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Water defluoridation by Fe(III)-loaded sisal fibre: Understanding the influence of the preparation pathways on biosorbents' defluoridation properties

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Water defluoridation by Fe(III)-loaded sisal fibre: Understanding the influence of the preparation pathways on biosorbents' defluoridation properties

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Abstract

Defluoridation properties of two Fe(III)-loaded plant biomass (Fe(III)-activated sisal fibre (Fe(III)-ASF) and post-alkalized Fe(III)-ASF (PA-Fe(III)-ASF)) distinguished by preparation pathways through exclusion/inclusion of post-alkalization are presented, with the aim of understanding the influence of post-alkalization in the preparation pathway to their fluoride removal properties. Findings reveal that PA-Fe(III)-ASF shows higher chemical stability with removal efficiency increasing towards acidic conditions, whereas Fe(III)-ASF manifests a lower chemical stability with removal efficiency increasing (in a wider pH range) with the increase in pH. This is attributable to the nature of the interactions between Fe(III) and the biomass surface functional groups. The removal efficiency by PA-Fe(III)-ASF has a strong positive correlation (0.98) to the surface charge/speciation induced by pH and the reverse is true for the Fe(III)-ASF. These findings therefore suggest that the principal fluoride removal mechanism is electrostatic interactions and ligand exchange for PA-Fe(III)-ASF and Fe(III)-ASF, respectively. Therefore, inclusion/exclusion of post-alkalization in preparation steps is an important aspect to consider in the production of Fe(III)-loaded biosorbents for water defluoridation for acquisition of specific defluoridation properties.

Keywords

Preparation pathways; Biosorbent; Post-alkalization; Iron(III)-loaded plant biomass; Fluoride removal mechanism