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Treatment of a low concentration of uranium solution with marl treated by heat at different temperatures

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ABSTRACT

In this study, a heat treatment was applied to a sample of marl in order to improve its ability to adsorb uranium. The morphological and textural properties of raw marl and marl treated at 200°C and 400°C were studied using various characterization techniques: XRF, FTIR, and N_2-adsorption analysis. XRF shows that the main compounds are silica, calcium, aluminium, iron, and potassium. N_2-adsorption analysis revealed that the mesoporous character predominates, with a specific surface area of 17.55 m^2/g for MPM-200 and 17.88 m^2/g for MPM-400. The heat treatment did not affect the grain size; however, the band corresponding to the bending vibrations of the OH groups belonging to H_2O in the IR spectra of MPM-400 disappeared with the influence of temperature. The adsorption capacity of uranium by marl is 3.5 mg/g for MPM-200 and 2.8 mg/g for MPM-400, obtained after 60 min with 80 mg of adsorbent and 10 mg/L of initial concentration at pH = 2. The kinetics follow the pseudo-second-order model, and the diffusion process is controlled simultaneously by intraparticle diffusion and liquid film diffusion. The best isotherm correlation for MPM-200 is Freundlich, and for MPM-400 is Freundlich and Sips. The thermodynamic study revealed that the uranium adsorption process is thermodynamically feasible, spontaneous, endothermic, with the existence of a slight order.

Keywords: Adsorption; Marl; Heat treatment; Uranium; Isotherms

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