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Abstract

Nanostructured Carbon Adsorbents for Water Depollution †

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Carbon materials, especially nanostructured ones, have well-known adsorbent properties due to their ability to establish covalent bonds, hydrogen bonds, hydrophobic, electrostatic, and π-π interactions [1]. A sustainable and low-energy method to obtain carbon nanomaterials is by hydrothermal carbonization of residual biomass with super-heated subcritical water under auto-generated pressure [2]. Depending on the reaction temperature, solid-to-water ratio and reaction time, carbon nanostructures of different shapes and with various functional groups can be obtained. Ground corn stalks were used as biomass raw material for hydrothermal carbonization in mild temperature conditions (≤250 °C), when a type of char rich in N- and O-functional groups is obtained, particularly named hydrochar. Methylorange (MO) was used as an organic dye pollutant representative due to its wide application in textile, leather, pulp and paper industries. The morphological structure and adsorbent properties of the obtained nanostructured carbon materials were analytically investigated by Fourier Transform Infra-Red spectroscopy (FT-IR), X-ray diffraction (XRD), transmission electron microscopy (TEM), nitrogen adsorption/desorption porosimetry, X-ray fluorescence (XRF), and UV-Vis spectroscopy. TEM images evidenced spherical carbon nanostructures, while nitrogen adsorption showed an increased porosity with the reaction temperature and time. FT-IR spectroscopy evidenced particular N- and O-functional groups in the nanostructured carbon materials and also specific functional groups of MO dye (XRD). XRD analyses confirmed the presence of MO in the carbon adsorbents, UV-Vis evidenced MO concentrations in supernatant, while XRF strengthened the presence of MO in carbon nanomaterials by correlation with the S content. In conclusion, nanostructured carbon adsorbents can be obtained by hydrothermal carbonization of residual biomass and the adsorbent properties depend both on the porosity and functional groups.

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