Proceedings of the 4th International Conference on Environmental Pollution and Remediation
Prague, Czech Republic, August 11-13, 2014
Paper No. 176

Use of Biochar for Immobilisation of Heavy Metals in Contaminated Soils

Gerhard Soja, Wolfgang Friesl-Hanl, Jasmin Karer, Anna Wawra, Vladimir Fristak
AIT Austrian Institute of Technology GmbH
Konrad Lorenz-Str. 24, 3430 Tulln, Austria
gerhard.soja@ait.ac.at; wolfgang.friesl-hanl@ait.ac.at

Franz Zehetner, Markus Puschenreiter
University for Natural Resources and Life Sciences
Peter Jordan-Str. 82, 1190 Wien, Austria
franz.zehetner@boku.ac.at; markus.puschenreiter@boku.ac.at

Gerald Dunst, Mario Wagner
Fa. Sonnenerde, Oberwarterstr. 100, 7422 Riedlingsdorf, Austria
g.dunst@sonnenerde.at; mario_wagner@ymail.com

Extended Abstract

Elevated concentrations of heavy metals in soils sometimes have geogenic origin but frequently they are caused by atmospheric deposition of emissions from industrial processes, mining, ore processing or sewage sludge applications. Though national guidelines usually prescribe threshold values based on total concentrations, the consideration of bioavailability is increasingly discussed as alternative assessment parameter. Inorganic immobilisation materials like Fe-oxides or clay minerals may be effective in certain soils to decrease the bioavailability and the migration tendencies of mobile elements but they cannot act as soil amendment. If it is the aim to amend contaminated soils by improving the nutrient supply, soil characteristics and support soil microbes, organic amendments may be more suitable as additives. Both compost and biochar may deliver nutrients for soil organisms, improve soil characteristics important for plant growth like bulk density and water holding capacity, raise a low pH and decrease the plant uptake of heavy metals or metalloids (Rees et al., 2014). Biochar has the additional advantage to sequester carbon in the soil for periods of more than 100 years, thereby acting as a climate change mitigation measure.

The potential of organic soil additives in soil remediation has initiated studies to quantify the metal sorption characteristics of biochar with or without compost under different environmental conditions. Apart from investigating the basic metal immobilisation characteristics of the additives, additional analyses are necessary that use historically contaminated soils for studying the immobilisation also by the reduction of plant uptake. Using soil from the vicinity of an earlier Cu/Zn smelter, we tested 10 different additive combinations for their capacity to reduce the uptake of heavy metals into Italian ryegrass (*Lolium multiflorum*) in a pot experiment under greenhouse conditions. These additives were based on different biochar-compost mixtures added in rates of 0.5 to 1.5 % (w/w), partly supplemented by Fe-oxides and gravel sludge (0.75 to 1.5 %, w/w). Biochar was produced from different raw materials in a Pyreg-reactor, ranging from cellulosic fiber pulp to wood chips and Miscanthus. The compost was based on green waste material. *Lolium* plants were analysed for dry matter productivity, Ni, Cu, Cd, Zn, and Pb concentrations. The most distinct reductions of heavy metal plant concentrations and total uptake were observed after the addition of a wood chip-based biochar and compost mixture (1:1) at a rate of 1.5 % (w/w). Concentrations of Cd and Ni in *Lolium* were reduced up to 35 % relative to control, with lower reductions for Zn and no significant reduction for Pb and Cu. Inorganic additives like Fe-oxides and gravel sludge did not further enhance the heavy metal immobilisation by the biochar-compost mixtures.

References

Rees F., Simonnot M. O., Morel J. L. (2014). Short-term effects of biochar on soil heavy metal mobility are controlled by intra-particle diffusion and soil pH increase. European Journal of Soil Science, 65, 149-161.