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The use of zero-valent Fe for curbing toxic emissions after EDTA-based washing of Pb, Zn and Cd contaminated calcareous and acidic soil

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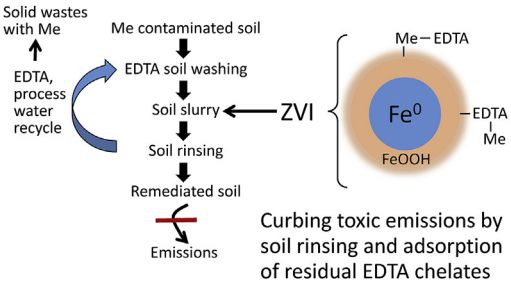
HIGHLIGHTS

- EDTA efficiently removed toxic metals from acidic and calcareous soil.
- Efficient soil rinsing of EDTA washed soil was essential in emission curbing.
- ZVI addition prevented post-remedial surge of EDTA and toxic metals emission.
- Toxic emissions from remediated soils were mitigated abiotically, by adsorption.
- Slow EDTA biodegradability was not an issue in curbing toxic emissions.

GRAPHICAL ABSTRACT



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ABSTRACT

The use of EDTA-based soil washing is prevented by chelant environmental persistence and the hazard of toxic post-remedial emissions. Calcareous and acidic soils with 828 and 673 mg Pb kg^{-1}, respectively, and co-contaminated with Zn and Cd, were washed with 90 and 60 mM EDTA, respectively, to remove 67 and 80% of Pb. Washed soils were rinsed until 6.5 and 5.1 mM EDTA, respectively, was measured in the final rinsing solutions. Emissions of residual EDTA and chelated metals from remediated soils were mitigated by adsorption on zero-valent Fe (ZVI), which was added (0.5–1.5%, w/w) to the slurry of washed soil immediately before rinsing. ZVI addition prevented the initial post-remedial surge of toxic metals leachability and minimised toxic emissions from calcareous and acidic soil as soon as 6 and 7 days after remediation, respectively. The extractability/leachability of EDTA and toxic metals from remediated and ZVI amended soils diminished to close to emissions from the original soils, frequently below the limit of quantification by flame-AAS, and was not affected by the pH of the leaching solutions. Efficient curbing of toxic post-remediation emissions as demonstrated herein is of paramount importance for recognition of EDTA-based remediation as environmentally safe.

1. Introduction

Fertile soil is a valuable, limited resource, but often contaminated with a number of toxic metals, with Pb representing the most pervasive and persistent risk to human health (Cai et al., 2016). Any exposure to Pb, the main soil contaminant in this study, is

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