2018-04-05

Crustacean derived calcium phosphate systems: Application in defluoridation of drinking water in East African rift valley

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Elsevier B.V.

https://doi.org/10.1016/j.jhazmat.2017.12.049

Crustacean derived calcium phosphate systems: Application in defluoridation of drinking water in East African rift valley

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Abstract

Calcium phosphate adsorbents, derived from prawns and crabs shell biomass wastes have been developed using wet chemistry and low temperature treatment. The adsorbents were characterized by X-ray diffractometry and Fourier transform infrared spectroscopy. Batch adsorption test were carried out to investigate their effectiveness in adsorption of fluoride from ground and surface waters. Adsorption capacities were compared with bone char and synthetic hydroxyapatite (CCHA). Results indicate that prawns derived adsorbent (PHA) formed hexagonal structure with phases identifiable with hydroxyapatite while crabs based adsorbent (CHA) formed predominantly monoclinic structure with crystalline phase characteristic of brushite. Vibrational analysis and kinetic studies predicted defluoridation occurred mainly by ion exchange and ion adsorption mechanisms. Defluoridation capacity of the adsorbents was found to be superior compared to bone char and CCHA. CHA was the most effective with efficiencies above 92% and highest capacity of 13.6 mg/g in field water with fluoride concentration of 5–70 mg/L. PHA had highest capacity of 8.5 mg/g which was still better than 2.6 mg/g recorded by CCHA and bone char. Adsorption was best described by pseudo 2nd order kinetics. The findings indicate that crustacean derived calcium phosphate systems have better potential for defluoridation than traditional bone char and synthetic systems.

Keywords
Adsorption; Crabs; Fluoride; Prawns; Kinetics