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KINETICS AND EQUILIBRIUM ADSORPTION STUDY OF LEAD (II) ONTO LOW COST CLAYS

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Abstract

The performance of four low cost Iraqi clays, bentonite (BT), kaolinite (KT), attapalgite (AT) and flint (FT) to remove lead ions from aqueous solutions by adsorption was investigated. Batch experiments were carried out at pre determined equilibration time, adsorbent dosage, solution pH, particle sizes, ionic strength, initial lead ions concentration and temperature. Adsorption of Pb^{2+} ions was strongly affected by pH and best adsorption is achieved at pH 4.5. The systems were investigated at 10, 25, 35 and 50 ^{o}C using Langmuir, Freundlich and Dubinin-Radushkevich (D-R) isotherms. At pH 4.5, the maximum lead adsorption capacity of BT, KT, AT and FT estimated with the Langmuir model at 25 ^{o}C and pH 4.5 was 24.814, 35.710, 30.488 and 7.692 mg g^{-1}, respectively. Dubinin-Radushkevich (D-R) isotherm model was also applied to equilibrium data. The mean free energy of adsorption (8.404, 7.305, 8.588 and 7.322 kJ/mole) onto BT, KT, AT and FT, respectively, indicates adsorption process may be carried out via physisorption mechanism. Pseudo first-order and pseudo second-order were used to fit the adsorption kinetics data. In comparison to first-order kinetic model, pseudo-second-order model described well the adsorption kinetics of Pb(II) onto four clays from aqueous solution. Thermodynamic parameters such as Gibbs free energy ΔG, enthalpy change ΔH and entropy ΔS were evaluated. The thermodynamics of Pb(II) on these clays indicates the spontaneous and exothermic nature of adsorption.

Key words: adsorption, attapalgite, bentonite, clays, flint, kaolinite, lead(II)

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