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Use of HCl-modified bentonite clay for the adsorption of Acid Blue 129 from aqueous solutions

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ABSTRACT

The adsorption of Acid Blue 129 (AB129) from aqueous solution onto hydrochloric acid-activated montmorillonite clay (HCl-bentonite) was investigated. The activated clay was characterized by scanning electron microscopy, energy dispersive spectroscopy, and Brunauer–Emmett–Teller surface area. Batch adsorption experiments were performed to investigate the effects of pH, contact time, initial dye concentration, and temperature (10, 20, 30, and 40°C). Acidic conditions was suitable for higher adsorption of AB129, and kinetic studies demonstrate that the process followed a pseudo-second-order model. An activation energy of 23.858 kJ mol^{-1} was obtained for adsorption process. Adsorption data were fitted to Freundlich and Langmuir isotherms and various adsorption parameters have been calculated. Standard enthalpy (ΔH°) and standard entropy (ΔS°) were −44.90 kJ mol^{-1} and −68.44 kJ mol^{-1} K^{-1}, respectively, showing that overall adsorption process was exothermic and is spontaneous in nature with a decrease in the disorder of the system at the dye/adsorbate interface. However, the mechanism of the dye–Bentonite interaction is likely to be very complicated, involving a wide range of sites having different energy considerations. The activated clay was effective toward adsorption of AB129. The results show that activated bentonite clay could be employed as low-cost materials for the removal of acid dyes from colored effluents.

Keywords: Adsorption; Acid Blue 129; Bentonite clay; Thermodynamics; Kinetics

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