

Área: FIS

Valorização de Resíduos de Carapaça de Caranguejo Vermelho em Filmes de Quitosana para Adsorção Aprimorada do Corante Reativo Preto 5

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Palavras Chave: Quitina; Biopolímero; Adsorção; Tratamento de água; Efluente..

Highlights

Valorization of Red Crab Shell Waste into Chitosan Films for Enhanced Reactive Black 5 Adsorption: the recovery of marine waste generates high-quality chitosan, capable of forming stable films with tunable mechanical and structural properties. The detailed characterization of the raw material, the polymer and the films explains the high adsorption performance, demonstrating that the study is not limited to the final application, but covers the entire material development process. The final paper was submitted and accepted for publication in the journal *Environmental Science and Pollution Research*, under DOI: 10.1007/s11356-025-36940-0.

Abstract

Red crab shell (*Chaceon notialis*) had 20.8% protein, 52.6% ash, 24.4% carbohydrates and 2.3% lipids on dry basis. After demineralization and deproteinization, chitin represented 22.7% of the initial mass. Deacetylation resulted in an overall mass balance of 18.6% chitosan. Chitosan had a degree of deacetylation of 97%. The molar mass was approximately 125 kDa. FTIR analysis confirmed the conversion of chitin into chitosan, with a reduction in the bands associated with acetyl groups. EDS analysis showed nitrogen contents of between 10 and 13%.

The chitosan/glycerol films obtained by casting showed good homogeneity, with regular thickness, although some bubbles were observed. The mechanical properties varied depending on the formulation: tensile strength (10.6-42.2 MPa) decreased with increasing glycerol, while elongation at break (2.9-45%) increased with higher chitosan content, a behavior typical of the action of the plasticizer. Water solubility was low (13-21%), indicating the stability of the material in aqueous media. Water vapor permeability increased with higher levels of chitosan and glycerol. Surface area analysis (BET) showed a porous structure made up mostly of micropores, and determination of the zero-charge pH were close to 8.8.

Films showed high efficiency in removing the RB5 dye. The maximum experimental capacity was 389.5 mg·g⁻¹. Saturation of 75% of the adsorption capacity was reached in around 120 minutes, and the kinetics were best described by the pseudo-first order model ($R^2 > 0.99$). The adsorption isotherms mainly fitted the Langmuir model, indicating a predominance of monolayer adsorption. Thermodynamics revealed a spontaneous process (negative ΔG° , -22.9 to -24.0 kJ·mol⁻¹), with a slight decrease in adsorption capacity at equilibrium at higher temperatures.

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