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Fractionation and Mobility of Toxic Trace Metals in Soils from E-Waste Processing Sites**Fernando, N.M.¹, Reinurshan Kanagaratnam², Rajapaksha, R.M.A.U.^{2,3*},
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Copenhagen, Denmark***anurajapaksha@sjp.ac.lk***Abstract**

The improper processing of E-waste for metal extraction leads to the accumulation of toxic metals in soil, posing long-term environmental and human health risks. The mobilization of toxic metals in soil depends on their binding nature in different geochemical fractions. This study investigates the geochemical fractionation and leaching behavior of Cadmium (Cd), Lead (Pb), and Chromium (Cr) in soils collected from four E-waste processing sites and one uncontaminated control site in Sri Lanka. A sequential extraction procedure that fractionates metals into eight fractions: F1: soluble + exchangeable, F2: easily mobilizable, F3: bound to Mn oxides, F4: bound to soil organic matter, F5: sulfide fraction, F6: occluded into amorphous Fe oxides, F7: occluded into crystalline Fe oxides, F8: residual fractions was used. The potential mobile fraction (PMF) ranged from 0.00%-20.13%, 3.83%-9.50%, and 0.27%-0.63% for Cd, Pb, and Cr, respectively. The mobile fraction was dominant for Pb and Cd, whereas Pb was mainly bound in F3 and F4, and Cr in F8. The leaching potential of toxic trace metals was evaluated using the US-EPA Toxicity Characteristic Leaching Procedure (TCLP). The leaching potential of toxic metal concentrations ranged from 1.56±0.15-30.15±6.93 mg/kg for Cd, 6.31±3.69-47.57±16.56 mg/kg for Pb, exceeding regulatory limits, whereas 0.01±0.00-0.46±0.07 mg/kg for Cr remained below the TCLP standards. Pearson correlation analysis revealed a significant positive correlation between TCLP extractable Cd and its mobile fraction ($r=0.833$, $p=0.001$), indicating its risk of leachability. In contrast, Cr showed a moderate, however, non-significant correlation ($r=0.539$, $p=0.348$), while Pb exhibited a negative correlation ($r=-0.450$, $p=0.447$), suggesting limited leachability due to strong binding with stable soil fractions. The results showed that the percentage of recovery ranged on average between 62% and 101% for Cd, 59% and 106% for Cr, and between 71% and 121% for Pb. The results highlight that the release of toxic metals from E-waste contaminated soil is a serious concern due to their potential for mobilization and environmental risk. Therefore, promoting safe E-waste processing practices is essential to safeguarding environmental and public health. Future studies should evaluate the potential of immobilizing these metals using biochar composites to mitigate long-term environmental risks.

Keywords: *E-waste, Geochemical fractions, Leachability, Metal mobility***Acknowledgement:** Financial assistance by the Research council of University of Sri Jayewardenepura