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Valorization of almond shell biomass to biocarbon materials: Influence of pyrolysis temperature on their physicochemical properties and electrical conductivity(Article)(Open Access)

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Abstract

Agricultural wastes are presently being used as animal feed or incinerated, yet they have the potential to become eco-friendly, value-added products. Converting agricultural waste into biocarbon material is one of the current advancements in their valorization. Biocarbons exhibit a wide range of application potential. The physical and chemical properties of biocarbons produced from agricultural feedstock differ based on pyrolysis conditions, in which the pyrolysis temperature plays a vital role. In this study, almond shell biomass was carbonized at three different temperatures: 300, 500, and 700 °C. The resulting biocarbons were analyzed to understand the influence of pyrolysis temperature on physicochemical characteristics. The carbon content in almond shells rose from 47% in the raw biomass to 75% in the biocarbon obtained at 700 °C. TGA-FTIR spectra indicated the release of volatiles such as CO_2, hydrocarbons, carbonyl groups, and ethers, the release of which increased with increasing temperature. Further, the increased pyrolysis temperature improved the thermal stability of almond shell derived biocarbons. The deconvoluted I_D/I_G ratios of Raman peaks were calculated to 1.274 and 1.012 for the biocarbons obtained at 500 and 700 °C, respectively, indicating a trend of increasing trubostratic carbons with increasing pyrolysis temperature. The biocarbon produced at 700 °C was 53 times more electrically conductive than biocarbon produced at 500 °C, likely due to the high carbon content and increased structural ordering of the carbons.

Author keywords

Agriculture waste | Almond shell | Biocarbon | Electrical Conductivity | Pyrolysis | Raman analysis | TGA-FTIR | Torrefaction

Indexed keywords

Engineering controlled terms: Agriculture | Biomass | Carbon | Electric conductivity | Fourier transform infrared spectroscopy | Physicochemical properties | Pyrolysis | Shells (structures) | Thermodynamic stability

Engineering uncontrolled terms: Agriculture wastes | Almond shells | Biocarbon | Electrical conductivity | Physicochemical property | Pyrolysis temperature | Raman analysis | Tga/ftir | Torrefaction | Valorisation

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