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Biochar Obtained from Different Wood Trunk Layers Allow to Stabilize Pb and As in a Mining Technosol

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Extended Abstract

Mining activities lead to widespread environmental pollution due to the presence of metal(loid)s in tailings. These contaminated areas present a health risk and hence need to be rehabilitated. *Ex situ* methods for soil remediation have been used for a long time but are expensive and disruptive to soil. Phytoremediation techniques for the stabilization or extraction of metal(loid)s could be an efficient alternative as they provide a low-cost and environmentally friendly option. However, due to the often poor nutrient content of these contaminated soils, amendments must be added to enhance plant growth and to improve phytoremediation efficiency. Biochar, a pyrogenic product, is a promising amendment for assisted phytoremediation. It has been demonstrated as a potential candidate for the remediation of metal(loid)s contaminated soils [1]. However, the mechanisms of contaminant-biochar retention and release depend on the amount of soil contaminants and physicochemical characteristics, as well as the durability of the biochar contaminant complex, which may be related to the pyrolysis process parameters and the biomass feedstocks. The objective of the present study was to evaluate, in a former contaminated mining site Pontgibaud (France) [2] presenting no vegetation cover and contaminated by high concentration levels of lead (11453mg.kg^{-1}) and arsenic (539 mg.kg^{-1}), the capacity of three biochar feedstocks (La Carbonerie, France) obtained from different *Quercus* wood trunk layers (bark, sapwood and heartwood) to significantly reduces lead and arsenic content in soil pore water. The biochars were applied at 2% and presented three different granulometry (0.2 to 0.4mm, 0.5 to 1mm and 1 to 2.5mm). The main physicochemical parameters of biochars and the Pb and As contents in soil pore water were determined during the time course of a phytotoxicity test realized on *Phaseolus vulgaris* germinations. The growth, the dry weight and the metal contents were analyzed at the end of the experiment in the different organs of the plantlets. Results showed that the addition of the three biochar improved soil conditions by increasing soil pH, electrical conductivity and water holding capacity. Furthermore, the application of the 3 biochars to Pontgibaud technosol reduced significantly Pb and As mobility and availability and allowed plant growth in a technosol where no plants were previously growing. In conclusion, the data clearly demonstrated that biochar application can be effectively used for Pb and As soil immobilization, thereby reducing their bioavailability. Moreover we demonstrate for the first time the capacity of a biochar obtained from bark feedstock to totally stabilize Pb and As in soil allowing no metal(loid)s to be detected in soil pore water. These results are very encouraging as to the possibility of using biochar as an amendment to reconquer abandoned areas due to significant soil metal(loid)s concentrations.

References

[1] M. Lebrun, et al., "Eco-restauration of a mine technosol according to biochar particle size and dose application: study of soil physico-chemical properties and phytostabilization capacities of *Salix viminalis*," *J. Soils Sediments*, DOI 10.1007/s11368-017-1763-8, 2017.

[2] M. Lebrun, et al., "Assisted phytostabilization of a multicontaminated mine technosol using biochar amendment: early stage evaluation of biochar feedstock and particle size effects on As and Pb accumulation of two Salicaceae species (*Salix viminalis* and *Populus euramericana*)," *Chemosphere*, vol. 194, pp. 316-326, 2018.