

***Reduction of Free Fatty Acid (FFA) Content in Waste Cooking Oil Using
Activated Carbon Adsorbent Derived from Robusta Coffee Bean Husk Waste
(Coffea canephora L)***

(Optimization Using the Response Surface Methodology Approach)

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ABSTRACT

Waste cooking oil contains a high level of free fatty acids (FFA), which must be reduced before it can be utilized as a feedstock for biodiesel production. This study aimed to analyze the effects of adsorbent concentration, adsorption time, and particle size of activated carbon derived from robusta coffee husk (**Coffea canephora** L.) on the reduction of FFA content in waste cooking oil, as well as to determine the optimum operating conditions using the Response Surface Methodology (RSM) with a Box-Behnken Design (BBD). The independent variables consisted of adsorbent concentrations of 2%, 4%, and 6%; adsorption times of 150, 175, and 200 minutes; and adsorbent particle sizes of 40, 60, and 80 mesh. The results showed that the highest FFA reduction of 63.86% was achieved at an adsorbent concentration of 6%, an adsorption time of 175 minutes, and a particle size of 40 mesh, reducing the FFA content from 2.2% to 0.8%. In contrast, the lowest FFA reduction of 43.17% was obtained at an adsorbent concentration of 4%, an adsorption time of 200 minutes, and a particle size of 80 mesh. RSM optimization indicated the optimum conditions at an adsorbent concentration of 5.55%, an adsorption time of 177.02 minutes, and a particle size of 40 mesh, with a predicted FFA reduction of 63.34% and a desirability value of 0.975. The adsorption process using activated carbon produced from robusta coffee husk resulted in treated waste cooking oil with a final FFA content of 0.8%, an acid value of 1.582 mg KOH/g, and a density of 0.896 g/cm³. These findings demonstrate that activated carbon derived from robusta coffee husk has strong potential as an effective adsorbent for reducing the FFA content of waste cooking oil.

Keywords: Adsorption, Coffee Husk Activated Carbon, FFA, RSM, Waste Cooking Oil.