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Soil Cadmium Removal by Fulvic Acid-aided Hydroxyapatite Nanofluid

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Engineered nanoparticles have a large potential for removing pollutants from contaminated soils. Elution of soil cadmium (Cd) by hydroxyapatite nanoparticles (nHAP) was investigated at different concentrations of nHAP and fulvic acid (FA). The adsorption capacity of Cd on nHAP was almost 123 times of that on the experimental loam soil. The nHAP nanofluid at 500 mg L^{-1}increased the elution rate of soil Cd by $\sim$4.34 times (from 0.64% to 2.78%) compared with nHAP-free background solution. Increasing nHAP concentration enhanced Cd removal due to the improvement of nHAP transport through the soil. The peak breakthrough levels (C/C_0) of nHAP at high input concentration (500 mg L^{-1}) was 2.4 times of that at low concentration (100 mg L^{-1}). The elution rate of soil Cd further increased to 3.31% after adding 20 mg $L^{-1}$of FA to the 500 mg L^{-1}nHAP nanofluid. This is primarily attributed to the increase in nHAP mobility and adsorption capacity of Cd on nHAP. Approximately 43% of nHAP (input concentration 500 mg L^{-1})readily passed through the packed soil in the presence of FA (20 mg L^{-1}) in the influent. Results suggest that nHAP nanofluid could act as an effective tool to remove Cd from contaminated soil under flow conditions.