



HAL
open science

Long-term effects assessment of biochar to remediate heavy-metals contaminated soils,

Frédéric Rees, Jean-Louis Morel, Marie-Odile Simonnot

► **To cite this version:**

Frédéric Rees, Jean-Louis Morel, Marie-Odile Simonnot. Long-term effects assessment of biochar to remediate heavy-metals contaminated soils,. Contaminated Site Management in Europe (CSME 2012) Sustainable Approaches to Remediation of Contaminated Land in Europe (SARCLE 2012), Centre de Microbiologie du Sol et de l'Environnement (CMSE). FRA., Oct 2012, Nancy, France. hal-02802399

HAL Id: hal-02802399

<https://hal.inrae.fr/hal-02802399>

Submitted on 5 Jun 2020

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

LONG-TERM EFFECTS ASSESSMENT OF BIOCHAR TO REMEDIATE HEAVY-METALS CONTAMINATED SOILS

Frédéric REES¹, Jean-Louis MOREL¹, Marie-Odile SIMONNOT²

¹Université de Lorraine/INRA, Laboratoire Sols et Environnement, 54500 Vandœuvre-lès-Nancy, France

²CNRS, Laboratoire Réactions et Génie des Procédés, 54000 Nancy, France

Biochar, the residual solid of biomass pyrolysis, has recently drawn considerable attention as a potential carbon sequestration agent in soils due to its high recalcitrance to biodegradation as long as a low-cost soil quality improver to increase plant growth¹. Recent studies suggest also biochar ability to immobilize heavy metals in soils and thus to reduce the toxic impact of these elements²⁻⁴. However, the sorption mechanisms and reversibility degree of biochar effects for the remediation of contaminated soils are still unclear and must be addressed to evaluate potential risks of biochar use in these soils⁵.

In a first attempt to evaluate biochar capacity to immobilize metals in solution, we set up batch sorption studies of cationic trace elements (Cu, Cd, Ni, Zn, Pb) on an alkaline biochar produced at about 450°C from conifers and deciduous wood. Kinetics results show that sorption speed is low and particles-size dependent, which may be attributed to limiting diffusion of metal inside biochar particles. Adsorption/desorption experiments with initial metal concentration of 10-500 µmol/L reveal different sorption trends depending on the elements: Freundlich-type isotherms of Cd and Zn are identical while Cu and Pb show a much higher affinity for biochar and Ni the lowest of all five elements. On the other hand, hysteresis with desorption isotherms reveal a marked sorption irreversibility especially for Cu and Pb. However, the sorption dynamics of heavy-metals on biochar remains complex and several environmental parameters have to be taken into account, e.g. the influence of pH variations of the system in order to mimic possible long-term acidification of contaminated soils amended with biochar.

In a second time, we will discuss the results of continuous solution analysis in column experiments with biochar alone and biochar-amended contaminated soils leached with different extracting solutions to describe the actual sorption dynamics on biochar of heavy-metals originating from historical atmospheric pollution by smelters in order to assess biochar potential for long-term remediation of contaminated sites.

REFERENCES

1. Atkinson, C. J., Fitzgerald, J. D. & Hipsley, N. A. Potential mechanisms for achieving agricultural benefits from biochar application to temperate soils: A review. *Plant and Soil* **337**, 1–18 (2010).
2. Beesley, L. & Marmiroli, M. The immobilisation and retention of soluble arsenic, cadmium and zinc by biochar. *Environmental Pollution* **159**, 474–480 (2011).
3. Trakal, L., Komárek, M., Száková, J., Zemanová, V. & Tlustoš, P. Biochar application to metal-contaminated soil: Evaluating of Cd, Cu, Pb and Zn sorption behavior using single- and multi-element sorption experiment. *Plant, Soil and Environment* **57**, 372–380 (2011).
4. Fellet, G., Marchiol, L., Delle Vedove, G. & Peressotti, A. Application of biochar on mine tailings: Effects and perspectives for land reclamation. *Chemosphere* **83**, 1262–1267 (2011).
5. Beesley, L. *et al.* A review of biochars potential role in the remediation, revegetation and restoration of contaminated soils. *Environmental Pollution* **159**, 3269–3282 (2011).