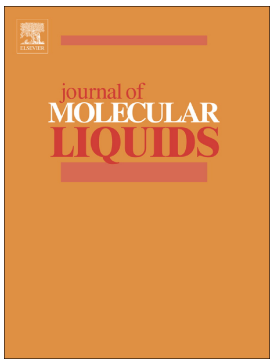

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A superior adsorbent of CTAB/H_2O_2 solution−modified organic carbon rich-clay for hexavalent chromium and methyl orange uptake from solutions

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Abstract

Raw clay (RC) rich in organic matter (OM) was separately treated by hydrogen peroxide (H_2O_2), cetyltrimethylammonium bromide (CTAB) and a solution of CTAB/H_2O_2. The new strategy of RC modification using CTAB/H_2O_2−solution presented a swollen product (CTAB/H_2O_2−clay) with porous structure. Raw and modified clays were characterized by XRD, SEM, FTIR, zeta potential, S_{BET} surface area and tested as adsorbents for hexavalent chromium Cr(VI) and methyl orange (MO) from solutions. Adsorption experiments were conducted under experimental parameters including pH, shaking time, initial concentrations, adsorbent mass, temperature and ionic strength. CTAB/H_2O_2−clay gave the highest adsorption capacities for Cr(VI) and MO as compared to the other products at pH 2.0 and 3.0, respectively. Adsorption equilibrium of Cr(VI) and MO was evaluated using Langmuir, Freundlich, Temkin and Dubinin–Radushkevich models. Langmuir model fitted well the uptake results and the maximum uptake capacities (q_{max}) at room temperature (25 °C) were found to be 67.05 and 194.28 mg/g for Cr(VI) and MO, respectively. The values of mean free energy (E) were greater than 8.0 kJ/mol revealed the chemical nature of Cr(VI) and MO uptake. The pseudo-second-order model with $R^2 = 0.9999$ described well the kinetics data. Thermodynamic parameters (ΔH^0, ΔG^0 and ΔS^0) indicated that the uptake of Cr(VI) and MO was spontaneous and endothermic.

Keywords: Raw clay; organic matter, hexavalent chromium, methyl orange; adsorption characteristics; thermodynamic studies