

Tri-Metallic Composite Incorporated Polyacrylamide Hydrogel for Removal of Fluoride ions from Aqueous Media

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Abstract: Fluorine exists as reactive fluorides in nature owing to its high electronegativity originating from either natural or human activities. Trace amounts of fluoride can exist in drinking water and essentially in all crops. Even though fluoride in low quantities is an indispensable micro-nutrient, which is expended on strengthening of bones and teeth, an excessive amount of fluorides is highly toxic which could cause skeletal and dental fluorosis, cancers, brittle bones, Alzheimer's syndrome, infertility, and thyroid disorder. Therefore, current study was designed to implement tri-metal incorporated polyacrylamide (PAM) gel for removal of excess amounts of fluoride ions from aqueous media.

The need for novel polymeric materials to remove and separate toxic heavy metal ions and fluoride ions through complexation and ion exchange mechanism has increased. Therefore, our attention has been drawn to develop a novel tri metal loaded PAM to achieve high defluoridation efficiency.

A novel iron–cerium–lanthanum trimetallic composite was synthesized by a co-precipitation method to enhance fluoride removal efficiency. Tri-metallic composite was incorporated into a PAM. PAM have been used as the matrix material of the fluoride removal system. The adsorption process was highly pH-dependent, and tri-metal incorporated PAM has shown maximum adsorption towards F^- ions with 107.52 mg/g at pH 7.0 and 301 K. The adsorption isotherm could be well described by Langmuir isotherm model with 0.99 for R^2 . The adsorption rapidly occurred in the initial 1 hour and adsorption equilibrium was established within 5 h. The pseudo second order rate could be well fitted with 0.99 for R^2 to fluoride adsorption kinetics. Fluoride ions adsorption is considerably unchanged when chloride ions present in aqueous media. However, presence of sulphate and bicarbonate ions in water body might affect adsorption of fluoride ions in aqueous media. The Fourier transform IR spectroscopy, X-ray Diffraction (XRD) and atomic absorption spectroscopic methods were used to characterize and analyze trimetallic composite for selectively removal of fluoride ions from aqueous media.

Keywords: fluoride, isotherm, kinetics, adsorption, polyacrylamide

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