



Efficient removal of fluoride using new composite material of biopolymer alginate entrapped mixed metal oxide nanomaterials

S.K. Swain^a, Tanushree Patnaik^b, R.K. Dey^{c,*}

^aDepartment of Applied Chemistry, Birla Institute of Technology, Mesra, Ranchi 835 215, India

^bDepartment of Chemistry, Stewart Science College, Cuttack 753 008, India

^cCentre for Applied Chemistry, Central University of Jharkhand, Ranchi 835 205, India

Tel. +91 671 2306624; email: ratan.dey@cuja.ac.in

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ABSTRACT

The present work reports preparation of a newly developed hybrid material of (Al/Ce)-alginate (Aluminium-Cerium-Calcium-Alginate [ACCA]) micro particles. The hybrid material was characterized by various instrument techniques. The average particle size of Al/Ce mixed metal oxide was found to vary between 29.39 to 553.2 nm. The XRD pattern of ACCA shows most significant peaks at 15.6, 28.4, 31.8, 45.3, 47.6, 56.5, 66.1, 75.3, and 83.9 in the 2θ range of 10–90°. The inorganic–organic hybrid material has the ability to remove fluoride from aqueous solution at the solid–liquid interface. The sorption of fluoride follows pseudo-second-order kinetics. Application of linearized form of Freundlich equation indicated the occupancy of 43.2% of active adsorption sites containing equal energy and a favorable condition for the adsorption of fluoride. The positive value of thermodynamic parameter (ΔS°) indicates increasing randomness during the sorption process. The influence of pH upon sorption–desorption characteristic of the hybrid material was quite prominent as evident from leaching of 89% of fluoride at pH 12. A possible mechanism of fluoride removal by the hybrid material was also proposed. Further, the reusable properties of the material support development for commercial application purpose.

Keywords: Alginate; Hybrid material; Nanocomposite; Fluoride; Adsorption; Kinetics

*Corresponding author.