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Synthesis and Characterization of Carbon Microspheres from Rubber Wood by Hydrothermal Carbonization

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EXTENDED ABSTRACT

Carbon has been a raw material for several thousands of industrial products and their production from various bioresources is an active area of research. This article details production of carbon microspheres from rubber wood via hydrothermal carbonization (termed as hydrothermal rubber wood carbon, HTRW carbon). Synthesis were coordinated in two sets: (i) in the first set, excess of water (20-40 × weight of biomass) was used in the hydrothermal process at 180-260 ^{0}C for 3-9 hours and (ii) in the second set, water ratio was 25 – 35 × weight of biomass and the HTC reaction temperature fixed at 260 ^{0}C. The chemical and physical characteristics of the products were studied by elemental analyzer, X-ray diffraction (XRD), Fourier-transform infrared (FTIR) spectroscopy, gas adsorption studies, thermogravimetric analysis (TGA) and scanning electron microscopy (SEM). The H/C and O/C atomic ratios of starting rubber wood was 1.78 and 0.85, respectively, which upon processing through the first strategy resulted in H/C ~0.78 and O/C ~0.29; thereby suggesting increased condensation under HTC. On the other hand, the above ratios remained mostly unaffected by processing through the second route at 260 ^{0}C. Besides, FTIR studies show that HTRW carbon at 260 ^{0}C have a different chemical structure than the starting rubber wood. The SEM images showed HTRW carbon are in the form of microspheres (size ~1.5–5μm). The proposed mechanism of the formation of hydrochar takes place via: hydrolysis of biomass (rubber wood fibre) chains, dehydration of the monomers that come from the hydrolysis of biomass and polymerization or condensation of the soluble products.