Use of biochars for the sorption of poly- and perfluorinated alkyl substances (PFAS) and heavy metals from contaminated soils

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INTRODUCTION

PFAS contaminated Soil

Shooting Range Soil

✓ PFAS used in aqueous film-forming foams, polymer additives, paper coatings, etc. Hydrophobic, oleophobic and resistance to chemical, biological and physical degradation processes
✓ Shooting range soils → heavy metal contamination
✓ PFAS and heavy metal → mobile and persistent in the environment.

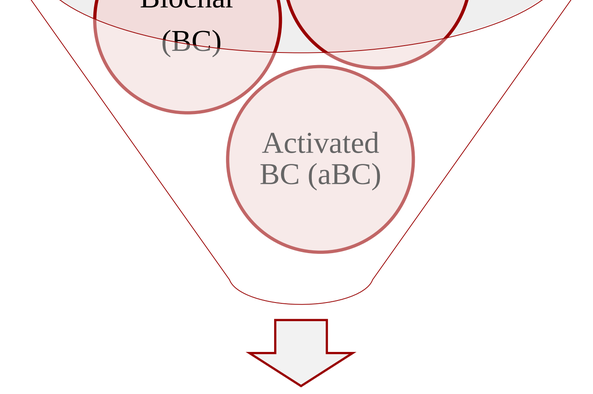
Biochar
✓ High sorption for metals and organic contaminants
✓ Possibility of functionalization
✓ Sustainable and cost-effective sorbent

OBJECTIVES

✓ Cost-effective sorbent for contaminated soil treatment
✓ BC production from wood chips waste

MATERIALS AND METHODS

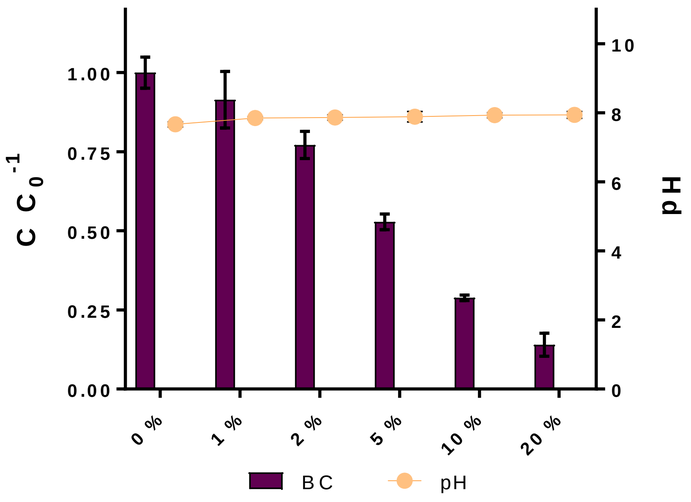
Sorption batch tests



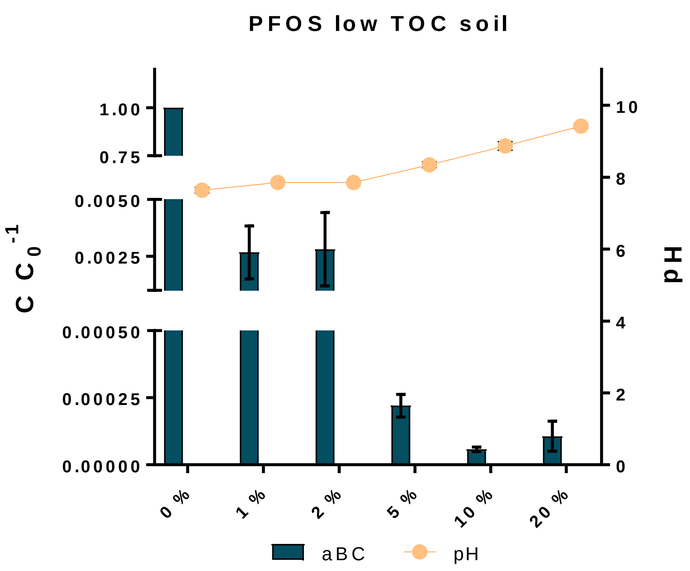
high and low TOC soils

RESULTS AND DISCUSSIONS

PFOS low TOC soil



PFOS low TOC soil



✓ TOC soil 1.6 %;
✓ PFOS leachate 242 ± 16 µg L^{-1};
✓ PFOS 3400 µg kg^{-1}

PFAS soil:

BC:

✓ 86 % PFOS removal from the leachate (20% BC);
✓ Freundlich model: log K_{Fr} 4.6 (ng kg^{-1}) (ng $L^{-1})^{-n}$;
✓ Dose effect

aBC:

✓ PFOS removal in the leachate > 99% (1% aBC);
✓ Freundlich model: log K_{Fr} 6.5 (ng kg^{-1}) (ng $L^{-1})^{-n}$;
✓ Dose effect

Shooting range soil:

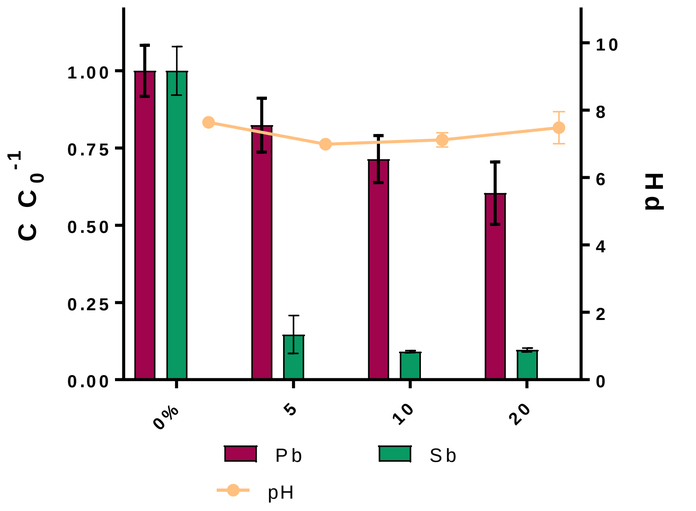
BC:

✓ 40 % Pb removal from the leachate (20% BC);
✓ 90 % Sb removal from the leachate (20% BC);
✓ Dose effect for Pb;
✓ No dose effect for Sb.

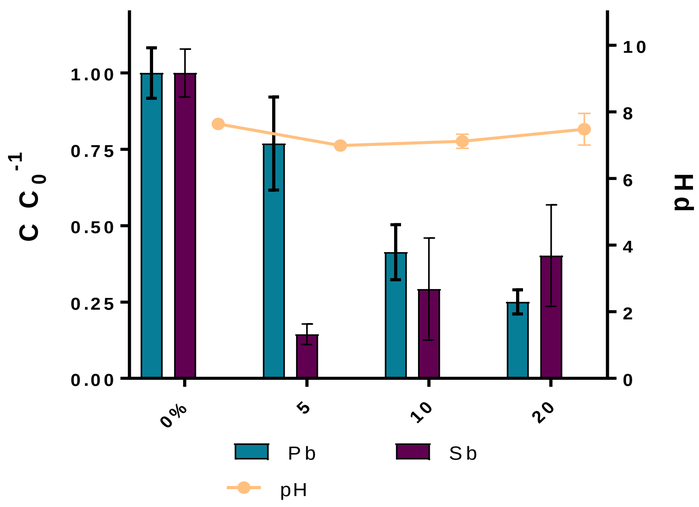
Fe-BC:

✓ 75 % Pb removal from the leachate (20% Fe-BC);
✓ 86 % Sb removal from the leachate (5% Fe-BC);
✓ Dose effect for Pb;
✓ No dose effect for Sb.

BC high TOC soil



Fe-BC high TOC soil



✓ TOC soil 10.2 %;
✓ Pb leachate 243 ± 30.6 µg L^{-1}, Sb leachate 307 ± 5.8 µg L^{-1};
✓ Pb 6600 mg kg^{-1}, Sb 210 mg kg^{-1}

CONCLUSIONS

PFAS soil

✓ BC made from wood waste and aBC can be used as cost-effective sorbents for PFAS;
✓ Activation of the BC increases sorption strenght.

Shooting Range Soil

✓ BC and Fe-BC can be used as cost-effective sorbent for heavy metals in soil
✓ Soil TOC% affect the sorption depending on the contaminants;
✓ Fe enrichment of the BC increases sorption strenght.

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