Geophysical Research Abstracts
Vol. 16, EGU2014-15624, 2014
EGU General Assembly 2014

Long-term balance in heavy metal adsorption and release in biochar derived from sewage sludge

Saran Sohi, Robert Cleat, Margaret Graham, and Andrew Cross

University of Edinburgh, UK Biochar Research Centre, School of GeoSciences, Edinburgh, United Kingdom (saran.sohi@ed.ac.uk)

In Europe, sewage sludge has major potential as a resource for producing biochar. Biochar from sludge could offer a means for the controlled recycling of phosphorus to soil, with the additional benefit of carbon stabilisation. Biochar made from contaminated feedstock could, however, also leach heavy metals into soil. Counter to release of metals, biochar from fresh plant biomass has a documented affinity and adsorption capacity. The longer term balance of release and adsorption of metals in sludge-derived biochar has not been established.

Our work compared the adsorption and release of both indigenous metals and metals adsorbed to sludge derived biochar. The hypotheses were threefold: (1) the capacity to adsorb metals is lower than the potential to release them, (2) the affinity for indigenous metals is higher than for metals in solution, 3) oxidative ageing of biochar leads to partial release of adsorbed metals.

Sludge biochar was produced in a horizontal, externally heated kiln at a feed rate of approx. 0.5 kg/hr. Dry sludge was converted in a 20 min. transit time with peak kiln temperature of 550^0C. Elemental analysis using ICP OES (after a published preparation step) showed Zn, Pb and Cu to be the most abundant heavy metals in the biochar. The same elements were assessed in sequential water and Mehlich III extracts. Adsorption of the metals from pure and mixed Zn, Pb and Pb solutions were undertaken before and after the other extractions. All the treatments were applied to the same biochar after oxidative ageing, in which biochar C was also found to be very stable.

Extractability of all three metals from fresh biochar was low (less than 5 %), but for two of the metals it was lower after ageing. For one of the metals, ageing increased extractability. For the same metal, adsorption was lower when undertaken with a mixed rather than pure solution. Capacity for adsorption of one of the other metals was higher after biochar ageing; the general capacity for metal adsorption was similar to indigenous content. The affinity of biochar for adsorbed metals was higher after ageing than it had been for fresh biochar.

The findings provide a quite positive picture in terms of the potential for safe use of sludge-derived biochar in agriculture, over the long- as well as near-term. Integrating further work on metals and its integration with work biochar phosphorus and C stability could lead to strategies that successfully address multiple goals and are also economically feasible.