Investigating heavy metal behavior and microbe response to different types of gasified biochars in historically contaminated soil

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Abstract

Application of biochar for soil remediation has received extensive consensus within the scientific community in laboratory scale in the last decade. To upgrade biochar application, efforts to identify a sustainable production route with steady supply of biochar should be initiated in the next stage. Since development in advanced pyrolysis technology, the gasification process can convert bio-waste into clean energy (syngas & bio-oil), and provide guarantee of biochar supply as well. Compared to conventional biochar, gasified biochar (GBC) reveals difference in composition and surface functionality due to different heating programs. Objective of this study was to evaluate impact of GBCs on heavy metal immobilization and their influence on microbial activity by incorporation of biochars into contaminated soil. In doing so, we have (1) characterized different kinds of gasified biochars in qualitative and quantitative views via a series of spectroscopic analysis, (2) assessed the efficacy of GBC to mediate concentration of cadmium (Cd) and zinc (Zn) in amended soil with a 21 days incubation using CaCl\textsubscript{2} extraction method, (3) investigated pH-dependent release of heavy metals from GBC treated soil, (4) explored GBC-induced changes in terms of soil microbial activity and diversity as well as dissolved organic matter (DOM) other than chemical and physical changes of soil. Results demonstrated that addition of GBC amendments could increase soil pH because presence of base cations in GBC matrix and simultaneously elevated soil EC, but did not exceed the saline limit. GBC application reduced concentration of CaCl\textsubscript{2}-extractable forms of Cd and Zn in varying degrees. Promotions in soil microbial abundance and diversity were detected in GBC treated specimens.

Keywords: soil remediation, gasified biochar, metal immobilization, soil microbe, DOM
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