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Mobilisation of Contaminant Metals from Municipal Solid Waste Incinerator Bottom Ash: The Potential Use of Organic Lixiviants from Metal Removal and Recovery

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Increasing municipal solid waste (MSW) production poses challenges for sustainable urban development. Incineration of MSW at modern energy from waste (EfW) facilities reduces its mass and volume, removes biodegradable materials, and recovers energy. In the UK, MSW incineration bottom ash (MSW IBA) is primarily reused in civil engineering applications. This study determined the pH-dependent leaching behaviour of contaminant metals in MSW-IBA, and whether these metals can be mobilized by environmental lixiviants.

MSW-IBA consists primarily of primary glass, a melt phase and fine ash aggregations. Its chemical composition is dominated by SiO_2 (30-50%), CaO (~15%), Fe_2O_3 (~10%), and Al_2O_3 (~8%). The contaminant metals with the highest concentrations are Zn and Cu. XANES analysis has shown that Zn and Cu are mainly oxygen-bound (adsorbed to oxy-hydroxides and as oxides) with some bound to sulphur. MSW-IBA equilibrates with deionised water at pH 11.3 and has a very high acid buffering capacity. In leaching tests with mineral acids, contaminant metals were only mobilised to solution when the pH was 6 or lower and concentrations were low until pH 4 or lower, requiring significant acid inputs to reach these pH values. Leaching with synthetic plant exudate solutions mobilised contaminant metals to solution at alkaline pH values, but aqueous concentrations were very low unless exudate concentrations that are unrealistically high for a natural system (≥ 1500 mg DOC per l) were used. We are currently evaluating whether environmental lixiviants can be used to create a “mobilise, transport, trap” system for removing contaminated metals from MSW-IBA.