Geophysical Research Abstracts
Vol. 15, EGU2013-10650, 2013
EGU General Assembly 2013

Investigating the influence of production conditions on the energy distribution between the solid, liquid and gaseous products of slow pyrolysis

Kyle Crombie (1) and Ondrej Masek (2)

(1) UK Biochar Research Centre, University of Edinburgh, Edinburgh,United Kingdom (k.crombie@ed.ac.uk), (2) UK Biochar Research Centre, University of Edinburgh, Edinburgh,United Kingdom (ondrej.masek@ed.ac.uk)

Slow pyrolysis is a well established technology for converting biomass into a more stable form of carbon (biochar) while also producing energy rich by-products of bio-oil and syngas. Biochar is the porous, carbonaceous material produced by thermo-chemical treatment of organic materials in an oxygen-limited environment. Biochar can be incorporated into soils to improve soil fertility, reduce greenhouse gas emissions as well as provide long term storage of carbon or alternatively it can also provide additional energy to a pyrolysis system through combustion. Biochar production conditions have a significant influence on the yield as well as physiochemical and functional properties of the final pyrolysis products, resulting in a selection process aimed towards either agricultural benefits and carbon mitigation or heat/energy generation.

This work aimed to investigate the effect of temperature, residence time and gas flow rate on the product energy distribution as well as the physical, chemical and soil functional properties of biochar, in order to optimise conditions best suited to maximise both energy value and agronomic benefit. Biochar samples were produced from wood pellets (WP) and straw pellets (SP) at two temperatures (350 and 650oC), with three residence times (10, 20 and 40 minutes) and three carrier gas flow rates (0, 0.3 and 0.6 L min-1). The energy balance of the system was determined through the calorimetric analysis of biochar and bio-oil, while the higher heating value for the syngas was calculated from the gas composition measured via mass spectroscopy. Biochar was also analysed for the physiochemical properties of proximate analysis and ultimate analysis as well as the functional property of environmentally stable carbon (C) content.

As expected the yield of biochar decreased with increasing temperature resulting in elevated yields of liquid and gas fractions. Increased temperature also resulted in higher values of fixed C, total C, stable C and calorific value due to the increased emission of volatiles. The higher heating value for the syngas was also shown to increase with temperature due to greater release of combustible gas species at higher temperatures. The impact of residence time and gas flow rate were not as clear as for temperature but still demonstrated decreasing biochar yields as the respective parameters were increased. However the greatest impact occurred at 350oC and diminished when temperature was increased to 650oC. An understanding of the influence that production conditions have on the long term stability of biochar as well as the energy content of the solid, liquid and gas fractions obtained from pyrolysis is critical towards the development of specifically engineered biochar to deliver a specific function be it for agricultural use, carbon storage, energy generation or combinations of the three.