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CHARACTERIZATION AND UTILIZATION OF ALUNITE ORE FOR ADSORPTIVE REMOVAL OF ZINC: BATCH AND COLUMN STUDY

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Abstract

Adsorption equilibrium, kinetic and dynamic studies were done for removal of zinc (II) from aqueous solutions using alunite ore. The alunite sample was characterized by using X-ray fluorescence (XRF), optical microscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM), Brunauer–Emmett–Teller (BET) porosimetry, differential thermal (DTA), and Thermogravimetric (TG) analyses. The batch equilibrium adsorption data of zinc (II) ions onto alunite particles were applied to some well-known isotherm models. The results showed that the adsorption process follows Redlich-Peterson isotherm model and that the maximum loading capacity for natural alunite sample is 3.92 mg g^{-1}. The removal capacity of natural alunite was then compared with three thermally-treated samples which were calcined in three different temperatures according to DTA results. Furthermore, effect of some operational conditions including contact time, solution pH, initial zinc (II) concentration, and sorbent particle size on removal efficiency was evaluated. Moreover, the obtained kinetic data were examined by pseudo-first order, pseudo-second order, and Elovich models. The kinetic behavior was best modelled by Elovich kinetic equation. Further in continuous studies, a fixed-bed column was designed and packed with alunite particles of -1.190+0.595 mm. Experimental breakthrough curve for removal of zinc (II) ions was then obtained. Finally, in order to predict breakthrough curves and column kinetic parameters, the adsorption data of this stage was applied to three models including Bohart-Adams, Thomas, and Yoon-Nelson. As a result, the column behaviour found to be best-fitted by Thomas empirical model. The study proves the potential feasibility of employing alunite ore to remediation of zinc-contaminated waters.

Key words: adsorption, alunite, wastewater remediation, zinc (II)

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