
Surface Acidity of Smectites in Relation to Hydration, Exchangeable Cation, and Structure*

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Abstract: Equilibrium studies on clay films exposed to NH_3 and H_2O vapors demonstrate the effect of exchangeable cations on surface acidity and its relationship to hydration. At a relative humidity of 98 per cent the order of acidity on the clay surface as indicated by protonation of NH_3 was $\text{Al} > \text{Mg} > \text{Ca} = \text{Li} > \text{Na} = \text{K}$ for Wyoming bentonite and $\text{Al} > \text{Mg} > \text{Li} > \text{Ca} = \text{Na} = \text{K}$ for nontronite. At a relative humidity of 20 per cent, however, the order was $\text{Al} = \text{Mg} > \text{Ca} > \text{Li} > \text{Na} > \text{K}$ for the bentonite and $\text{Al} = \text{Mg} > \text{Li} > \text{Ca} > \text{Na} > \text{K}$ for nontronite. The largest change in proton donation properties due to hydration effects was in the calcium clays. For Ca-bentonite the NH_4^+ formation was 16 me/100 g at 98 per cent and 80 me/100 g at 20 per cent relative humidity. In Ca-nontronite, the NH_4^+ formation was 14 and 64 me/100 g for the wet and dry systems respectively. The differences in proton donation between the bentonite and nontronite clays are believed to be due to charge site location and its effects on ion hydration. The NH_4^+ formed by the protonation process seemed to exist in different environments in the bentonite and nontronite as indicated in the i.r. absorption spectra.

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