

Adsorption of Rhodamine B dye onto iodo-polyurethane foam: kinetics and thermodynamic study

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ABSTRACT

Even today, public health and water resources pollution issues by dyes are still the attention of researchers. Rhodamine B (RhB) is a highly toxic dye classified as carcinogenic and toxic. Among separation techniques, adsorption is used to treat polluted samples effectively. For the present study, iodo-polyurethane foam (I-PUF) was studied and tested as a solid-phase extractor for RhB adsorption. The adsorption of RhB onto I-PUF from aqueous media reached equilibrium at $\text{pH} \approx 3$ in 30 min. The kinetics was evaluated through different non-linear kinetic models (Lagergren's pseudo-first-order, pseudo-second-order, Avrami and Elovich). The results indicated that the adsorption of RhB followed pseudo-second-order kinetic ($R^2 = 0.9999$). Additionally, the adsorption mechanism was evaluated by intraparticle diffusion models (Weber–Morris, Reichenberg and Bangham). Adsorption isotherms were examined by non-linear isotherm (Langmuir and Freundlich) models. The results indicated that the adsorption of RhB onto I-PUF was controlled by film diffusion and intraparticle diffusion. The maximum adsorption capacity of I-PUF was equal to $22.032 \text{ mg} \cdot \text{g}^{-1}$. The thermodynamic parameters were calculated. The negative values of ΔH ($-31.488 \text{ J} \cdot \text{mol}^{-1}$) proved the exothermic nature of RhB adsorption onto I-PUF. The value of ΔS was $-37.223 \text{ J} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$. The negative value of ΔG ($-19.9316 \text{ kJ} \cdot \text{mol}^{-1}$ at 298 K) indicates the spontaneous nature of adsorption. As a result, the I-PUF efficiency has been demonstrated, and it was considered a suitable adsorbent for RhB adsorption.

Keywords: Rhodamine B; Iodo-polyurethane; Non-linear kinetic; Thermodynamic

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