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Magnesium-Palm Kernel Shell Biochar Composite for Effective Methylene Blue Removal: Optimization via Response Surface Methodology

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ABSTRACT

This study investigates the properties and potential application of Mg-PKS biochar composite for methylene blue solution (MB) adsorption. The Mg-PKS biochar composite was developed from palm kernel shell biochar via steam activation followed by $MgSO_4$ treatment and carbonization. The effect of process parameters such as solution pH (4-10), contact time (30-90 min) and adsorbent dosage (0.1-0.5 g) were investigated via central composite design, response surface methodology. Results revealed that the Mg-PKS biochar composite has irregular shapes pore structure from SEM analysis, a surface area of 674 m^2g^{-1} and average pore diameters of 7.2195 µm based on BET analysis. RSM results showed that the optimum adsorption of MB onto Mg-biochar composite was at pH 10, 30 min contact time and 0.5 g/100 mL dosage with a removal efficiency of 98.50%. In conclusion, Mg treatment is a potential alternative to other expensive chemical treatment methods for biochar upgrading to the adsorbent.

Keywords: Adsorption, magnesium treatment, methylene blue, palm kernel shell biochar, response surface methodology

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INTRODUCTION

Methylene blue (MB) is a common basic dye applied in paper colouring, hair dye, cotton dyeing and others (Ba et al., 2020). Methylene blue was also studied for medical uses, including antimicrobial chemotherapy,

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