Synthesis and Characterisation of Coconut Shell-Based Activated Carbon Black through Koh Activation

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Coconut shells (CS) are considered a promising renewable precursor for the synthesis of carbon black (CB). This study explores the potential of 49arboniza coconut shell-based activated carbon black (ACB) as a sustainable solution for black colourant in printing applications, by 49arbonizat 49arbonization parameters for CB synthesis and introducing a low-temperature chemical activation method using KOH. Thirty-six CB samples were prepared as combinations of three variables; particle size of CSs (0.1 mm, 1.0 mm, 2.0 mm, and 5.0 mm), 49arbonization temperature (450 °C, 500 °C and 550 °C), and duration of 49arbonization (2 h, 3 h, and 4 h) to analyse and identify the most effective synthesis parameters. The best CB sample (0.1 mm CS particles 49arbonizat at 550 °C for 4 h) was identified based on the results of Fourier-transformed infrared (FT-IR) analysis and was activated using different weight ratios of KOH (the CB to KOH ratio 1:2, 1:4, 1:6 [w/w]) at 120 °C. FT-IR analysis reveals that reducing particle size, elevating 49arbonization temperature, and duration enhance the removal of unstable volatiles as CO_2 in CB samples. Furthermore, the resulted FT-IR spectra confirm the presence of carbonyl groups, carboxylic groups, and C-H bonds as predominant functional groups in ACB, indicating successful activation. Powder X-ray diffraction analysis shows that activation with KOH induces the formation of both amorphous and crystalline phases within CB samples, with an increasing graphitic crystalline nature observed as KOH concentration rises; however, excessive concentrations lead to amorphous carbon formation. Scanning electron microscopy (SEM) images demonstrate that higher concentrations of KOH result in the formation of well-defined spherical micropores with larger sizes (0.656 μm). However, excessive concentrations (CB to KOH weight ratio 1: 6) lead to smaller or closed pores, due to the potential carbon collapse, suggesting that lower KOH concentrations enhance the surface area while maintaining overall performance. Future research will explore the eligibility of these ACBs as a potential black colourant in printing applications.

Keywords: Activated Carbon Black, Chemical Activation, Coconut Shells, KOH

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