

Kinetics and equilibrium studies for removal of fluoride from underground water using cryptocrystalline magnesite

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ABSTRACT

In the present study, the defluoridation capabilities and adsorption mechanisms of cryptocrystalline magnesite were evaluated. All experiments were done by batch procedure. Conditions assessed include time, dosage, concentration, pH and the effects of competing ions. Optimum defluoridation conditions were observed to be 20 g/L magnesite, 2:100 solid:liquid ratio, 20 min of agitation and 60 mg/L fluoride concentration. Adsorption of fluoride by magnesite was observed to be independent of pH. Cryptocrystalline magnesite showed >99% efficiency for fluoride removal. Adsorption kinetics fitted better to a pseudo-second order than a pseudo-first order thus confirming chemisorption. Adsorption data fitted better to a Langmuir than a Freundlich adsorption isotherm thus confirming monolayer adsorption. Cryptocrystalline magnesite successfully removed excess fluoride from aqueous solution to below Department of Water Affairs and Forestry water quality guidelines. As such, this material can be used for a point source defluoridation technique in rural areas and households in South Africa and other developing countries. Based on comparison studies, cryptocrystalline magnesite proved to have high adsorption capacity for fluoride removal and can be used as a substitute for conventional treatment methods.