BIOCHAR AS AN AMENDMENT FOR THE REMEDIATION OF HEAVY METAL CONTAMINATED SOIL

Reinhart Van Poucke, **J. Ainsworth, E. Meers, F. Tack**
Department of Applied Analytical and Physical Chemistry, Ghent

Reinhart.vanpoucke@ugent.be

Keywords: Biochar; remediation; Cd; Zn

Introduction

Heavy metal contamination is a global problem. In the Campine region in Flanders one hundred years of non-ferric metal smelting activities caused Cadmium and Zinc concentrations to reach problematic levels. Crops, especially species such as *Spinacia oleracea*, grown in this region will exceed the European food and feed standards when harvested. Heavy metal contamination poses serious problems to ecosystems and human health. Exposure to Cd causes toxicological effects to the kidneys, liver, lungs, immune and reproductive systems. This element is also listed as human carcinogenic by the International Agency for Research on Cancer.

Since organic matter has the tendency to reduce the bioavailabity of heavy metals in the soil, activated carbon is often used to remediate the soils. For this research cheaper options were evaluated. Compost, peat and biochar were be added to the soil to immobilize the heavy metals.

Methods

The biochar was derived from holm oak, pyrolysed at 650°C and was used for the immobilization of Cd and Zn. The influence of the addition of biochar to the soil from the Campine region on the mobility of the metals, was evaluated in a pot experiment. Biochar was compared with peat, compost and liming. The pH effect from biochar was compared with the addition of lime.

Results

Despite the peat measuring a significantly larger cation exchange capacity than both the biochar and compost, it recorded the lowest Cd and Zn removal in all the ranges of metal solutions tested during the sorption test. This could be explained by the peats lower pH (3.9) compared to the biochar (9.6) and compost (8.0) since the solution pH in this experiment was not controlled. The pH of a solution is known to be the most significant factor in determining a metals speciation, solubility and mobility.

After 14 weeks of equilibrium, rhizon extractions showed a significant reduction in Cd and Zn in the soil solution in the biochar 2% and 4% treatments, compared to the untreated soil. The biochar was not found to be significantly more effective than lime for Cd and Zn immobilization. The addition of compost had no significant effect and peat even a negative effect, compared with the untreated soil.

Leaching tests under continuous acidification did however show biochar to be more effective than lime and equally effective as the compost and peat at retaining Cd and Zn from the solution. Results indicate that the immediate immobilization capacity of biochar for Cd and Zn is due to its liming properties, but its capacity to adsorb cationic metals may further retain Cd and Zn from the soil solution under continuous acidification.

Proceedings of the 18th International Conference on Heavy Metals in the Environment, 12 to 15 September 2016, Ghent, Belgium

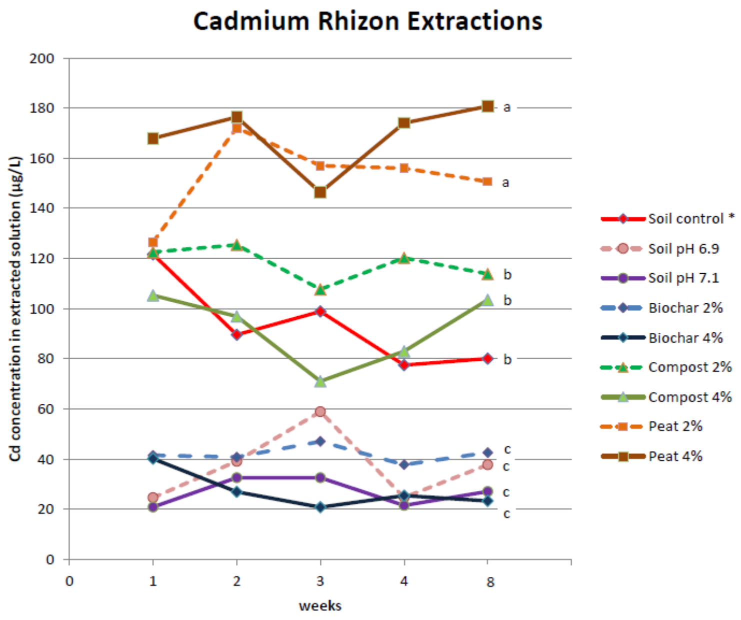

Figure 1. Comparison of Cd concentrations in rhizon extracted soil solutions over time between the nine treatment groups. Alike letters indicate no significant difference, to a 0.05 level, in the week 8 extraction. A * indicates if the Cd concentrations differ significantly within the group between weeks 1 and 8.

Conclusion

Biochar had a higher pH compared to the other treatments. Rhizon extractions showed that biochar was significantly more effective than compost and peat for Cd and Zn immobilization.

It can be concluded that this biochar combines the pH effect of lime with the sorption capacities of products such as peat or compost. This results in a long term sustainable reduction of the heavy metal mobility even when the soil acidifies.