ADSORPTION BEHAVIOR OF PALM OIL EMPTY FRUIT BUNCH ACTIVATED CARBON BY PHOSPHORIC ACID IMPREGNATION ACTIVATION

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ABSTRACT

Adsorption Behavior of Palm Oil Empty Fruit Bunch Activated Carbon by Phosphoric Acid Impregnation Activation

The discharge of synthetic dyes such as methylene blue (MB) into water sources poses serious environmental concerns due to their toxicity and resistance to degradation. Conventional wastewater treatment methods often face limitations in effectively removing these pollutants. This study aimed to develop a low-cost and sustainable adsorbent using palm oil empty fruit bunch (POEFB), an abundant agricultural waste in Malaysia, for the removal of MB from wastewater. POEFB was converted into activated carbon through carbonization at 600 °C followed by phosphoric acid impregnation to enhance its porosity and surface area for adsorption applications. The produced activated carbon was characterized using FTIR analysis, iodine number, ash and moisture content, bulk density, and pHpzc measurements to evaluate its physicochemical properties. Batch adsorption experiments were conducted to examine the effects of initial dye concentration, adsorbent dosage, and contact time on MB removal efficiency. The activated carbon exhibited a high iodine number of 1189.57 mg/g, low ash content of 2.50%, moisture content of 6.18%, and a pHpzc of 4.3. The highest removal efficiency achieved was 99.87% at 200 mg/L MB concentration, 1.0 g adsorbent dosage, and 180 min. of contact time. These findings demonstrate that POEFB-derived activated carbon is an effective, low-cost, and sustainable adsorbent for the removal of MB dye from wastewater, supporting waste valorisation within the palm oil industry while addressing environmental pollution concerns.

TABLE OF CONTENTS