SUPPORTING INFORMATION

Synthesis of copper benzene 1,3,5-tricarboxylate (CuBTC)/*Macadamia* biochar composite for adsorption of oxytetracycline in water

Thu Phuong Nguyen[1], Thi Hai Do[2], Hong Nam Nguyen[1], Phuong Thu Le[1], Tien Le[1], Quoc Nghi Pham[3], Phu Nhuan Pham[4], Thi Mai Thanh Dinh[1,*]

[1]*University of Science and Technology of Hanoi, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet, Nghia Do Ward, Ha Noi, Viet Nam*
[2]*Hanoi University of Mining and Geology, 18 Pho Vien Street, Dong Ngac Ward, Ha Noi, Viet Nam*
[3]*Université Paris-Saclay, CNRS, ICMMO, 91405 Orsay, France*
[4]*University of Engineering and Technology, Vietnam National University, 144 Xuan Thuy, Cau Giay Ward, Ha Noi, Viet Nam*

[*]Email: *dinh-thi-mai.thanh@usth.edu.vn*

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Abstract. With the increasing number and complexity of emerging pollutants in water, such as antibiotics, the development of new materials with high adsorption capacity has garnered significant research interest. In this study, a CuBTC/biochar composite derived from macadamia was synthesized via the hydrothermal method. The synthesized composite combined biochar microstructure with cubic and rod-like CuBTC nanostructures, enhancing the overall adsorption performance. Energy Dispersive X-ray (EDX) analysis confirmed the presence of Cu, O, and C elements, while Fourier Transform Infrared (FTIR) spectra revealed characteristic peaks corresponding to both CuBTC and biochar. X-ray Diffraction (XRD) patterns identified the 3 Dimensional (3D) crystalline phase of CuBTC, and it was observed that the hydrothermal process reduced the specific surface area of the biochar. Based on the material properties and initial adsorption results, a CuBTC/biochar ratio of 1:1 was selected for further investigation in the treatment of oxytetracycline. The optimal adsorption conditions were determined to be 0.1 g of adsorbent, 1 hour of contact time, and an initial pH of 6. The adsorption process followed the pseudo-first-order and Redlich-Peterson models, with a maximum adsorption capacity of 34 $mg.g^{-1}$ as described by the Langmuir model. The negative values of standard Gibbs free energy change (ΔG) and enthalpy change (ΔH) indicated that the process is spontaneous and exothermic. The adsorption mechanism involves both physical and chemical interactions, including pore filling, electrostatic attraction, π-π interactions, hydrogen bonding, and surface complexation. Remarkably, after one year, despite a 38-fold decrease in the specific surface area of the composite, the material retained nearly 80 % of its adsorption efficiency. These findings highlight the potential of combining macadamia biochar derived from abundant solid waste sources, durable structure and high carbonization efficiency, with metal-organic frameworks such as CuBTC to develop synergistic materials for the removal of emerging pollutants like oxytetracycline antibiotics.

Keywords: CuBTC, biochar, oxytetracycline, adsorption, hydrothermal.

Classification numbers: 2.9.4, 3.4.2

1. FIGURE

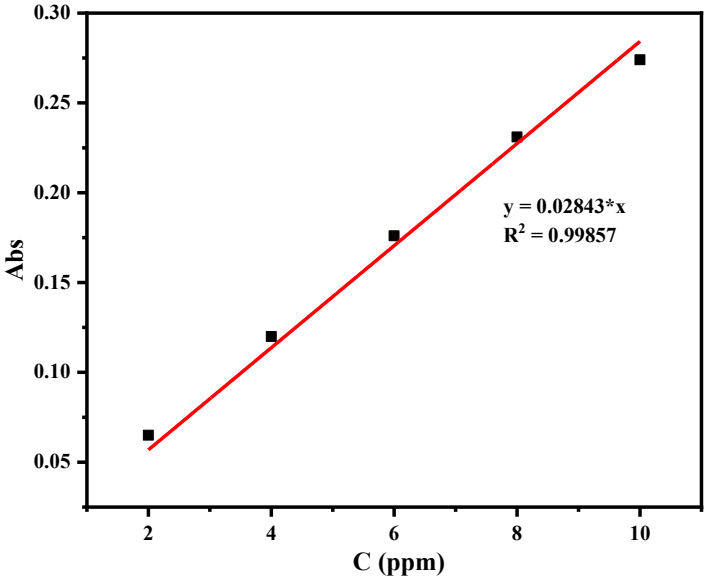

Figure S1. Standard curve of OTC.