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Physicochemical properties and sorption capacities of sawdust-based biochars and commercial activated carbons towards ethoxylated alkylphenols and their phenolic metabolites in effluent wastewater from a textile district

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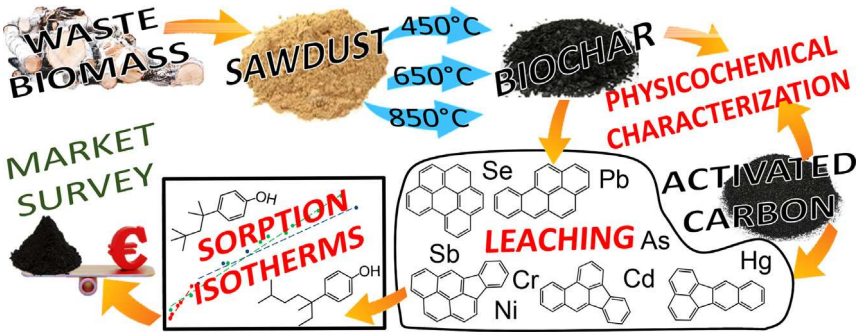
HIGHLIGHTS

- Sorption by biochar of ethoxylated alkylphenols and alkylphenols was investigated.
- Biochars comply with the EN 12915-1/2009 limits for metal and PAH release in water.
- Biochar obtained at 650 °C (BC650) showed for most analytes the best sorptions.
- The best alkylphenol sorptions were 9–13 times lower in BC650 than activated carbon.
- A market survey showed biochar as cost-efficient compared to activated carbon.

GRAPHICAL ABSTRACT



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ABSTRACT

Three biochars were produced using sawdust from waste biomass, via a simple pyrolysis thermal conversion at 450, 650, and 850 °C (BC450, BC650, and BC850), without any activation process. These materials, together with vegetal and mineral commercial activated carbons (VAC and MAC), were characterized for their elemental composition, Brunauer–Emmett–Teller surface area, t-plot microporosity and Barrett-Joyner-Halenda mesoporosity. Moreover, iodine, phenol and methylene blue porosity indexes were measured. The materials were also evaluated for their pH of the point of zero charge, as well as near-surface chemical composition and surface functionality by means of X-ray photoelectron and Fourier-transform infrared spectroscopy. Ash content, water-extractable metals and polycyclic aromatic hydrocarbons (PAHs) were also determined. BC650 showed a much higher surface area (319 $m^2\ g^{-1}$) compared to BC450 (102 $m^2\ g^{-1}$), as well as an increase in aromatization and the residual presence of functional polar groups. BC850 exhibited a loss of polar and aromatic groups, with the dominance of graphitic carbon and the highest value of surface area (419 $m^2\ g^{-1}$). Biochars comply with the EN 12915-1/2009 limits for

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