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ADSORPTION KINETICS AND OPTIMIZATION OF METHYLENE BLUE REMOVAL USING CALCINED VOLCANIC ROCK

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ABSTRACT

ADSORPTION KINETICS AND OPTIMIZATION OF METHYLENE BLUE REMOVAL USING CALCINED VOLCANIC ROCK

This study investigated the potential of pre-treated volcanic rock from Mount Merapi as an effective and sustainable adsorbent for methylene blue (MB) removal from aqueous solution. This study aims to quantify its adsorption capacity, determine the influence of parameters and identify the underlying kinetic behaviour. Volcanic rock undergoes pre-treatment via acid treatment and calcination. Adsorption experiments were conducted in batch mode to evaluate the effects of calcination time, contact time, adsorbent dosage and pH on MB removal, with kinetic models used for analysis. Optimal calcination for 2 hours at 800°C can enhance MB removal up to 100% and achieve an impressive adsorption capacity of 2.70 mg/g. Adsorption was rapid with near complete removal within 30 minutes, and optimal conditions were identified at a 2.00 g adsorbent dosage and a solution pH of 9. Kinetic analysis indicated a strong fit to the Pseudo-Second-Order model, with R^2 was 0.9954, suggesting a chemisorption mechanism. The findings confirmed treated volcanic rock as an eco-friendly solution for efficient cationic dye wastewater treatment, highlighting its potential for sustainable pollution control.

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