PRODUCTION, CHARACTERIZATION AND APPLICATION OF ACTIVATED BIOCHAR FROM WOOD RESIDUES

Flavia Lega Braghiroli, Research Forest Institute (RFI), University of Québec in Abitibi-Témiscamingue (UQAT), 445 Boul. de l'Université, Rouyn-Noranda, Québec, QC J9X 5E4, Canada
flavia.braghiroli@uqat.ca; flavia.braghiroli@cegepat.qc.ca
Hassine Bouafif, Technology Center for Industrial Waste (CTRI), Cégep de l'Abitibi-Témiscamingue (College of Abitibi-Témiscamingue), 425 Boul. du Collège Rouyn-Noranda, QC J9X 5E5, Canada
Carmen Mihaela Neculita, Research Institute on Mines and the Environment (RIME), University of Québec in Abitibi-Témiscamingue (UQAT), 445 Boul. de l'Université, Rouyn-Noranda, QC J9X 5E4, Canada
Ahmed Koubaa, Research Forest Institute (RFI), University of Québec in Abitibi-Témiscamingue (UQAT), 445 Boul. de l'Université, Rouyn-Noranda, Québec, QC J9X 5E4, Canada

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Biochar is a carbon-rich material characterized by physicochemical properties desirable in multi-disciplinary areas of science and engineering such as waste management, soil amendment, carbon sequestration, bioenergy, and degraded sites rehabilitation. However, the porosity and surface area of such materials are often very low. For example, the surface area of white birch biochar obtained by fast pyrolysis at 450°C, does not exceed 5 $m^2 g^{-1}$. Recently, there is growing interest of the research and industrial communities in converting biochar into activated biochar due to: i) its low-cost availability; ii) potential economic feasibility in large-scale production; and iii) its effectiveness in several applications such as the treatment (sorption) of drinking water and wastewater, energy storage, as electrodes in batteries and supercapacitors, and as catalyst support. Therefore, in this study, wood residues were converted into biochar by fast pyrolysis (CarbonFX technology using a temperature range from 315 to 450°C), and physical (in the presence of CO_2) or chemical (in the presence of KOH) activation was carried out in a prototype furnace developed in laboratory, at 900°C (see Fig. 1). The results show that the specific surface area of the activated biochar with CO_2 and KOH, at 900°C, was highly developed: 880 ± 44 and 2070 ± 103 $m^2 g^{-1}$, respectively. These values are approximately 8 to 20 times higher than the specific surface area of the initial biomass or biochar, and even higher than several activated carbons from mineral origin. Physically activated biochars have been evaluated as potential adsorbents for the removal of an organic contaminant such as phenol in synthetic (C_0 = 5-200 ppm) and in real effluents such as from barks residual parks in Québec region (C_0 = ~ 0.5 ppm). Relative to biochars and commercial activated carbon, activated biochars were very effective in removing low and high concentrations of phenol (between 90 and 100% of removal) for artificial and real effluents. In current works, activated biochars have been applied as adsorbents for mining effluents containing cooper or arsenic and in electrochemistry applications including electrodes for supercapacitors.

Figure 1 – Right side: the pilot-scale industrial torrefaction unit at CTRI (CarbonFX, Airex Energy); Left side: the prototype furnace developed at CTRI for activation.