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Disposal of cesium ion from wastewater using biocompatible titanate nanotube

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ABSTRACT

Due to the extensive use of radioisotopes, effective methods to manage radioactive waste are highly required. For this reason, the capture of cesium ion from groundwater and aquatic ecosystems has attracted special attention. In the present study, the synthesized titanate nanotubes can be applied to remove cesium ion from aqueous solutions through the cation exchange process. In addition, the ion exchange properties of titanate nanotubes were investigated by calculation of the adsorption of cesium ion through the batch method. Hence, the effect of initial concentration, pH and the contact time of solution and exchanger phases on the adsorption value and the optimum conditions for optimal performance of exchanger for the capture of cesium ion were determined. In this regard, the titanate nanotube was synthesized hydrothermally at the optimum temperature of 150°C. After that, 0.1 g of this titanate nanotube was exposed to 50 mg/L of cesium ion at pH = 6 and 25°C temperature in 25 mL of wastewater. Batch experiments confirmed that around 85% of cesium ion (4.25 mg/mL) could be captured 90 min after induction. In addition, in order to evaluate the biocompatibility of these titanate nanotubes, MTT assay was used for their cytotoxicity potential. X-ray diffractometer analysis represented a nanoscale composition with anatase phase which showed that the arranged titanate nanotube was crystallized and had a BET surface area of 194.4 m^2/g. Furthermore, the kinetic data were described with pseudo-first and second-order models, and results showed that the Freundlich model was more suitable than the Langmuir model to describe the equilibrium of cesium ion.

Keywords: Aquatic pollution; Cesium adsorption; Titanate nanotube; Hydrothermal method

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