Interactions of Polycations of Aluminum and Iron with Clays

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Abstract: Polycations of limited molecular size were prepared from 0.1 M solutions of Fe(III)$(NO_3)_3$ and Al$(NO_3)_3$ by ultrafiltration. Various amounts of the polycations were added to Na-kaolinite, Na-montmorillonite, and a Na-soil clay and the effect on the flocculation of the clay and electrophoretic mobility compared. Flocculation occurred just before zero net charge was obtained. Addition of further polycation resulted in the dispersion of clay with a net positive charge. The Al polycations possessed a high positive charge (0.49 per gram atom of Al), and their interaction with the clays indicated a planar shape. Adsorption of Al polycations decreased markedly the cation-exchange capacities of the kaolinite and the soil clay but had little effect on surface areas determined by low-temperature N_2 adsorption. The Fe polycations were spheres $10-100$ Å in diameter with a positive charge of 0.2 per gram atom. The surface areas of the kaolinite and the soil clay were substantially increased by the addition of the Fe polycations but their cation-exchange capacities were reduced by one fifth. Al polycations increased the surface areas of the montmorillonite (to 300 m^2) presumably by propping open the interlamellar spaces and rendering the a – b planes accessible for nitrogen adsorption. The Al polycations in intedamellar spaces prevented collapse to 14 Å on heating to 150üC. There was no evidence of regular interlayer Fe as might be anticipated from the size of the spheres.

Key Words: Aluminum • Electrophoresis • Intercalation • Iron • Kaolinite • Montmorillonite • Polycations • Surface charge

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