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Removal of aluminum from synthetic solutions and well water by chitin: batch and continuous experiments

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ABSTRACT

The intake of aluminum by humans is a matter of interest because it has shown potential association with health disorders, especially neurological complications, after long periods of chronic exposure. In this work, the removal of monomeric aluminum (Al^{3+}) from synthetic solutions and drinking well water using chitin as a sorbent agent was evaluated. Removal experiments in batch and in continuous regimes were carried out, along with isothermal and kinetic studies, which were performed to determine the adsorption mechanism and removal rates. Batch experiments demonstrated that 0.80 g chitin L^{-1} completely removed the Al^{3+} from synthetic solutions (concentrations upto 2.75 mg Al^{3+} L^{-1}) and from well water (upto 0.83 mg Al^{3+} L^{-1}). Isothermal studies in synthetic solutions demonstrated that the Al^{3+} removal via chitin was best fit by the Tóth isothermal model (maximum adsorption capacity of 20.14 mg Al^{3+} g^{-1} chitin), which is consistent with a chemisorption mechanism with weaker interactions than those proposed in the Langmuir model. The removal fitted pseudo-second-order kinetics, which is consistent with a chemisorption mechanism, showing a high initial adsorption rate. Descending flux column (flow 19.80 mL min^{-1}) experiments with well water resulted in a removal capacity of 9.53 mg Al^{3+} g^{-1}. Scanning electron microscopy/energy dispersive X-ray spectroscopy analysis revealed adsorption sites for aluminum along the chitin surface. Infrared spectroscopy did not show covalent bonds between the chitin and the aluminum in the samples, which is consistent with the isothermal studies.

Keywords: Drinking water; Aluminum removal; Chitin; Chemisorption

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