 5 to 1/6. Adsorption isotherms of oleic acid from aqueous solution were obtained by mixing 0.02 g of adsorbent with 200 mL of aqueous oleic acid solutions, based on the colorimetric analysis[1)] .

The basal spacing of KF-$2C_{18}$ expanded sequentially from 2.9 to 4.1 nm with increasing loaded oleic acid. Negligible change in the basal spacing was observed for KF-C_{18} in $r < 1$ (2.0 nm to 1.9 nm) by exchanging water with oleic acid. In addition, oleic acid was adsorbed as anionic form (COO^-), suggesting that ion-dipole interactions between the carboxylic group and C_{18} cations are a dominant force for the adsorption on KF-C_{18}. In aqueous solution, the adsorption on KF-C_{18} was conformed to Langmuir type, while Henry type isotherm (characteristics for hydrophobic interactions) was obtained for KF-$2C_{18}$. Solvent molecules and ion-dipole interactions should be considered for discussion on the adsorption as exemplified using KF-C_{18}.

1) Gregory, G. R. E. C., *Analyst*, **91**, 251 (1966).