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Removal of the anionic dye Biebrich scarlet from water by adsorption to calcined and non-calcined Mg–Al layered double hydroxides

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ABSTRACT

A native layered double hydroxide Mg–Al–CO_3, denominated LDH, containing Mg(II) and Al(III) in the layers, was prepared by a co-precipitation method. Its calcined form Mg–Al, (CLDH), was obtained by calcination at 500˚C. Both materials were characterized by powder X-ray diffraction (PXRD), Fourier transformation infrared spectroscopy, thermogravimetric analysis, and the determination of the point of zero charge. The porous structure of the solids was investigated by nitrogen adsorption at 77 K. The adsorptive affinity of these materials for Biebrich Scarlet was studied as a function of dye–adsorbent contact time, initial pH of the solution, initial dye concentration, and temperature. Sorption kinetics data fitted best to a pseudo-second-order model suggesting that the process of BS adsorption is controlled by reaction rate for interaction of dye molecules rather than by diffusion. Equilibrium data for both adsorbents were in accordance with both Sips and Langmuir isotherm models. The sorption capacity of CLDH was found to be almost independent on the initial pH, while sorption capacity of LDH was lower in neutral and alkaline conditions than at acidic pH. The adsorption process was also found to be spontaneous and endothermic in nature.

Keywords: Layered double hydroxides; Dye adsorption; Characterization; Kinetics; Isotherms

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