Preparation of Delaminated Clay Having a Narrow Micropore Distribution in the Presence of Hydroxyaluminum Cations and Polyvinyl Alcohol

Kenzi Suzuki, Toshiaki Mori, Kaoru Kawase, Hiroshi Sakami and Shozo Iida

Government Industrial Research Institute, Nagoya Hirate-cho, Kita-ku, Nagoya 462, Japan

Abstract: The pillaring of Na-montmorillonite with cationic oligomers of hydroxyaluminum (COHA) in the presence of an aqueous solution of polyvinyl alcohol resulted in the formation of a clay having a large surface area and pore volume. The pore-size distribution determined from a N_2 adsorption/desorption hysteresis was narrow and centered at about 25 Å. The peak width at half height in the distribution curve was <5 Å. As a result of delamination, the layer structure of the prepared clay was found from X-ray powder diffraction measurements to be lost. Short-range ordering, however, still existed in this delaminated clay, because exchangeable cations in the montmorillonite completely exchanged with Al^{3+}, a requisite step for pillaring.

The order of adding the starting materials (Na-montmorillonite, polyvinyl alcohol, and COHA) greatly affected the surface area and the pore volume of the delaminated clay. Two orders of addition (Na-montmorillonite, then COHA, then polyvinyl alcohol; and COHA, then Na-montmorillonite, then poly- vinyl alcohol) gave no measurable surface area and pore volume. Two other orders of addition (polyvinyl alcohol, then COHA, then Na-montmoriUonite; and polyvinyl alcohol, then Na-montmorillonite, then COHA) gave surface areas of 107 and 160 m^2/g and pore volumes of 0.13 and 0.29 cm^3/g, respectively. The amounts of the COHA solution and polyvinyl alcohol added greatly influenced the surface area and pore volume of the delaminated clay. Both properties increased monotonically with increasing amount of added polyvinyl alcohol, and increased to a maximum and then decreased with increasing amount of added COHA solution. The maximum surface area of the prepared delaminated clay was 330 m^2/g.

Key Words: Delaminated clay • Hydroxy aluminum • Montmorillonite • Ordering • Pillaring • Polyvinyl alcohol • Pore size • Surface area

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