Rubber seeds (*Hevea brasiliensis*): an adsorbent for adsorption of Congo red from aqueous solution

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**ABSTRACT**

This study aims to investigate the use of rubber (*Hevea brasiliensis*) seeds, a solid agricultural waste, as a novel adsorbent for the adsorption of Congo red (CR) from aqueous solution in batch mode. Experiments were carried out as a function of contact time, dye concentration, adsorbent dosage, pH, and temperature. Langmuir, Freundlich, and Sips adsorption isotherm models were applied to describe isotherm parameters. The results showed that equilibrium contact time was 90 min. The experimental results indicate that, the percentage of dye adsorption increases with an increase in the adsorbent dosages and temperature. The CR adsorption percentage decreased with increasing dye concentration and pH solution from 3 to 12. Thermodynamic parameters data indicated that the CR adsorption process was non-spontaneous and endothermic under the experimental conditions, with the Gibbs free energy (ΔG˚) in the range of 9.13–8.12 kJ/mol, enthalpy (ΔH˚) and entropy (ΔS˚) of 14.15 kJ/mol and 16.85 J/mol, respectively. The Langmuir isotherm model fit the equilibrium data better than both the Freundlich and Sips isotherm models, with adsorption capacity 9.82 mg/g. The kinetic data for adsorption processes were described by pseudo-second-order model with a rate constant in the range of 0.043–0.156 g mg/g min⁻¹. The rubber seeds investigated in this study showed a high potential use for the adsorption of CR from aqueous solution.

**Keywords:** Adsorption; Congo red; Langmuir isotherm; Kinetic; Rubber seed