Equilibrium, kinetic and thermodynamic studies on the removal of reactive dye RBBR using discarded SBS paperboard coated with PET as an adsorbent

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ABSTRACT

A waste material in the form of discarded solid bleached sulfate (SBS) paperboard coated with polyethylene terephthalate (PET) was characterized by Fourier transform infrared spectroscopy and scanning electron microscopy. The aim was to investigate its use as an adsorbent for the removal of the reactive dye Remazol Brilliant Blue R (RBBR) from aqueous solutions in batch mode. The effects of pH, agitation speed and adsorbent dosage were determined using the response surface methodology. Sorption of RBBR onto SBS paperboard coated with PET was found to be efficient at pH 2. The optimum conditions were adsorbent dose of 4.5 g and agitation speed of 100 rpm. With regard to the kinetics, four different isotherm models were tested and the pseudo-second-order model best described the sorption mechanism ($R^2 = 0.999$). The equilibrium data were analyzed using Freundlich, Langmuir, Temkin and Dubinin–Radushkevich isotherms. The Freundlich adsorption capacity ($Q_o$) was found to be 1.21 mg g⁻¹ with $R^2 = 0.995$. Thermodynamic studies showed a negative $ΔH°$ value, indicating that the sorption process is exothermic.

Keywords: Textile dye; Adsorption; Experimental design