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Adsorption of As(III) from aqueous solutions by iron-impregnated quartz, lignite, and silica sand: kinetic study and equilibrium isotherm analysis

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ABSTRACT

In this study, adsorption of As(III) removal on iron oxide-coated quartz, iron oxide-coated lignite sand, and iron oxide-coated silica sand were investigated. Batch studies were performed to evaluate the influences of various parameters like initial pH, adsorbent dose, and initial concentration for the removal of As(III). Optimum conditions for As(III) removal on the three adsorbents were found to be pH 7, adsorbent dose 20 g/l of solution, and equilibrium time 6 h. The kinetics study of As(III) removal have also been determined using a pseudo-first-order, pseudo-second-order, Weber and Morris, and Elovich model. Among the conventional models, the $q_{e,exp}$ and the $q_{e,calc}$ values from the pseudo-second-order kinetic model are very close to each other and followed by Weber–Morris and Elovich model for all adsorbents. In this system, the effective diffusion coefficient (D_e) value of As(III) is more than the order of 10^{-9} cm^2/s. This order shows in the literature that pore diffusion is the rate-limiting step for all the adsorbents. Equilibrium isotherms for the adsorption of As(III) on all the three adsorbents were analyzed by Langmuir, Freundlich, Redlich–Peterson (R–P), and Temkin isotherm models using nonlinear regression technique. R–P and Freundlich isotherm was found to be the best to represent the data for As(III) adsorption on all the adsorbents. The parameters obtained in this study for different kinetic and equilibrium models of all adsorbents are very comparable with other reported values for sand-based and other adsorbents.

Keywords: Adsorption; As(III); IOCLS; IOCQS; IOCSS; Isotherms; Kinetics

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