
Formation, Compositions, and Properties of Hydroxy-Al- and Hydroxy-Mg-Montmorillonite

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Abstract: Hydroxy-Al- and hydroxy-Mg-montmorillonite were prepared by treating dispersed Na-montmorillonite with aluminum and magnesium nitrate solutions and titrating with NaOH solutions so that the OH/Al ratio varied from zero to 3.0 and the OH/Mg ratio from zero to 2.0. External precipitation of Al and Mg hydroxides was observed when the OH/M ratios (M = metal) approached 3 and 2, respectively. From chemical analyses of the initial Na-montmorillonite and the hydroxy-metal montmorillonites, structural formulae were derived by assuming that the silicate layer compositions remained unchanged. Prior to the addition of NaOH, the average interlayer material approximated in composition to $[\text{Al}(\text{OH})_2]^+$ and $[\text{Mg}(\text{OH})]^+$. With additions of NaOH the interlayer compositions moved progressively towards $\text{Al}(\text{OH})_3$ and $\text{Mg}(\text{OH})_2$. When the hydroxy interlayers approached completion, external precipitation was observed. X-ray powder diffraction data showed that the hydroxy-Mg products have less tendency to swell in ethylene glycol and water, and greater thermal stability than the hydroxy-Al products. Initially, when the average interlayer compositions were near $\text{Al}(\text{OH})_2$ and $\text{Mg}(\text{OH})$, swelling followed more nearly the normal behavior.

Key Words: Hydrolysis • Hydroxy interlayer • Montmorillonite • Swelling • Thermal stability

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