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Removal of Cadmium (II) from aqueous solution by zinc oxide nanoparticles: kinetic and thermodynamic studies

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ABSTRACT

In this study, the removal of cadmium ions by ZnO nanoparticles, prepared by a modified sol-gel method, was investigated. The kinetics, thermodynamic and equilibrium parameters of the cadmium ion adsorption on the nanomaterial were determined in batch mode experiments. The adsorption process was found to be highly concentration dependent, and the adsorption rate increased proportionally with temperature indicating an endothermic process. The kinetics of the adsorption process was found to follow the pseudo-second-order rate law. The adsorption isotherm data were in good agreement with the Langmuir model. The maximum adsorption capacity of ZnO nanoparticles for Cd(II) was found to be 217.4 mg.g^{-1} at 328 K. Thermodynamic parameters revealed the endothermic and spontaneous nature of the adsorption process. Nevertheless, the global reaction rate is probably controlled by the intra-particular diffusion of Cd(II) ions.

Keywords: ZnO nanoparticles; Cadmium removal; Adsorption kinetic and equilibrium

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