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REMOVAL OF FLUORIDE IONS BY ION EXCHANGE RESIN: KINETIC AND EQUILIBRIUM STUDIES

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Abstract

The extent of the problem of the excessive fluoride in drinking water remains an important health issue. In the present work, strong-base anion resins were investigated to assess their sorptive removal capacity of fluoride from water. It was found that the removal of fluoride was high at natural pH (7) and was improved for increasing contact time and adsorbent dosage. The maximum sorption of the resin was 13.7 mg/g according to the Langmuir model, namely higher than the values reported in the literature for other sorbents and in the range of maximum capacities of some geo-materials, showing the efficiency of strong-base anion resins for fluoride removal. Among the Langmuir, Freundlich and Temkin isotherm models tested, it was found that the Freundlich model was the most appropriate to describe fluoride sorption at equilibrium (r^2>0.99); while among the pseudo-first order, pseudo-second order and modified pseudo-first order models, the pseudo-first order model was found to match experimental kinetic data. It was also shown that the rate-limiting step was the film diffusion rather than the intra-particle diffusion. A simple and efficient statistical method, based on factorial design analysis using linear regression model, was applied for the determination of the optimal removal conditions deduced from 3D plots and contour plots. To approach real conditions, the effect of co-existing ions showed slightly reverse effect of hardness and chloride ions while a higher reverse effect for nitrate. Contrarily, sulfate had no significant effect on fluoride removal.

Key words: adsorption, batch study, fluoride, ion exchange, isotherms, kinetic, removal

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