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Dynamic column adsorption of As on iron-oxide-coated natural rock (IOCNR) and sludge management

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ABSTRACT

An extended column adsorption study on arsenic (As(III)/As(V)) was conducted using the developed adsorbent iron-oxide-coated natural rock. We considered a column with a diameter of 2 cm and varying bed depths, including 10 , 15 , and 20 . The breakthrough ($C/C_0 = 0.016$) times were 31.0, 49.0, and 63.0 h and the exhaust ($C/C_0 = 0.90$) times were 60.0, 90.0, and 110.0 h, respectively for As(III). For As(V), those were found to be (breakthrough times corresponding to $C/C_0 = 0.0033$) 5.0, 11.0, and 18.0 h and 20.0, 27.0, and 36.0 h, respectively. The up-flow rate was maintained at 8 mL min^{-1}. The As(III) and As(V) concentrations were 0.6 and 3 mg L^{-1}. Bohart and Adams sorption model was employed to determine the important column design parameters. The column was designed by the bed-depth-service-time model. The adsorption capacity (N_0) and the adsorption rate constant (K) calculated were 295.30 mg L^{-1} and 20.41 L mg^{-1} h^{-1}, respectively, for As(III) and 599.82 mg L^{-1} and 0.233 L mg^{-1} h^{-1}, respectively, for As(V). The effects on the variation of initial concentrations and flow rates were also investigated. The 10-cm exhaust bed (As(III)) was regenerated with 1 M NaOH, and its performance was evaluated. An attempt has been made to minimize the As adsorbed exhausted sludge mixing with Portland cement and the prepared blocks were used for leaching tests in different inorganic mediums for 90 d; immobility was accounted from D_e values.

Keywords: Arsenic; Column adsorption; Natural rock; BDST model; Sludge management

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