Title: Two step synthesis and application of porous carbon for removal of copper (II) from wastewater: Statistical optimization and equilibrium isotherm analysis

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Abstract: In this study, activated carbon (ACs) adsorbent was synthesized using the lignocellulosic waste (LCB) seed from *Adansonia digitata* L. (BSP) using two steps of hydrothermal carbonization (HTC) followed by activation. The hydrothermally produced char of BSP was activated to produce porous activated carbon BSPAC, where K_2CO_3 was used as a chemical activating agent. Box Behnken Design was used to optimize the input variables of pyrolysis temperature (A_1), residence time (B_1), and ratio (C_1) for the pyrolysis process. Removal percentage (β_1), percentage carbon yield (β_2), and fixed carbon (β_3) percentage were chosen as output responses. The analysis of variance was utilized to generate appropriate mathematical models with subsequent statistical analysis. Physiochemical characterizations were carried out for the hydrothermally carbonized sample (BSPC) and the optimized activated sample (BSPAC). Langmuir, Freundlich, and Temkin models were employed to estimate the isotherm model parameters. The results demonstrated that HTC with subsequent mild activation using K_2CO_3 can be considered as a greener route to obtain better-quality porous carbon having surface area of 599 m^2/gm for removal of Cu(II) cations from wastewater.

Keywords: Activated Carbon Hydrothermal Carbonization (HTC) Box–Behnken Design Adsorption Isotherms Wastewater Treatment (Cu^{2+} Removal)

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