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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 mg$^{1-1/n}$ L$^{1/n}$ g^{-1}) was more effective than chitosan (K_F = 0.19 mg$^{1-1/n}$ L$^{1/n}$ 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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