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Potential use of CeO_2, TiO_2 and Fe_3O_4 nanoparticles for the removal of cadmium from water

Ada Rebecca Contreras[a], Ana García[a], Edgar González[b], Eudald Casals[b], Victor Puntes[b,c], Antoni Sánchez[a,*], Xavier Font[a], Sonia Recillas[a]

[a]*Department of Chemical Engineering, Escola d'Enginyeria, Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain*
Tel. +34 935811019; Fax: +34 935812013; email: antoni.sanchez@uab.cat
[b]*Institut Català de Nanotecnologia, Campus de la Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain*
[c]*Insitut Català de Recerca i Estudis Avançats, Passeig Lluís Companys, 23, 08010 Barcelona, Spain*

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ABSTRACT

Inorganic nanoparticles (NPs) of cerium oxide (CeO_2), iron oxide (Fe_3O_4) and titanium oxide (TiO_2) were studied for the removal of dissolved cadmium from water at concentrations ranging from 25 to 350 mg/L. Adsorption was the predominant mechanism for sequestration, and particularly efficient cadmium removal was demonstrated for Fe_3O_4 NPs. Experimental data were fitted to three different adsorption isotherms: Langmuir, Freundlich and Temkin. The best fit was obtained for the Freundlich isotherm ($R^2 > 0.96$ for all NPs). Adsorption was shown to follow pseudo second-order kinetics ($R^2 \geqslant 0.91$ for all NPs). All three NPs showed some removal of cadmium in aqueous solution, but after 72 h of process, Fe_3O_4 NPs showed a higher capacity of cadmium adsorption (101.1 mg Cd/g NP) than CeO_2 NPs (49.1 mg Cd/g NP) or TiO_2 NPs (12.2 mg Cd/g NP). These results demonstrate the potential use of this NPs to remove dissolved cadmium at high concentrations.

Keywords: Cadmium; Adsorption; Nanoparticles; Water treatment; Adsorption kinetics; Adsorption isotherm

*Corresponding author.