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Immobilizing Pb in soil polluted with Pb batteries effluents: Confirmation at biological and chemical scales

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Abstract

Untreated effluents from Pb battery repair workshops pollute the soil when released. Resultantly, higher concentrations of Pb in the surrounding soils are observed in several areas of Punjab, Pakistan. Fortunately, cement containing phosphate (PC) can efficiently immobilize Pb in soil and reduce ecological and human health issues linked with Pb. In this experiment, we collected Pb battery polluted soil having Pb concentrations of 711 mg kg⁻¹ and amended with six doses of PC, i.e. 0, 0.5, 1, 1.5, 2, and 2.5% of soil. The soil was initially incubated for 50 days and later used for plant experiment, earthworm incubation, and chemical scales for a further 50 days. Pb fixation in soil was measured by different scales, i.e., chemical scales [Ca(NO₃)₂ and diffusive gradient in thin films (DGT)] and biological scales (lettuce plants and earthworms). After the experiment, concentrations of Pb in lettuce roots and shoots and earthworms decreased with increasing PC dose to 2%, while no significant changes were observed for 2 and 2.5% doses. Biomass of both biological entities also followed identical patterns. Moreover, bioavailable Pb in the soil after the experiment, as assessed by Ca(NO₃)₂ and DGT, significantly decreased by raising the PC dose to 2%, and there was no change thereafter. Correlations between Pb concentrations in biological entities and chemical scales were > 0.96, depicting the efficacy of PC for remediating Pb-polluted soils. Phosphate in PC reacted with Pb to form a stable Pb-phosphate compound, leading to Pb fixation in soil. A 2% PC dose was more efficient and economical than 2.5% for ecological restoration.

Key Words: *Effluents, Workshops, Cement, Biomass, Correlation, Efficient*

