Invited Speaker
Bamboo activated carbon produced using 2-in-1 carbonisation-activation reactor for phenol removal

Mohamad Faizal Ibrahim[1,*], Mariam Jamilah Mohd Fairus[1], Nahrul Hayawin Zainal[3], Suriani Abd -Aziz[2] and Phang Lai Yee[2]

[1]Nanomaterials Synthesis and Characterisation Laboratory, Institute of Nanoscience and Nanotechnology, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.
[2] Department of Bioprocess Technology, Faculty of Biotechnology and Biomolecular Sciences, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia.
[3]Biomass Technology Unit, Engineering & Processing Division, Malaysian Palm Oil Board (MPOB), No.6 Persiaran Institusi, Bandar Baru Bangi, 43000 Kajang, Selangor, Malaysia.

[*]Corresponding author: E-mail: faizal_ibrahim@upm.edu.my

Abstract

The production of activated carbon from biomass represents a valuable approach to waste valorization and environmental sustainability. The selection of suitable raw materials is very important to produce high-quality activated carbon despite the optimal carbonization and activation process. There are three primary carbonization technologies which are conventional heating, microwave heating, and hydrothermal heating. Conventional heating is noted for its simplicity and widespread use, while microwave heating offers rapid, uniform heating, enhancing efficiency. Hydrothermal heating is advantageous for processing wet biomass, allowing simultaneous carbonization and activation. The produced biochar can be further activated to develop activated carbon, a material renowned for its high surface area and porosity. Activated carbon produced from biochar demonstrates excellent adsorption capabilities, particularly in the removal of phenolic compounds from wastewater. For example, bamboo-activated carbon (BAC) produced using a double-insulated pilot-scale two-in-one carbonization and activation reactor, with carbonization at 500˚C for 2 hours, followed by activation at 800˚C for an additional 2 hours exhibited a high specific surface area of 1018 m^2/g and a pore volume of 0.46 cm^3/g, making it highly effective for phenol removal. Batch adsorption experiments demonstrated that over 90% of phenol was removed within just 15 minutes using an adsorbent dosage of 0.4 g. Furthermore, BAC maintained its efficacy across a wide range of pH levels and initial phenol concentrations, highlighting its versatility. This study underscores the potential of biomass-derived activated carbon in various applications, particularly for the efficient adsorption of hazardous compounds from wastewater.

Keywords: activated carbon, bamboo, biochar, sustainability, phenol