Characterization of biomass wastes and potential use of biochar synthesis for wastewater treatment

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Abstract

The recovery of biomass waste by converting it to biochar is an efficient and environmentally-friendly method of treating biomass. Argan (AR) and olive (OR) residues are low-cost agricultural wastes produced after oil extraction that contain cellulose, hemicelluloses, proteins, and lipids, among other constituents. Characterizing these biomass components and understanding their nature is important for the overall performance of the process of converting biomass materials into the desired biochar. The objective of this study is to determine the physicochemical, structural, and thermal properties of prevalent agricultural residues in Morocco. The physicochemical, structural, and thermal characteristics of biomass samples were analyzed using TGA, HHV, CHNS, XRF, FTIR, and XRD analysis. The thermal degradation behavior in an inert environment of both biomass samples collected locally was studied. The thermogravimetric analysis demonstrated that both residues were most thermally stable. AR showed higher calorific values compared to OR (24.4 and 19.7 MJ kg-1, respectively). The proximate analysis of both biomasses showed a good combination of primary characteristics for their recycling and especially for AR compared with OR, i.e., low moisture (1.5 and 2.5%), high volatile matter (85.9 and 71.6%), moderate ash content for AR and high percentage for OR (3.5 and 12.8%), and low fixed carbon (10.8 and 15.6%). Elemental composition revealed that AR had a higher carbon content (52%) than OR (48%), making it the most effective raw material to produce biochar. However, OR had a higher oxygen content (49.5%), which explained the acidic functional groups on its surface. The FTIR analysis confirmed the presence of acidic functional groups and explained the measured pH values of both biomasses (6.9 and 5.9). This work offers new perspectives for using AR and OR residues as optimum bioresources for biochar production.

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