CHARACTERIZATION OF WASTE-WOOD DERIVED BIO- AND HYDRO-CHAR

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Abstract

Carbon materials, such as biochar (BC) and hydrochar (HC) have attracted special attention recently due to the cheap feedstock, wide range of the application possibilities, as well as non-toxicity to the environment. BC and HC could be produced from various biomasses under relatively low reaction temperatures and anoxic conditions [1]. These carbon materials are characterized by a large surface area and porous structure, which makes them a good candidate as a soil conditioner in agriculture [2] and adsorbent important for removal of environmental pollutants [3]. The aim of this work was to compare morphological and chemical characteristics of BC and HC obtained from woody biomass. The BC was synthesized from sawdust of beech and oak wood mixture by pyrolysis at 700°C under atmospheric pressure (Basna doo, Čačak, Serbia). The HC was synthesized by hydrothermal carbonization of wood sawdust at 200°C under auto generated pressure of about 1.5 MPa. The results of gravimetric analysis showed that both BC and HC have very high presence of dry matter (85% BC and 95% HC), of which the largest part is volatile organic matter (78% and 94%, respectively), while the ash content is less than 5%. Both samples are characterized by a heterogeneous surface and a very porous structure determined by scanning electron microscopy (SEM). The pore sizes of BC (5-14 μm) are much higher than the pore size of HC (1-2 μm). Elemental analysis performed by X-ray energy dispersion (EDS) showed that carbon and oxygen are two dominant elements in BC (90% C and 9% O) and HC (76% C and 24% O); potassium and calcium are present in traces in BC , while copper is detected in traces in HC. The gas chromatographic analysis with mass spectrometric detection (GC-MS) of the contents of 12 selected polycyclic aromatic hydrocarbons (PAHs) from a group of 16 EPA PAHs revealed rather similar content of 3-ring and 4-ring compounds in the toluene extracts of both types of char, being the most dominant and representing about 46% and 36% of the total sum, respectively. The most carcinogenic PAHs benzo(a)pyrene and dibenz(ah)anthracene were not detected.

Acknowledgements

This work was supported by the Ministry of Education, Science and Technological Development of Republic of Serbia (Project 451-03-68/2020-14/200134).

References

[1] G. Gascó, J. Paz-Ferreiro, M.L. Álvarez, A. Saa, A. Méndez, Waste Manag. 79 (2018) 395.
[2] Z. Zhang, Z. Zhu, B. Shen, L. Liu, Energy 171 (2019) 581.
[3] X. Tan, Y. Liu, G. Zeng, X. Wang, X. Hu, Y. Gu, et al., Chemosphere 125 (2015) 70.