Geophysical Research Abstracts
Vol. 13, EGU2011-4914, 2011
EGU General Assembly 2011

Biochar for carbon sequestration in soil – Effect of feedstock and pyrolysis conditions on physical and chemical biochar characteristics

Stephanie Kloss (1,2), Franz Zehetner (2), Alex Dellantonio (2), Bernhard Wimmer (1), Raad Hamid (1), Volker Liedtke (3), Franz Ottner (2), Martin Gerzabek (2), and Gerhard Soja (1)

(1) AIT, 2444 Seibersdorf, Austria (gerhard.soja@ait.ac.at), (2) University of Natural Resources and Life Sciences, 1190 Vienna, Austria, (3) AAC, 2444 Seibersdorf, Austria

Biochar is the solid residue of pyrolysed biomass. These carbon-rich materials can be produced from any organic materials but currently agricultural and forest residues are the main feedstock. The use of other organic waste materials is an option that still has to be developed and the respective legal basis only exists partially. The interest in biochar is based on its potential for long-term carbon sequestration and as a soil amendment for agricultural and horticultural uses, among others for ameliorating soils poor in organic matter and deprived of nutrients. Depending on the deployment strategies, different characteristics of biochar are desirable. These properties, however, depend on the feedstock and on the pyrolysis conditions. Therefore this study presents some results about the physical and chemical characteristics as influenced by original biomass and process parameters of pyrolysis.
Five different biomass feedstock materials (cereal straw, vineyard prunings and wood chips from Populus, Picea and Fraxinus) have been pyrolyzed at temperatures from 400 – 525 °C with different furnace residence times. The original biomass and the pyrolysis product were analysed for elemental and mineral compositions, active surface, thermogravimetric and calorimetric behavior and concentrations of polycyclic aromatic hydrocarbons (PAH 16 EPA).
Thermogravimetric analyses revealed that higher pyrolysis temperatures were associated with delayed mass loss during biochar heating. Biochar from poplar, ash and spruce wood chips were more resistant against mass loss than the other feedstock materials. Differential scanning calorimetry showed specific shifts in the exothermic peaks with cereal straw as the most sensitive biochar material. Again, higher pyrolysis temperatures caused higher thermal stability of the resulting biochars, with spruce biochar as the most recalcitrant material. Generally, higher recalcitrance in terms of decomposition can be expected for all biochars with increasing pyrolysis temperature.
Surface area, measured as BET values, was lower in straw biochar than in the other feedstock variants and increased with higher pyrolysis temperatures. Maximum values were reached for vineyard prunings pyrolyzed at 525 °C (57 m2.g-1). At this pyrolysis temperatures, the carbon content of biochar ranged between 74 and 80 % whereas the feedstock had consisted of 44-48 % carbon. Lower pyrolysis temperatures resulted in lower carbon enrichments. No significant changes in the C/N-ration were observed, irrespective of furnace temperature.
The PAH 16-EPA-concentrations in cereal straw increased in parallel to the pyrolysis temperatures whereas in all the other feedstock materials a decreasing trend could be observed. Under unfavorable conditions, the threshold value of 6 mg.kg-1 was exceeded in biochar. However, the selection of 525 °C pyrolysis temperature and a non-straw feedstock proved as a reliable measure to produce biochar with low PAH concentrations. Under these conditions, naphthalene was the main PAH, implying a good prospect for a rapid biological degradation in soil.