FTIR Study of Deuterated Montmorillonites: Structural Features Relevant to Pillared Clay Stability

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Abstract: FTIR studies of six partially-deuterated montmorillonites (MS) reveal the presence of two O-D stretching bands, one between 2702 – 2728 cm^{-1} and another near 2680 cm^{-1}. For homoionic (Li, Na, Mg, Ca, or La) Wyoming-type MS, the position of the higher frequency band, designated as $(O\text{-}D)_h$, is between 2714 – 2728 cm^{-1}, whereas for homoionic Cheto-type MS it is between 2702 – 2706 cm^{-1}. The lower frequency band, designated as $(O\text{-}D)_l$, is in the narrow range of 2674 – 2684 cm^{-1}. Resolution of two corresponding O-H bands, appearing near 3670 and 3635 cm^{-1}, was observed only after partial dehydroxylation of the smectites. The changes in the relative intensities of the two O-D stretching bands as a function of the smectite type and of the Lewis acidity (charge density) of the exchangeable ion were determined. For Wyoming-type MS, the intensity of the $(O\text{-}D)_h$ band is much lower than that of the $(O\text{-}D)_l$ band, whereas for Cheto-type MS, the intensity of the $(O\text{-}D)_h$ band is about equal or slightly higher than that of the $(O\text{-}D)_l$ band. The observed resolution can be ascribed tentatively to the presence of (at least) two types of octahedral OH groups in the smectites, the $(O\text{-}D)_h$ band being assigned to AlMgOH and the $(O\text{-}D)_l$ band to AlAlOH groups. Pillaring of Cheto-type MS with hydroxy-Al_{13} oligocations resulted in products showing much higher thermal stability between 400 – 600 ° C compared to that of identically pillared Wyoming-type MS. Compositional and other factors, e.g., CEC values and mode of pillaring, may cause this difference in stability.

Key Words: Deuterated montmorillonites • FITR • Pillared smectites • Thermal stability

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