# EFFECT OF PYROLYSIS ATMOSPHERE ON BIOCHAR PRODUCTION FROM SPRUCE BARK, NEEDLE, TWIG AND FOREST RESIDUE

Liang Wang, SINTEF Energy Research
liang.wang@sintef.no
Jone Dambås, SINTEF Energy Research
Julie Cathrine Guldahl, SINTEF Energy Research
Elisa Magnanelli, SINTEF Energy Research
Nikalet Everson, SINTEF Energy Research

Key Words: Spruce Bark, needles, twigs and forest residues, Biochar, Characterization

Biochar produced from pyrolysis of biomass has great potentials to be used for soil improvement and abate climate change. With unique properties, use of biochar in agronomy can improve soil fertility, increase crop yields and sequestrate carbon as well. Production conditions have considerably effects on yield and property of biochar and gas and liquid byproducts. This work aimed to investigate the impact of highest treatment temperature (HTT), atmosphere ($CO_2$ and $N_2$) and feedstock on yield of solid, liquid and gas products from pyrolysis of spruce bark, needles, twigs and forest residues as well as characteristics of the produced biochar. The raw feedstocks were pyrolyzed in a fixed bed reactor under slow heating conditions with presence of nitrogen and carbon dioxide, which continuous monitoring gases products. The produced biochars were characterized by a combination of proximate analysis, elemental analysis, $N_2$ and $CO_2$ adsorption for BET surface area and porosity analysis, Raman, FTIR, XRD and scanning electron microscopy analysis. It was found that products distribution from pyrolysis of the studied feedstocks are considerably different, mainly owing to the differences in physical and chemical properties of them. In both nitrogen ($N_2$) and carbon dioxide ($CO_2$) atmosphere, yields of biochar and liquid products decreased at a higher HTT, together with production of more gas products. The experimental and analysis results indicate that pyrolysis behaviors of the biomass in $N_2$ and $CO_2$ is different. Pyrolysis in $CO_2$ led to different extents of pyrolysis reactions and produced biochar with changed physico-chemical properties compared to those produced in $N_2$ atmosphere. The $CO_2$ seems to enhance cracking of volatile organic carbons, leading to reduction of amount of formed liquid products. The experimental findings in this study indicate that the carbon neutral biomass and $CO_2$ could be co-utilized as feedstock and influencing carrier gas with multi benefits for biochar production, energy generation and waste management.

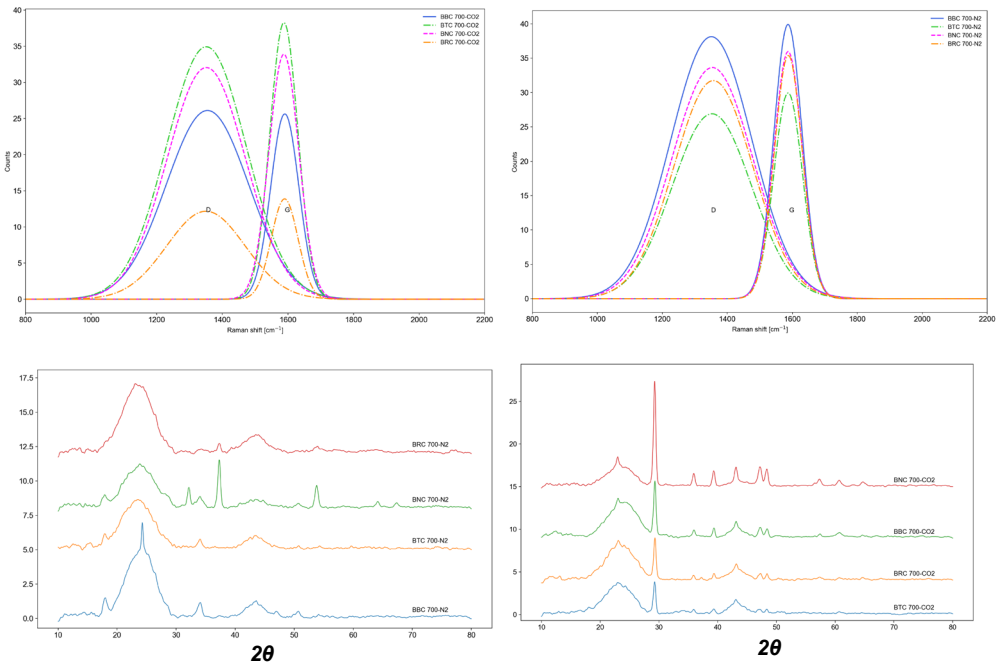


*Figure 1 – Raman and XRD analysis of biochar of spruce bark (BC), spruce needles (NC), spruce twigs (TC) and spruce forest residues (RC) at 700 °C at $N_2$ and $CO_2$ atmospheres*