Effects of Iron and Aluminium Oxides on the Colloidal and Surface Properties of Kaolin

Manuel Arias, M. Teresa Barral and Francisco Diaz-Fierros

Departamento de Edafoloxía e Química Agrícola Facultade de Farmacia. Univ. Santiago de Compostela 15706. Santiago, Spain

Abstract: The association between clay silicates, and iron and aluminium oxides has a major influence on the chemical and physical properties of soils. In this work the interaction of a kaolin substrate with iron and aluminium oxides and/or hydroxides obtained by basification of solutions of the metal ions was compared to that of quartz. Both precipitates were obtained in the presence of the substrates.

The aluminium precipitates had higher crystallinity, and thus led to smaller increases in specific surface area than those of iron, and were more effective modifiers of the surface electrical properties of the kaolin-oxide mixtures. At concentrations as low as 0.43% Al (g/100 g of substrate) the point of zero charge (PZC) of the components with variable charge was measurable, while Fe required 2.23% and gave lower PZCs than those of corresponding concentrations of Al. In both cases the PZCs shifted to higher pH as metal concentration was increased, as did the flocculation interval of colloidal suspensions of kaolin, which were close to the PZCs (where these were evaluated).

The Al and Fe oxides precipitated on quartz had higher crystallinities. Both metals increased the specific surface area to a similar extent, with an almost linear relationship to metal concentration. Samples containing ca. 6.5% Fe or Al had similar or slightly higher PZCs than corresponding kaolin samples.

The results were interpreted by assuming, in the case of kaolin, the union of the metal precipitate with the basal faces of the substrate, so decreasing the negative charge at this surface; and in the case of quartz, the formation of a hydroxide coating that neutralizes the negative charge on the silica surface. The difference between the results obtained for each metal was attributed to the different morphologies of their oxide precipitates.

Key Words: Aluminium oxides • Colloidal stability • Iron oxides • Kaolinite • PZC

Clays and Clay Minerals; August 1995 v. 43; no. 4; p. 406-416; DOI: 10.1346/CCMN.1995.0430403

Clay Minerals Society (www.clays.org)