



Development of new alginate entrapped Fe(III)–Zr(IV) binary mixed oxide for removal of fluoride from water bodies

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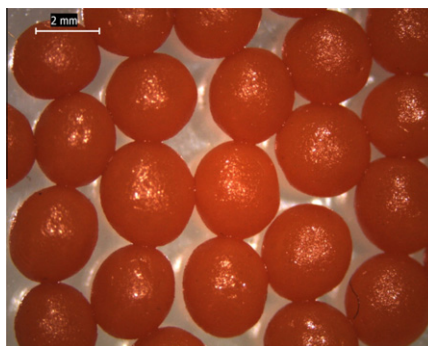
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HIGHLIGHTS

- ▶ Simple route for the preparation of nano/microparticles of Fe–Zr mixed oxide and immobilization in biopolymer alginate.
- ▶ EDS mapping of Fe and Zr.
- ▶ Second order kinetics for fluoride adsorption.
- ▶ Suitable alkaline pH for elution of fluoride.
- ▶ Efficient regeneration properties of the material for sustainable operation.

GRAPHICAL ABSTRACT

Optical microscopic view of FZCA.



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ABSTRACT

The present work reports the decontamination of fluoride from water bodies using a newly developed hybrid material of (Fe/Zr)–alginate (FZCA) microparticles. The hybrid material was characterized by various instrumentation techniques. The average particle size of the Fe–Zr particle was found to vary between 70.89 nm and 477.7 nm. The XRD pattern of FZCA shows most significant peaks at 11.5, 35.3, 26.9, 39.4 and 56.1 in the 2θ range of 10–90°. Various physico-chemical parameters such as equilibrium contact time, pH, initial fluoride concentration and adsorbent dose, were studied in batch adsorption experiments. The sorption of fluoride follows pseudo-second order kinetics. The positive value of thermodynamic parameter (ΔH°) indicates increasing randomness during the sorption process. The desorption characteristic of the hybrid material shows that nearly 89% of fluoride could be leached out at pH 12. A possible mechanism of fluoride removal by the hybrid material was also purposed. Further, the reusable properties of the material support further development for commercial application purpose.

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1. Introduction

Fluoride contamination in the drinking water due to natural reasons and human activities is a major problem worldwide

[1,2]. Excess fluoride intake causes fluorosis, skeletal deformities, metabolic disorder in soft tissues and fluoride interference in DNA synthesis [3]. World Health Organization (WHO) guideline suggests 1.5 mg L⁻¹ as the maximum acceptable fluoride concentration in drinking water [4]. Fluoride occurs mainly as sellaite (MgF₂), fluorspar (CaF₂), cryolite (Na₃AlF₆) and fluorapatite [3Ca₃(PO₄)₂Ca(F,Cl₂)]. It is also found as fluorspar in sedimentary rocks

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