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Defluoridation using hybrid clay – influence of process conditions and modeling

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ABSTRACT

Fluoride contamination in groundwater is identified as a serious threat to the ecosystem due to its hazardous after-effects. In this experimental research, a hybrid clay was synthesized using clay and *Phoenix dactylifera* biochar and employed to remove fluoride under shaking conditions. Parametric experiments were conducted to study the effect of pH (2.0–9.0), initial fluoride concentration (10–40 mg/L), sorbent dose (0.25–8.0 g/L) and temperature (303–313 K) on defluoridation efficiency. At pH 3.0, the maximum fluoride removal efficiency of 90% was achieved with an equilibrium time of 180 min. Higher initial fluoride concentrations required more removal times due to the limitation of sorption sites availability. The following empirical equation relating fluoride uptake and clay dose was established as: RE = 31.648ln(w) + 34.424. The kinetic data fitted well to pseudo-second-order model compared with power function model. The removal efficiencies increased with increase in temperature and confirmed the endothermic nature. The pseudo-second-order rate constant was determined as 0.0456 g/mg min at a temperature of 308 K and 30 mg/L fluoride concentration. Thermodynamic studies were conducted to verify the feasibility of sorption.

Keywords: Fluoride; Kinetics; Removal; Hybrid clay

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