

OPTIMIZED BIOCHAR FOR EFFICIENT METHYLENE BLUE ADSORPTION AS A MODEL OF ORGANIC POLLUTANTS

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ABSTRACT

An innovative dual approach combines agricultural waste recycling with wastewater treatment by transforming waste into BC and using it as an adsorbent to treat wastewater, particularly for removing organic pollutants, creating a circular system, and supporting resource conservation and environmental sustainability. The present study was conducted to optimize the biochar (BC) preparation, investigate the impact of pyrolysis temperature (600, 700, and 800 °C) and biomass type (DOW: de-oiled olive mill waste, PAC: pellet argan cake, WAC: white argan press cake, and BAC: black argan press cake) on the physicochemical, structural, morphological properties of produced BCs, and their adsorption capacity toward methylene blue (MB) as an organic pollutant model, and Evaluate the optimal BC produced for use in a large-scale filter for treating organic pollutants in wastewater. The findings indicate that the BC characteristics consistently change with pyrolysis temperature and bio-waste composition. Regardless of the biomass type, the increase of pyrolysis temperatures increases C content, fixed carbon (FC), thermal stability (TS), and specific surface area (SSA) of produced BCs due to the increased release of volatiles, while the production yield, moisture, and volatile matter decreased. The structural and morphological characterisation of BC samples revealed that pyrolysis conditions have a significant and pronounced influence on their surface structure, inorganic composition, crystallinity, and surface functional groups. The MB adsorption tests showed a progressive increase in BCs adsorption capacity as the pyrolysis temperature was increased. Furthermore, the BCs from DOW showed the higher BC yield (31-33%), TS (0.66-0.68), C content (65-78%), FC (52-57%), SSA (7-22 m²/g), and adsorption capacity of MB (42 - 432 mg/g). The optimization study showed that using DOW as a raw material and a pyrolysis temperature of 800°C provided the best BC, maximizing its production yield, SSA, and improving MB adsorption.

KEYWORDS

Optimisation, Biochar; Argan residues; Methylene blue; Adsorption capacity

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