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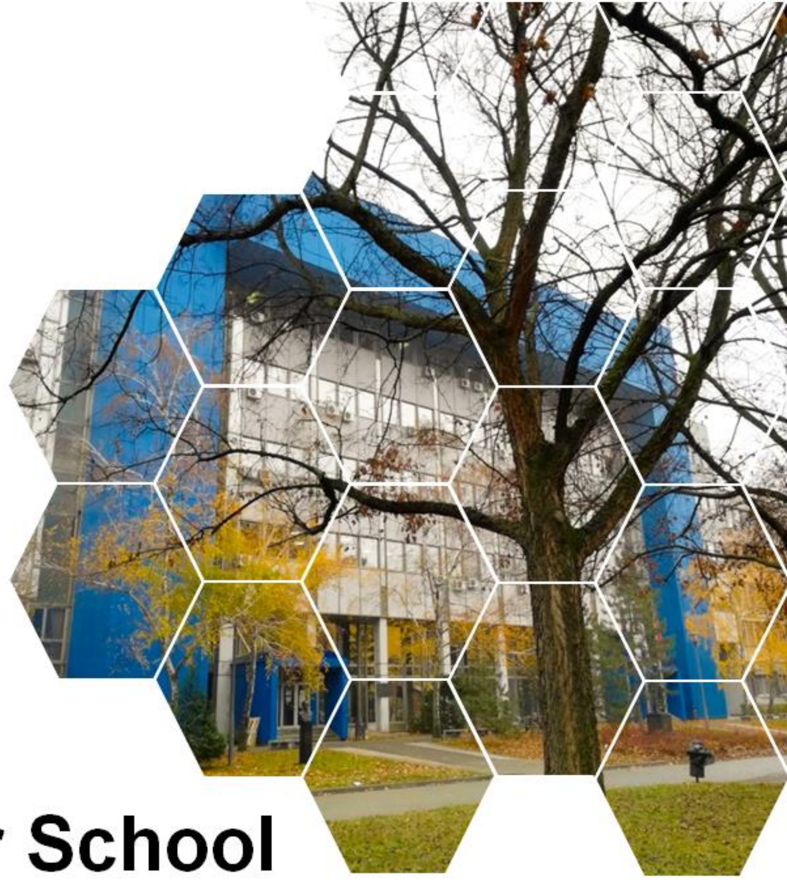

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on Sustainable organic amendment applications from a soil and ground water management perspective

-learning, training, and knowledge exchange activity-

02-06. June 2025, Novi Sad, Serbia

Faculty of Sciences Novi Sad, Serbia, 1969

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Editors Prof. Dr. Srđan Rončević, University of Novi Sad, Faculty of Sciences
Prof. Dr. Snežana Maletić, University of Novi Sad, Faculty of Sciences
Dr. Tamara Apostolović, University of Novi Sad, Faculty of Sciences
Dr. Marko Šolić, University of Novi Sad, Faculty of Sciences
Dr. Irina Jevrosimov, University of Novi Sad, Faculty of Sciences

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THE INFLUENCE OF PYROLYSIS TEMPERATURE ON THE PROPERTIES OF BIOCHAR DERIVED FROM WHEAT STRAW

***Nina Đukanović*[1]*, Tamara Apostolović[1], Jasmina Anojčić[1], Sanja Mutić[1], Tijana Marjanović Srebro[1], Snežana Maletić[1], Jelena Beljin[1]**

*[1]Department of Chemistry, Biochemistry and Environmental Protection, Faculty of Sciences, University of Novi Sad, Trg Dositeja Obradovića 3, 21000 Novi Sad, Serbia, *nina.djukanovic@dh.uns.ac.rs*

Biochar, as a carbon-rich material, can be obtained from various organic feedstocks using slow pyrolysis, a thermal decomposition process that occurs in the absence of oxygen. The type of biomass, temperature, and retention time significantly affect the physicochemical and structural properties of biochar. Due to its diverse properties, biochar is a material with potential for environmental applications. This work aimed to examine the effect of pyrolysis temperature on the properties of biochars obtained by pyrolysis of wheat straw at temperatures of 400°C and 700°C for 1 h in an inert atmosphere. The biochars are labeled as WS400 and WS700. For the characterization of the biochars, Brunauer-Emmett-Teller method (BET), X-ray diffraction (XRD), Raman spectroscopy, thermogravimetric analysis (TGA), scanning electron microscopy (SEM), and energy-dispersive X-ray spectroscopy (EDS) were performed. SEM images show that WS700 has significantly more cracks and deep, wide pores of small size, with almost completely degraded fibers compared to WS400. SEM results were confirmed by the specific surface area (SSA) obtained by BET analysis, as SSA increased from 3.68 m^2g^{-1} for WS400 to 80.88 m^2g^{-1} for WS700. The elemental composition of the produced biochars, determined by EDS in combination with CHNS analysis, shows that in both biochars the carbon content was significantly high compared to the other elements (about 66%), while the second major element was oxygen (6.5-8.5%), and all other elements in the biochars contained mostly less than 1%. The total weight loss during TGA was about 89% for WS400 and about 82% for WS700, with the highest thermal degradation observed between 300 and 500 °C. XRD analysis resulted in similar diffraction patterns for both biochars. One broad peak was observed in the band with a peak at around 2θ=23°, indicating the presence of graphitic carbon planes (002). Two sharp peaks were observed for both biochars at around 2θ=29°, indicating the presence of mineral components, such as calcium carbonate, and at around 2θ=40°, corresponding to the (220) crystal plane in the cubic structure of KCl. Raman spectroscopy for these two biochars was not specific, as the D band was not pronounced, so the I_D/I_G ratio could not be calculated, and for WS700 there was a flat line along the entire spectrum. For WS400 biochar, a peak at approximately 1592 cm^{-1} was identified as the G-band, which corresponds to in-plane vibrations of sp^2-bonded carbon atoms in the graphitic structures and can be attributed to aromatic ring systems in the biochar. The results indicate that increasing the pyrolysis temperature from 400°C to 700°C significantly enhances the porosity and specific surface area of wheat straw-derived biochar, making it more suitable for environmental applications. Structural and compositional analyses confirm that higher temperatures promote carbonization and mineral retention, which can influence biochar's adsorption properties and stability.

Keywords: Biochar, Wheat straw, Slow pyrolysis, Characterization

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