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Rapid and highly efficient cesium removal by newly synthesized carbomer encapsulated potassium copper hexacyanoferrate composite

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Abstract

Copper hexacyanoferrate–carbomer composite (CuHCF-carbomer) was synthesized and used as an ion exchanger for the removal of hazardous cesium ion from aqueous solution. The composite composition, properties and morphology were characterized by several techniques namely, FTIR, SEM, EDX, XRD and TGA-DSC. The influence of pH of aqueous solution, initial concentration, shaking time and solution temperature on the adsorption of cesium onto CuHCF-carbomer composite were studied by batch technique. Maximum adsorption capacity value of 1.74 mmol g^{-1} of Cs^+ on CuHCF-carbomer was obtained at pH 9, 9 $mmolL^{-1}$ Cs^+, and 25^{o}C. Adsorption isotherms, kinetic and thermodynamic parameters of the adsorption process were obtained and used to describe the adsorption of Cs^+. In addition, column method was used in the same purpose of Cs^+ ion removal. The effect of bed depth and flow rate on the adsorption characteristics of composite was examined at the optimum conditions of pH=9 and initial Cs^+ concentration = 5 $mmoL^{-1}$. Moreover, the prepared composite could be regenerated effectively by 2 M KCl and was used successfully for five times. Thomas and Yoon–Nelson kinetic models were applied to evaluate column adsorption performance.

Keywords: Cesium adsorption; Potassium copper hexacyanoferrate; Carbomer; Batch method; Column method.