Single/synchronous adsorption of Cu(II), Cd(II) and Cr(VI) in water by layered double hydroxides doped with different divalent metals

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Layered double hydroxides (LDHs) are a class of excellent adsorbents for the simultaneous removal of anionic and cationic pollutants in water. In this paper, four types of LDHs doped with different divalent metals were prepared by the co-precipitation method, namely MgAl-LDH, ZnAl-LDH, CaAl-LDH and CoAl-LDH, to explore their adsorption performance for Cu(II), Cd(II) and Cr(VI) respectively. The removal efficiencies of Cu(II) and Cd(II) by MgAl-LDH and CaAl-LDH were higher, and the removal efficiencies of Cr(VI) by MgAl-LDH and CoAl-LDH were higher. In comparison, MgAl-LDH showed the best all-around adsorption performance, and its corresponding optimal dosage was 0.50 g/L.

Effects of pH, initial pollutant concentration, coexisting heavy metals and coexisting anions on adsorption by MgAl-LDH were studied. The adsorption behavior of MgAl-LDH was consistent with the pseudo-second-order kinetic model and the Freundlich isotherm model. In the synchronous adsorption system, the removal efficiencies of MgAl-LDH for Cu(II), Cd(II) and Cr(VI) reached 99.50%, 70.28% and 22.50%, respectively. Combined with scanning electron microscopy, energy-dispersive X-ray spectroscopy, Fourier-transform infrared spectroscopy, X-ray diffraction and Brunauer–Emmett–Teller characterization results, the main removal mechanisms of Cu(II), Cd(II) and Cr(VI) were deduced.

Keywords: Single adsorption; Synchronous adsorption; Layered double hydroxides; Heavy metals