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Phenol removal by bamboo activated carbon produced using fabricated simultaneous carbonization and activation reactor

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Abstract: Phenol contamination in wastewater from untreated industrial effluent poses significant risks to both the ecosystem and human health. According to the Malaysia Environmental Quality Act 1974, industrial effluents must maintain phenol concentrations below 1 mg/L. This study aimed to produce bamboo-activated carbon (BAC) using a pilot-scale continuous carbonization-activation reactor. The BAC was simultaneously carbonized at 500°C for 2 hours, followed by activation at 800°C for an additional 2 hours within the same system, resulting in a high specific surface area of 1018 m²/g. In batch adsorption tests, BAC removed over 90% of phenol within just 15 minutes at an adsorbent dosage of 0.4 g, across a wide range of pH levels (2-12) and initial phenol concentrations (50-300 mg/L). The phenol adsorption followed pseudo-first-order with R² values of 0.9995 and best fit the Freundlich isotherm model with an R² value of 0.9588. These findings suggest that BAC produced in this pilot-scale system shows great potential as an effective adsorbent for phenol and possibly other pollutants.

Keywords: *Continuous carbonization and activation system; bamboo-based activated carbon; effective pollutant removal; kinetic and isotherm study*