

Combining biochar and carbon nanomaterials for development of high-capacity adsorbents: Application for the removal of Endocrine Disrupting Compounds from water

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Biochar is the carbonaceous solid product derived from biomass pyrolysis. While multiple uses of this sustainable product have been researched for agronomic application as soil amendment, its environmental uses are growing in the past few years. Production of biochar nanocomposites is a new trend aiming at synthesizing new, effective, and application-targeted adsorbents capable to compete with Activated Carbon (AC). Graphene Oxide (GO) and Carbon Nanotubes (CNTs) are two nanomaterials that can be effectively used for this purpose.

The goal of this study was to produce and characterize biochar and biochar nanocomposites from Rice Husks (RH) and Sewage Sludge (SS) combined with two nanomaterials, GO and CNTs, at two pyrolytic temperatures, 400°C and 600°C, in order to apply them as adsorbents for the decontamination of water from Emerging Contaminants (ECs). Emerging Contaminants are organic pollutants found at low concentrations (ng L^{-1} to $\mu\text{g L}^{-1}$) in Wastewater Treatment Plant (WWTP) effluents and in surface waters and are being thoroughly investigated in recent years because of their potential harm to the aquatic environment.

Six specific ECs were used in this study: 2,4-Dichlorophenol (2,4D), Bisphenol A (BPA), Norethindrone (NOR), Androsterone (ADT), Estradiol (E1), and Ethinyl Estradiol (EE2). Results showed that the induction of nanomaterials into biochar production led to the physicochemical enrichment of the produced biochar nanocomposites, especially in terms of C content, Specific Surface Area and surface functional groups. Adsorption experiment results showed that GO-doped biochar nanocomposites efficiently removed (>80%) ECs from water and wastewater after approximately 60min of contact time, while in the case of CNT-doped biochar nanocomposites, just 5min of contact time were enough to remove >90% of the ECs from water and wastewater.