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Adsorption of F on Bio-Filter sorbent: kinetics, equilibrium, and thermodynamic study

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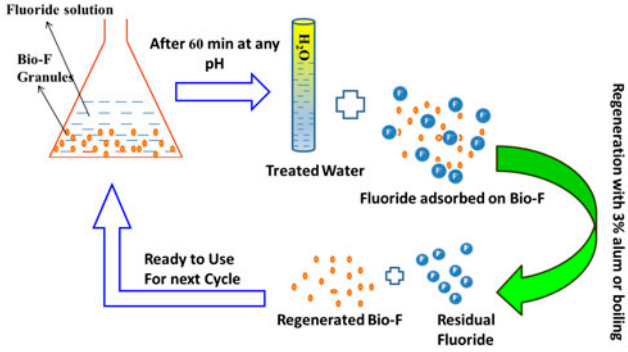

ABSTRACT

The aim of this research work is to investigate the potential of a commercially available Bio-Filter (Bio-F) sorbent for defluoridation of drinking water. Batch equilibrium experiments were conducted with respect to change in pH of solution, initial concentration of F, contact time, and competitive anions to evaluate the fluoride adsorption behavior of Bio-F. Sorption of F onto Bio-F was found to be independent of pH. Scanning electron microscopy, sieve method, and porosity test were used to characterize the physical attributes of Bio-F. More than 97% removal of fluoride (28 mg/L) was achieved within 60 min of contact time at neutral pH. Results demonstrated that among the kinetic models tested, pseudo-second-order model fitted the kinetic data well with a correlation coefficient greater than 0.99, suggesting the chemisorption mechanism. Different adsorption isotherm models like Langmuir, Freundlich, Redlich–Peterson, Sips, and Toth were used to analyze the experimental data and the model parameters were evaluated. Experimental data revealed that three-parameter Redlich–Peterson Isotherm model gives best fit for F removal. The maximum adsorption capacity of Bio-F for F deduced from Langmuir model was ~5.530 mg/g. The calculation of thermodynamic parameters at different temperatures showed that adsorption was

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spontaneous and endothermic. All studied competitive anions (SO_4^{2-}, NO_3^-, Cl^-) have negligible effect on F sorption by Bio-F. Regeneration studies were performed by alum solution (3% aqueous solution) and boiling means. This study showed that the removal of F by Bio-F is a promising technique.

Keywords: Defluoridation; Drinking water; Equilibrium isotherms; Adsorption kinetics; Error function; Thermodynamics