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Evaluation of arsenic adsorption capacity of indigenous materials for their suitability as filter media

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ABSTRACT

Low-cost filter developed with indigenous materials seems to be the only option in rural areas of arsenic contaminated villages in Assam valley. To meet the desired objective, adsorptive properties of some chosen native materials, that is, red soil, sand and naturally oxidized iron scraps (NOISs) are evaluated by conducting a series of batch experiments and surface morphological analysis. The materials have been characterized by field emission scanning electron microscopy and X-ray powder diffraction (XRD) for their morphological study. Batch experiments are performed by changing various parameters including the contact time, pH, temperature, adsorbent dose and initial arsenic [As(III) and As(V)] concentration in the aqueous solutions. Results suggest that the efficiency of the adsorbents in adsorbing both As(III) and As(V) from aqueous solutions sharply declined with increasing pH, particularly for NOIS. The sorption process occurs mainly by intraparticle diffusion followed by film diffusion. The experimental kinetics data can be best described by pseudo-second-order reaction model, while the thermodynamic study showed that the arsenic sorption process is exothermic in nature. The maximum adsorption capacities of red soil, sand and NOIS were found to be 40.26, 19.69 and 166.95 μg g^{-1}, respectively, for the sorption of As(V) from the solution. Such adsorption can be attributed to the amorphous nature of the NOIS, as verified from the XRD patterns. The results indicate that NOIS can be used as promising adsorbent for the removal of arsenic from water.

Keywords: Arsenic; Iron scraps; Sand; Red soil; Adsorption; Indigenous materials; Iron scrap; Batch study; Assam; Groundwater contamination; Kinetic modeling; Thermodynamic study; Diffusion

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