The Surface Chemistry of Imogolite

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Abstract: Imogolite is a tubular aluminosilicate which is common in Andosols and Spodosols. The high pH at point-of-zero charge at the outer parts of the tube and the anomalously high chloride adsorption of imogolite suggested that there may be structural charge associated with this mineral. The structural charge may arise because of changes in bond valence imposed by the incorporation of orthosilicate anions in a gibbsite-type sheet. By using a Basic Stern Model approach, it is shown that the surface charge properties of imogolite are explained if the mean Al-O bond valence of the outer $-Al_2OH$ groups is higher than the inner $-Al_2OHSiO_3$ groups. Hence, a weak positive charge is developed on the outer tube walls whereas a negative charge develops in the tubular pores. The best model fits were obtained where either one or two units of structural charge per unit cell of tube were assumed. The model may also explain why imogolite tubes are normally aggregated in large bundles in close hexagonal packing, because bound counterions may hold the tubes together. However, to arrive at good model descriptions, the deprotonation of $-Al_2OH$ groups must occur at a higher pH than that expected when assuming that all surface oxygens form two hydrogen bridges with H_2O. A more precise structure of imogolite is required to test fully this hypothesis.

Key Words: Adsorption • Basic Stern Model • Bond Valence • Chloride • Imogolite • Point-of-Zero Charge • Surface Charge

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