Fluoride sorption by zirconium (IV) loaded carboxylated orange peel

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ABSTRACT

The article reports on an investigation into the ability of zirconium (IV)-loaded carboxylated orange peel to remove the fluoride ion from drinking water and the parameters involved in this process. Various spectroscopic and microscopic techniques were used to characterize the adsorbent. The results suggested that the adsorbent exhibited reasonably significant fluoride removal over a wide range of pH value (3.0–8.0). The kinetic studies indicated that the adsorption process followed pseudo-second-order model. The adsorption isotherm has been modeled by the Langmuir, Freundlich, Temkin, and DR equation. The adsorption isotherm was well described by DR equation. The negative value of ΔG˚ and positive value of ΔH˚ revealed that the adsorption process was spontaneous and endothermic. The presence of NO₃⁻, Cl⁻, and SO₂⁻ ions have negligible effect, whereas PO₄³⁻ and HCO₃⁻ retarded the fluoride removal capacity to some extent. The reuse study of the adsorbent resulted in retention of 83% capacity in 8th cycle. Desorption studies showed that the fluoride can easily be desorbed by using 0.1 N NaOH solution. The wide pH range, second-order kinetics, operation at normal temperature, high adsorption capacity, and good recycle potential of the new adsorbent would make it an ideal material for the removal of fluoride from drinking water.

Keywords: Fluoride; Orange peel; Zirconium; Adsorption; Kinetic; Isotherm