Investigation of competitive adsorption and desorption of heavy metals from aqueous solution using raw rock: Characterization kinetic, isotherm, and thermodynamic

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Abstract:

Heavy metals are the most dangerous inorganic pollutants Due to their bioaccumulation and their nonbiodegradability, for this, several studies have focused on the recovery of these metals from water using different techniques. In this context, our study consists of evaluating an efficient and eco-friendly pathway of competitive recovery of heavy metals (Cd, Cr and As) from aqueous solutions by adsorption using raw rock. This adsorbent was characterized before and after the adsorption process by several techniques. The multi-metals adsorption process in the batch mode was undertaken to evaluate the effect of adsorbent mass, contact time, pH, Temperature, and initial heavy metals concentration. The kinetic data were analyzed using the pseudo-first-order, pseudo-second-order and intra-particle diffusion kinetic models. According to the modeling of the experimental results, the adsorption kinetics of heavy metals were adapted to the pseudo-second-order model. The adsorption isotherms were evaluated by the Langmuir and Freundlich isotherm models. The experimental isotherm data of heavy metals were better fitted with the Langmuir model rather than Freundlich isotherm models. The maximum experimental adsorption capacities (Q_{max}) predicted by the Langmuir model are 15.23 mg/g for Cd (II), 17.54 mg/g for Cr (VI) and 16.36 mg/g for As (III). The values of thermodynamic parameters revealed that the heavy metals adsorption was exothermic, favorable, and spontaneous in nature. The desorption process of heavy metals showed that this raw rock had excellent recycling capacity. Based on the results, these untreated clays can be used as inexpensive and environmentally friendly adsorbents to treat water contaminated by heavy metals.

Keywords: Raw rock; Characterization; Heavy metals; Adsorption; Desorption; kinetic; Isotherm; Thermodynamic.