OPTIMIZATION OF THE REACTIVE RED 195 DYE REMOVAL FROM AQUEOUS SOLUTIONS USING ZIZIPHUS JUJUBE SEEDS USING RESPONSE SURFACE METHOD

Khawlan Mohammed AL KHAWLANY[1], Elcin YILMAZ[2]

[1,2] *Chemical Engineering Department, Yildiz Technical University, Istanbul, Turkey*

Abstract

Water is an essential resource, crucial for the survival of all living organisms. Yet, the rapid industrialization and urbanization of recent decades have severely impacted water quality and aquatic ecosystems. One major environmental issue is the contamination of water by synthetic dyes. Various methods are employed for dye removal, but among the different techniques, adsorption stands out as one of the most preferred for treating dye-contaminated wastewater. This is due to its low cost, high removal efficiency, and environmentally friendly nature. In this study, an agricultural waste product, *Ziziphus Jujube* seeds was applied to investigate the removal of Reactive Red 195 (RR195) dye from aqueous solutions via the adsorption process. The study examined the effects of pH, temperature, and adsorbent dosage on adsorption efficiency. Data from the adsorption experiments were optimized using Response Surface Methodology (RSM) through the Design Expert software. The experiments were conducted with a 100-ppm reactive red 195 dye solution under varying conditions: pH levels of 2, 3, and 4; temperatures of 25 °C, 35 °C, and 45 °C; and adsorbent dosages of 0.5 g/100 mL, 0.75 g/100 mL, and 1 g/100 mL, over a 60-minute contact period. The optimal process conditions were a temperature of 25 °C, pH of 2, and adsorbent dosage of 0.75 g/100 ml. Under these conditions, RR195 dye removal efficiency reached 97.19%, with an adsorption capacity (q_e) of 13.114 mg/g.

Analysis of adsorption isotherms and kinetic models showed that the Freundlich isotherm and the Pseudo-Second-Order kinetic model provided the best fit for describing the adsorption process. The results indicate that the synthesized adsorbent is highly effective in removing MB dye from aqueous solutions.

Keywords: *Adsorption, dye removal, reactive red 195, bioadsorbent, ziziphus jujube.*

References:

[1] Agarwala, Rishabh, and Lavanya Mulky. 2023. "Adsorption of Dyes from Wastewater: A Comprehensive Review." *ChemBioEng Reviews* 10(3): 326–35.

[2] Aksakal, Ozkan, and Handan Ucun. 2010. "Equilibrium, Kinetic and Thermodynamic Studies of the Biosorption of Textile Dye (Reactive Red 195) onto Pinus Sylvestris L." *Journal of hazardous materials* 181(1–3): 666–72.

[3] Allen, S J, and B Koumanova. 2005. "Decolourisation of Water/Wastewater Using Adsorption." *Journal of the university of chemical technology and metallurgy* 40(3): 175–92.

[4] Arslan, Serkan, Murat Eyvaz, Ercan Gürbulak, and Ebubekir Yüksel. 2016. "A Review of State-of-the-Art Technologies in Dye-Containing Wastewater Treatment–the Textile Industry Case." *Textile wastewater treatment*: 1–29.