APPLICATION OF A BRITISH HARDWOOD BIOCHAR IN SOIL REMEDIATION

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Introduction

The physicochemical properties of a British hardwood biochar and its adsorption characteristics towards heavy metals were investigated in laboratory. A field remediation treatment was carried out to examine the long-term effect of this biochar on the immobilisation of heavy metals on a sand-based contaminated site in Castleford, UK. The extracted concentrations of nickel (Ni) (II) and zinc (Zn) (II) in the carbonic acid leaching tests were reduced by 83 - 98% over three years. The sequential extraction results indicated that biochar addition (0.5 - 2%) increased the residue fractions of Ni (II) (from 51% to 61 - 66%) and Zn (II) (from 7% to 27 - 35%) in the soils through competitive sorption against more mobile fractions. A short-term laboratory study was carried out to investigate the influence of this biochar on the mobility and speciation of lead (II) in a clay soil (kaolin). It was observed that biochar did not affect the mobility or speciation of lead (II) in the kaolin. The mechanisms involved in the above findings were investigated and discussed.

Methods

Physicochemical properties of biochar: BET surface area, Cation exchange capacity, FT-IR, SEM, XRD, elemental analysis using aqua regia digestion followed by ICP test.

Adsorption characteristics: Kinetics, the influence of solid to liquid ratio on sorption, the influence of solution pH on sorption, equilibrium study.

Field application of biochar to immobilize heavy metals (sandy soil): Leaching test on the site soils. Sequential extraction on the site soils.

Laboratory application of biochar on model soil (clay soil): Leaching test and sequential extraction test.

Results

Biochar addition (0.5 - 2%) increased the residue fractions of Ni (II) (from 51% to 61 - 66%) and Zn (II) (from 7% to 27 - 35%) in the soils through competitive sorption against more mobile fractions three years after application. (Figure 1). In contrast, biochar did not affect the speciation of lead (II) in the kaolin in a 28-day laboratory investigation (Figure 2).

Conclusion

This study suggests the effectiveness and potential of biochar application in immobilising heavy metals in sandy soil in the long term. However, it did not affect the mobility or speciation of lead in kaolin in the short term.

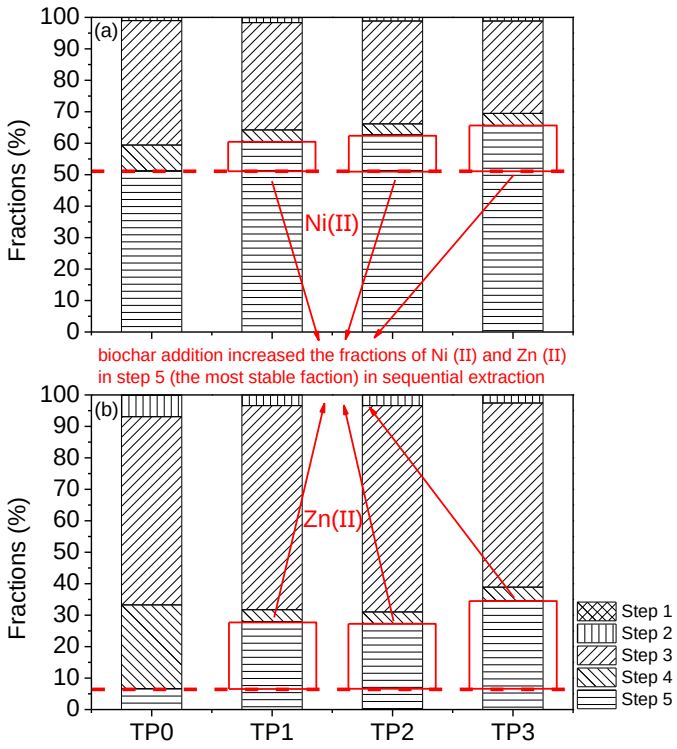

Figure 1. Fractions of metals in the field sandy soil from each step of sequential extraction (a - Ni (II), b (II) - Zn) in field contaminated soil remediated with biochar (TP0 – control; TP1 – 0.5%biochar; TP2 – 1% biochar; TP3 – 2% biochar).

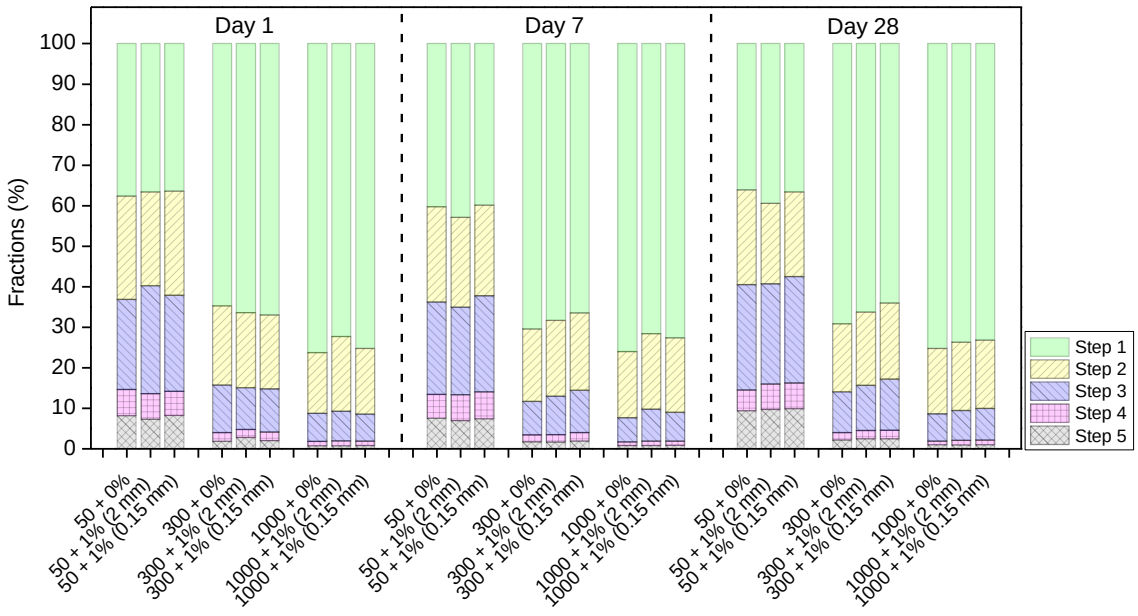

Figure 2. Fractions of lead in the clay soil from each step of sequential extraction. The horizontal axis indicates the contamination level (mg/kg) + the dosage of biochar treatment (0% or 1% in w/w).