Biochars and Green Waste Compost for the Immobilisation of Cu in Contaminated Soil - HOMBRE/ Greenland Joint Project

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Presentation Overview

- Project Background and Aims
- Amendments and Analyses
- Results
- Discussion + Conclusions
Project Background

- Collaborative undertaking between two EU projects: HOMBRE and Greenland

- **HOMBRE (Holistic Management of Brownfield Remediation)**
  Task 5.4 /Deliverable 5.4 – Technology development: operating window investigation for two low input technologies for greening urban brownfield.

- **Greenland – Gentle Remediation Options**
  TASK 4.3/Deliverable 4.27 - Use of amendments for reducing TE bioavailability (phytostabilisation)

- Two supporting MSc projects (University of Reading)
  Not reported here
Site

- Former wood-preservation site in South-West France
- Heavily Cu contaminated (also PAH).
- Low OM
- Spatial variability of contamination
Aims

- Evaluate the potential of biochar and GWC as GRO to:
  - Immobilise Cu in soil
  - Aid re-vegetation of contaminated site

- In order to:
  - Assess potential for production of usable biomass for energy on marginal land
  - Add to ongoing work attempting to define operating windows for GRO
  - Assess recycling biomass produced on contaminated sites for further site improvement
Amendments

• Three different biochars trialled:

  • BC1 – a specialised biochar product called “C-Cure-Metal” developed for remediation of metal contaminated substrates (C-Cure Solutions Limited, Farnham, UK)

  • BC2 – Biochar produced using poplar grown at the Biogeco site (AIT, Austria)

  • BC3 – Fe-amended poplar char (AIT, Austria)

• Green Waste Compost
Project Concept

**Treatment Regime**
- Amendment (biochar, compost)
- Plant Growth

**Interacting Influencing Factors**
- DOC
- EH
- CEC
- OM
- pH
- N, P, K + micronutrients

**Key Impacts**
- Cu Availability in Soil
- Leaching to Water Bodies
- Phytotoxicity

Direct influence
Analysis/Activities

- Background analyses (Technalia – total metals, PAH)
- Leach tests – pre incubation, post incubation, post growth
  → Incubation period (14d, wet/dry cycle)
- pH, EH
- DOC
- Plant trials – biomass and metal uptake
Results: Pre Incubation Leaching Tests
Results: Pre Incubation pH & DOC
Results: Pre Incubation EH
Results: Post Incubation Leaching Tests

Leachable Cu mg kg dry soil$^{-1}$

Unamended, BC 1 (1%), BC 2 (1%), BC 3 (1%), BC 1 (3%), BC 2 (3%), BC 3 (3%), C (1%), C (2%), BC 1 (1%) + C (1%), BC 2 (1%) + C (1%), BC 3 (1%) + C (1%), BC 1 (3%) + C (1%), BC 2 (3%) + C (1%), BC 3 (3%) + C (1%), BC 1 (1%) + C (2%), BC 2 (1%) + C (2%), BC 3 (1%) + C (2%), BC 1 (3%) + C (2%), BC 2 (3%) + C (2%), BC 3 (3%) + C (2%)
Results: Post Incubation pH & DOC
Results: Post Incubation EH
Results: Post Growth Leaching Tests

Leachable Cu mg/kg dry soil$^{-1}$

(Pre-growth)
Results: Post Growth pH & DOC
Post Growth EH
Leaching Tests: BC1 (C-Cure)

Pre-incubation

Post-incubation

Post-growth
Leaching Tests: BC2 (poplar)
Leaching Tests: BC3 - (poplar+Fe)
Plant Growth – at 7 weeks
Results: Above Ground Dry Biomass

Dry biomass (g)
Result: Plant Growth
Result: Plant Growth

BC1 (3%) + c (2%)

Unamended
Results: Metal uptake

mg Cu Kg dry biomass\(^{-1}\)

Unamended  BC 1 (1%)  BC 2 (1%)  BC 3 (1%)  BC 2 (3%)  BC 3 (3%)  C (1%)  C (2%)  BC 1 (1%) + C (1%)  BC 2 (1%) + C (1%)  BC 3 (1%) + C (1%)  BC 1 (3%) + C (1%)  BC 2 (3%) + C (1%)  BC 3 (3%) + C (1%)  BC 1 (1%) + C (2%)  BC 2 (1%) + C (2%)  BC 3 (1%) + C (2%)  BC 1 (3%) + C (2%)  BC 2 (3%) + C (2%)  BC 3 (3%) + C (2%)

Leaf  Stem
Discussion + Conclusions

• BC1 overall reduced leachable Cu before growth (clear distinctions between treatments and controls; less obvious after the growth period)

• BC1 increased plant growth most significantly

• Generally, higher application rates and combination with compost improved results for all biochars for both phytotoxicity and leachable Cu reduction

• Discussion point: dramatic reduction in leachable Cu post growth – where has the leachable Cu gone?
  – Leached from soil?
  – Taken up by plants?
  – Changed to a less available form? If so, what were the determining factors?
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