31º ENCONTRO DE QUÍMICA DA REGIÃO SUL
A QUÍMICA COMO PROPULSORA DE NOVOS ECOSSISTEMAS DE INOVAÇÃO
19 A 21 DE NOVEMBRO
Campus Toledo
Unioeste

Area: AMB

Adsorption study of tartrazine yellow onto chemically treated palm kernel shell activated carbon

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Keywords: *Adsorption; Tartrazine Yellow; Industrial Effluents; Water Treatment.*

Highlights

- Dosage and concentration were the most relevant variables for the adsorption of tartrazine yellow
- The best condition for removal was a concentration of 23.8 mg L^{-1}, a dosage of 7 g L^{-1}, and acid treatment
- Maximum tartrazine yellow removal reached 100.0%

Resumo/Abstract

Adsorption is an effective physico-chemical process for removing pollutants from effluents, utilizing adsorbent materials that retain ions or molecular substances on their surfaces. However, challenges remain in developing selective materials with high adsorption capacity, cost-effectiveness, and sourcing from renewable or abundant materials, emphasizing the sustainability of both materials and processes. In this study, palm kernel shell activated carbon (PKSAC) was employed for the removal of the dye tartrazine yellow (TY) from aqueous solutions. Parameters such as adsorbent dose (D) (3.0, 5.0, and 7.0 g L^{-1}), adsorbate concentration (C) (10.0, 20.0, and 30.0 mg L^{-1}), and treatment type (T): untreated (PKSAC-n), H_3PO_4-treated (PKSAC-a), and NaOH-treated (PKSAC-b), were evaluated using a Box-Behnken experimental design. TY removal was monitored by measuring the decrease in absorbance at 426 nm using UV-Vis spectrophotometry. Chemometric analysis enabled the construction of a Pareto Chart (Figure 1A) and a response surface for the two most significant variables: dose and concentration (Figure 1B).

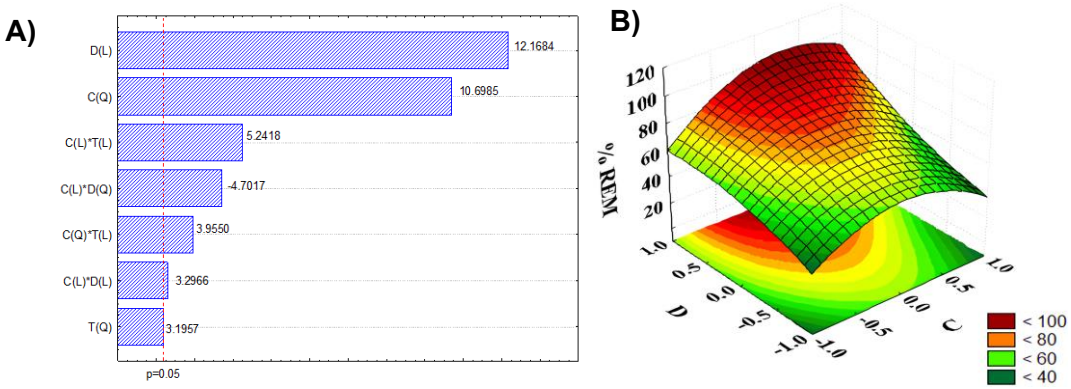

Figure 1: TY adsorption onto PKSAC. **A)** Pareto Chart where L is the linear interaction between the variables and Q is the quadratic interaction between the variables and **B)** Response surface

Based on this significance, the response surface revealed a maximum TY removal of 100% (concentration of 23.8 mg L^{-1} and dose of 7 g L^{-1}). The results indicated that, under specific experimental conditions, TY removal can be maximized, allowing the use of the untreated adsorbent (PKSAC-n), in line with the principles of green chemistry and sustainability.

Agradecimentos/Acknowledgments

Fundação Araucária and UEM.