Summary

„Biochars from thermochemical conversion of biomass for adsorption, energetic and fertilizer applications”

Author: **MSc. Eng. Jakub Mokrzycki**
Supervisor: **PhD habil. Eng. Piotr Rutkowski,**
Wroclaw University of Science and Technology, Faculty of Chemistry, Department of Process Engineering and Technology of Polymer and Carbonaceous Materials

The goal of this PhD thesis was application of plant wastes, fast-growing plants and algal biomass for biochars production. Biochars were made using two thermochemical conversion methods, namely torrefaction and pyrolysis. The impact of thermochemical conversion temperature on physical and chemical properties of biochars was investigated in wide range from 250 to 800 °C, with heating rate of 10 °C·min^{-1} and residence time of 1 h. According to proximate and ultimate analyses, the possible applications of biochars were estimated. As a criterion, the contents of mineral matter, volatile matter and carbon were adopted. Thus, four different applications were examined: (*i*) biochars as Cr(III) ions adsorbents from aqueous solutions, (*ii*) biochars as avtivated carbons precursors, (*iii*) biochars as smokeless solid fuels, and (*iv*) biochars as plant germination stimulants.

The obtained results indicated, that simple treatment methods, namely torrefaction and pyrolysis, allowed to improve biomass properties. Biochars were found to be effective Cr(III) ions adsorbents. What more, the impact of their preparation parameters and chemical composition – cellulose, hemicellulose, lignin and mineral matter contents, on sorption capacity increase was investigated. The effect of the carbonization temperature on specific surface area development of KOH activated carbons was examined. The obtained activated carbons were efficient isoproturon (herbicide) adsorbents. Biochars higher heating values were comparable with lignite and coal. As a result, they might become an attractive fuel for co-combustion with coal. Biochars for fertilizers production were examined as radish seed germination stimulants. It was found, that the type of raw material used for biochar production influenced the amount of healthy sprouts. Also, the impact of carbonization temperature and biochar dose were examined in terms of seed germination stimulation.