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Equilibrium and kinetics study of reactive dyes removal from aqueous solutions by bentonite nanoparticles

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ABSTRACT

Today, environmental pollution by various pollutants such as dyes is one of the most important issues of the world. Colored wastewaters are entering to the environment by many industries (for instance, textile and paper industries). Various technologies have been used to remove these pollutants. In this study, we have demonstrated the effectiveness of bentonite nanoparticles as a low cost adsorbent for removal of Reactive Yellow 15 (RY15) and Reactive Yellow 42 (RY42). The effects of variables such as pH, contact time, dye concentrations, adsorbent dosage and solution temperature, on the removal process have been studied. Residual of RY15 and RY42 dyes concentration was measured using a spectrophotometer set in 420 and 430 nm wavelengths, respectively. Also, the bentonite nanoparticles were characterized by scanning electron microscopy, Fourier transform infrared spectroscopy, X-ray diffraction and Brunauer–Emmett–Teller. Finally, the data were examined by isotherms of Langmuir, Freundlich, pseudo-first-order and pseudo-second-order kinetics and thermodynamic parameters. The maximum amount of adsorption for both dyes was at the pH = 3. With increasing the contact time and concentration of dye, adsorption capacity increased as well. Also, increasing the adsorbent dosage resulted decreasing the adsorption capacity. In optimum conditions, the maximum absorption capacity was 156.9 mg/g for RY15 and 170.7 mg/g for RY42. It was shown that removal of dyes of RY15 and RY42 follow, respectively, Freundlich isotherm and Langmuir isotherm and pseudo-second-order kinetics. The results of examining temperature and thermodynamics of the process showed that $\Delta S°$ and $\Delta H°$ are negative for both dyes. However, $\Delta G°$ was positive or negative for different temperatures. Since bentonite nanoparticles of this research were effective, cheap and available, so it can be used as an effective adsorbent for removal of RY15 and RY42.

Keywords: Bentonite nanoparticles; Adsorption; Reactive Yellow dye; Isotherm; Kinetic; Thermodynamic

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