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REACTIONS OF POLYNUCLEAR HYDROXYALUMINUM CATIONS WITH MONTMORILLONITE AND THE FORMATION OF A 28-Å PILLARED COMPLEX: REPLY

Key Words—Aluminum, Anion deficiency, Hydroxy-Al, Montmorillonite, Pillared interlayer complex.

Turner's comments on our paper (Singh and Kodama, 1988) appeared to have been caused by his misunderstanding on the purpose of the paper. The main objective of the paper was to investigate the reactions of "relatively stable" (not more stable) polynuclear hydroxy-Al cations with montmorillonite and to characterize the resulting "stable" clay complex. Therefore, Table 1 of that report is important in that it verifies a nearly constant proportion of polynuclear hydroxy-Al which was maintained for as long as 90 days. Based on this fact, we carried out the interaction experiments. We did not intend to investigate the effect of aging on polynuclear hydroxy-Al cations and their equilibrium relationship.

Polynuclear hydroxy-Al cations were determined by reaction with 8-hydroxyquinoline for 0.5 hr (Turner, 1969) without filtering, because no noncrystalline material was detected. The other two references (Turner, 1976; Turner and Sulaiman, 1971) were included, because they give more detailed chemistry of the polynuclear hydroxy-Al cations.

From the data in Table 1, Table 2, and Figure 1 of Singh and Kodama (1988), Turner calculated on the basis of mass balance an excess of 1.7×10^{-3} mole/liter of OH^- in the system. The calculation was correct, but to what extent such a calculation was applicable to a complex system like ours is questionable. Nevertheless, as shown in Table 1, the total Al was accounted for and was present as monomers and polynuclear hydroxy-Al cations. We, therefore, had no evidence from which the presence of noncrystalline aluminum hydroxide could be suspected. Our recent studies (Kodama and Singh, 1989) have shown that the following properties are independent of the OH/Al ratio of the partially neutralized Al solutions, if the ratio is between 1.5 and 2.0: the average composition of the polynuclear hydroxy-Al, the relative stability of the polynuclear hydroxyl-Al, and the amount of polynuclear hydroxyl-Al adsorbed by the montmorillonite. Whatever the reason, in the 1989 investigations (OH/Al $\simeq$ 1.8), the excess of OH did not alter the properties and characteristics of the polynuclear hydroxyl-Al-montmorillonite complex.

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