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Adsorption of arsenic (V) ions onto cellulosic-ferric oxide system: kinetics and isotherm studies

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ABSTRACT

A novel microporous adsorbent, cross-linked cellulose acetate matrix impregnated with Fe_2O_3 was synthesized by precipitation method for the expunging of As (V) ions. Elimination of As (V) ions was successfully executed through adsorption from prepared arsenate solution in preliminary batch systems. Various parameters affecting adsorption of analyte ions viz. solution pH, Fe_2O_3 content in beads, amount of adsorbent, contact time, and initial concentration of As (V) ions were satisfactorily interpreted. Optimized adsorption percentage of 65% was recorded with initial concentration of As (V) ions as 10 mgL^{-1} in the pH range of 5.0, using 1gm of adsorbent impregnated with 20 wt.% Fe_2O_3 in 4 h; characterization of the adsorbent was executed by X-ray diffraction, scanning electron microscopy, Fourier transform infrared, and BET theory. Langmuir, Freundlich, Temkin, and Dubinin–Radushkevich equilibrium adsorption isotherm models were studied to determine the nature and process of adsorption. Adsorption kinetics was found to be in a commendable agreement pseudo-first-order mechanism. The adsorbent was found to be efficacious up to 5 cycles of adsorption without considerable decrease in efficiency. Thermodynamic investigation established that adsorption of As (V) ions was a spontaneous process with free energy change −8.38 kJ/mol. The present prospective provides a cost-effective and efficient approach that can be used to moderate the arsenic concentration to environmental acceptable level.

Keywords: Arsenic (V) ions; Cellulose acetate; Ferric oxide; Adsorption; Isotherms-kinetics

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