Mangosteen peel waste as a sustainable precursor for high surface area mesoporous activated carbon: Characterization and application for methylene blue removal

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Abstract:

The aim of this study was the production of high surface area activated carbon (AC) under optimized synthesis conditions from Mangosteen Peels (MP) waste using a single step ZnCl2 activation process. The influence of the various activation parameters such as impregnation ratio, impregnation time, carbonization time, and carbonization temperature on surface area and pore characteristics of synthesized AC was investigated. The AC prepared under optimized conditions showed BET surface area, average pore diameter, and total pore volume of 1621.8 m2/g, 4.4 nm, and 1.805 cm3/g, respectively. The optimized synthesis conditions were as follows: 1:4 impregnation ratio, 600 °C calcination temperature, and 30 min calcination time. The characteristics of the optimized AC were analyzed using nitrogen adsorption-desorption isotherm, scanning electron microscopy, pore structural analysis, Fourier transformed infrared spectroscopy and X-Ray diffraction analysis. The adsorption capacity of activated carbon prepared under optimized conditions for methylene blue was 1193 mg/g. Equilibrium data was best fitted to the Langmuir isotherm, while adsorption kinetics was favorably described by the pseudo-second-order kinetic model. The findings reveal the feasibility of mangosteen peel waste to be used as a potential and cheap precursor for the preparation of high surface area mesoporous AC.