**Surface Chemistry, Texture, and Adsorption Properties of Activated Carbons Derived from Agricultural Waste for the Removal of the Anionic Dye: An Application Study**

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**Abstract:**

In this study, cost-effective and environmentally friendly activated carbons were synthesized from palm waste residues, a type of agricultural waste. These prepared activated carbons were employed for the adsorption of the anionic dye Congo Red. Texture characterization tests, such as iodine number and methylene blue adsorption, were conducted to assess the properties of the prepared activated carbons. To evaluate the adsorption potential of the activated carbons, batch adsorption experiments were carried out by varying various parameters such as pH of the medium (from 2 to 10), adsorbent dosage (from 0.025 to 1.5 g/L), contact time (from 20 to 600 minutes), and initial dye concentration (from 20 to 800 ppm).

Fourier-transform infrared spectroscopy (FTIR) was used to characterize the activated carbons before and after adsorption. The experimental data were fitted to Langmuir and Freundlich isotherm models to describe the adsorption behavior. The results clearly demonstrated that the adsorption phenomenon closely followed the Langmuir isotherm model. Furthermore, the sequential adsorption kinetics of Congo Red dye onto the activated carbons were best described by a pseudo-second-order kinetic model.

**Keywords**: Palm Residues; H3PO4-Activated Carbon; Adsorption; Congo Red.