

ABSTRACT

Boehmite (γ -AlOOH) is an important aluminium oxyhydroxide. Its high surface area and amphoteric properties makes it suitable for adsorbing cations and anions that are present in the soil solution and aquifers. Then, it may have an important role in the regulation of speciation, distribution and mobility of different chemical in natural aquatic environments.

Many organic compounds present in natural environments possess functional groups in their structure that make them suitable to adsorb on mineral particles affecting their mobility. On the other hand, the pollution of natural water with heavy metals arising from industrial wastewaters is very common. These heavy metals can be mobilized as free entities or can be transformed into bioavailable species by reaction with dissolved organic matter. Therefore, it is very important to understand under which conditions these metallic elements are mobilised.

In this work, the influence of phosphonic ligands on heavy metals adsorption, Cu(II), Zn(II) and Cd(II), was studied using boehmite as adsorbent. Boehmite was characterized by X-ray diffraction, thermogravimetric and differential thermal analysis and infrared spectroscopy. The BET surface area and acid-base properties of the boehmite were also measured.

Adsorption studies as a function of pH were performed using phosphonic acids as BHAMP (N,N-bis(2-hydroxyethyl) aminomethylphosphonic acid), HEDP (1-hydroxyethane-(1,1-diphosphonic acid)) and NTMP (nitrilotris(methylenephosphonic ácido)) which possess one, two and three phosphonic groups in their structure respectively. It was found that these compounds adsorb on boehmite showing a typical anion behavior, being removed by 100% at lower concentrations (50 μ M). In order to characterize the surface species formed by the interaction of the oxide with phosphonic compounds, ATR-FTIR (attenuated total reflectance Fourier transform infrared spectroscopy) studies were performed.

The adsorption of Cu (II), Zn (II) and Cd (II) onto boehmite was also studied. The affinity observed, Cu > Zn > Cd, is in agreement with what was reported by other authors.

Finally, stoichiometric and nonstoichiometric amounts of ligand and metal were employed to study the influence of the three phosphonic acids on the adsorption of the metals and vice versa. Different experiments varying the surface sites / solute concentration ratio were also performed.

The modeling of the experimental data in the systems ligand-boehmite, metal-boehmite, and metal-ligand-boehmite was carried out using the surface complexation model taking into account the formation of surface mononuclear complexes. The simple constant capacitance (CCM) model of double layer was employed. To achieve a good fit of the experimental values at different concentrations studied in the metal-ligand-boehmite system it was necessary to take into account of the formation of ternary complex surface.

The results show that the studied metals do not affect the behavior of phosphonic ligands studied. However, the presence of phosphonics modifies, in certain metal / ligand ratios the adsorption behavior of the three metals used, retaining them via the formation of surface ternary complexes of the type surface-ligand-metal.
