A NEW KINETIC AND THERMODYNAMIC APPROACH TO PHENOL BIOSORPTION BY CHITOSAN AND KERATIN

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Abstract

Chitosan and keratin were tested as low cost biosorbents to remove phenol from water solutions at variable temperature (20–50°C), initial phenol concentration (10–90 mg L⁻¹) and pH (5.0–10.0), and fixed biosorbent dosage (10 g L⁻¹). The pseudo-second order kinetic model exhibited the best fit to the experimental data and allowed estimating theoretical values of sorption capacity of 4.51 mg g⁻¹ with keratin and 2.87 mg g⁻¹ with chitosan. Equilibrium isotherms, described at best by the Freundlich model, pointed out that keratin (K_F = 1.34 mg¹⁻¹ L¹/n g⁻¹) was more effective than chitosan (K_F = 0.19 mg¹⁻¹ L¹/n g⁻¹) in phenol removal, although the sorption intensity was almost coincident (n = 1.18–1.19). The results of tests performed at different temperatures suggested a novel thermodynamic approach based on the occurrence of a sorbent inactivation equilibrium, whose changes of enthalpy and entropy were estimated to be 35.7 kJ mol⁻¹ and 118 J mol⁻¹ K⁻¹ with chitosan, and 256 kJ mol⁻¹ and 845 J mol⁻¹ K⁻¹ with keratin. The main functional groups involved in phenol sorption by both raw and phenol-bound materials were identified by FT-IR spectroscopy.

Key words: biosorption, chitosan, keratin, phenol, thermodynamics

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