Adsorption Studies on Kaolinites

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Abstract: Adsorption studies have been performed on Georgia kaolins having a broad range of crystallinity and particle size distributions (from 0 · 1μ to 44μ) using N_2 (78 ° K.), H_2O (273 ° K.), and $BuNH_2$ (298 ° K.). Using both vapor and liquid phase adsorption techniques, surface affinities of the adsorbates were determined.

Modified Frenkel-Halsey-Hill plots were used to compute the preferential adsorptivity of H_2O vapor over N_2 (hydrophilicity index, H.I.) as a function of crystallinity index, C.I., and particle size. For amine adsorptivity, non-aqueous adsorption isotherms were obtained.

Within any geographic deposit, crystallinity exhibits an inconsistent pattern with respect to particle size. A single generality is the tendency for crystallinity to increase toward the fine particle size range, $D \rightarrow 0 \cdot 2\mu$. Adsorptivities of N_2, H_2O, and $BuNH_2$ show no dependence upon crystallinity within a given particle size range. However, F.H.H. compensated slopes, describing the preferential adsorptivity over N_2, show a definite decrease as crystallinity increases. A striking anomaly occurs in the vicinity of $0 \cdot 2 < \text{C.I.} < 0 \cdot 7$ where H.I. increases briefly then returns to the original trend. The rate of decrease of H.I. vs. C.I. is consistently steeper with increasing particle size. Adsorption of water vapor most likely occurs as a 1:1 configuration on each silica-alumina edge group, 1:1 on each basal silica, and 1:2 (hindered configuration) on each basal alumina group.

The data suggest that amines adsorb preferentially and quantitatively on the edges, i.e. the Lewis and Bronsted acid sites, and follow a Langmuir pattern.

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