

Adsorption of low-level phosphate by Mg-Al layered double hydroxides and its competitive interaction with carbonate, sulfate, and chloride ion

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ABSTRACT

Mg-Al-Cl and Mg-Al-NO₃ layered double hydroxides (LDHs) were synthesized by precipitation from homogeneous solution using urea hydrolysis. The scanning electron microscope images of the two LDHs showed plate-like particles. The Brunauer–Emmett–Teller surface area of the Mg-Al-Cl and Mg-Al-NO₃ LDHs were 21.37 and 38.45 m²/g, respectively. The phosphate adsorption studies were carried out as a function of LDHs content, contact time, temperature, initial pH, and competitive anions. The Mg-Al-Cl and Mg-Al-NO₃ LDHs showed a good adsorption capacity on phosphate. It was found that the optimum condition for phosphate maximum removal rate onto LDHs were at pH of 4–10, temperature of 20°C and content of 0.05 g, the maximum removal rates of Mg-Al-Cl and Mg-Al-NO₃ LDHs for phosphate were more than 98%. The competitive anions (CO₃²⁻, SO₄²⁻, and Cl⁻) had similar interferences on removal of phosphate by Mg-Al-Cl and Mg-Al-NO₃ LDHs, and the adverse impact of CO₃²⁻ was much greater than that of SO₄²⁻ and Cl⁻. The X-ray diffraction patterns revealed the characteristic basal reflections of the LDHs materials. The Fourier transform infrared spectroscopy results confirmed the ion exchange and ligand exchange process during the adsorption of phosphate on the LDHs.

Keywords: Layered double hydroxides; Adsorption; Phosphate; Urea hydrolysis; Competitive anions

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