Effects of Exchanged Cation on the Microporosity of Montmorillonite

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Abstract: The micropore volumes of 2 montmorillonites (SAz-1 and SWy-1), each exchanged with Ca, Na, K, Cs and tetramethylammonium (TMA) ions, were calculated from the measured vapor adsorption data of N_2 and *neo*-hexane by use of *t*- and α_s-plots. The corresponding surface areas of the exchanged clays were determined from Brunauer-Emmett-Teller (BET) plots of N_2 adsorption data. Micropore volumes and surface areas of the samples increased with the size of exchanged cation: TMA > Cs > K > Ca > Na. The SAz-1 exchanged clays showed generally greater micropore volumes and surface areas than the corresponding SWy-1 clays. The vapor adsorption data and *d*(001) measurements for dry clay samples were used together to evaluate the likely locations and accessibility of clay micropores, especially the relative accessibility of their interlayer spacing. For both source clays exchanged with Na, Ca and K ions, the interlayer spacing appeared to be too small to admit nonpolar gases and the accessible micropores appeared to have dimensions greater than 5.0 Å, the limiting molecular dimension of *neo*-hexane. In these systems, there was a good consistency of micropore volumes detected by N_2 and *neo*-hexane. When the clays were intercalated with relatively large cations (TMA and possibly Cs), the large layer expansion created additional microporosity, which was more readily accessible to small N_2 than to relatively large *neo*-hexane. Hence, the micropore volume as detected by N_2 was greater than that detected by *neo*-hexane. The micropore volumes with pore dimensions greater than 5 Å determined for clays exchanged with Na, Ca and K likely resulted from the pores on particle edges and void created by overlap regions of layers. The increase in micropore volumes with pore dimensions less than 5 Å determined for clays exchanged with TMA and possibly Cs could be caused by opening of the interlayer region by the intercalation of these large cations.

Key Words: Exchanged Cation • Interlayer Accessibility • Microporosity • Montmorillonite • Surface Area

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