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Laboratory to Field Relationship and Recommendations for Leaching Assessment

David S. Kosson[1] and Hans A. van der Sloot[2]

[1] Vanderbilt University, Nashville, Tennessee, USA
Email: david.kosson@vanderbilt.edu

[2] Hans van der Slot Consultancy, Langedijk, The Netherlands
Email: hans@vanderslootconsultancy.nl

Abstract

A forthcoming USEPA report examines the relationships between the results of laboratory leaching tests, as defined by the Leaching Environmental Assessment Framework (LEAF) or analogous international test methods, and leaching of constituents from a broad range of materials under disposal and beneficial use scenarios. Chemical speciation modeling is used as an additional tool to aid interpretation of leaching data.

Ten example field evaluation cases of either disposal or beneficial use that contain a combination of laboratory testing and field analysis were examined. The seven material types tested in these ten cases include: (i) coal fly ash, (ii) fixated scrubber sludge (a combination of coal fly ash with acid gas scrubber residue and lime), (iii) municipal solid waste incinerator bottom ash, (iv) a predominantly inorganic waste mixture comprised of residues from soil cleanup, contaminated soil, sediments, construction and demolition waste and small industry waste, (v) municipal solid waste, (vi) cement-stabilized municipal solid waste incinerator fly ash, and (vii) portland cement mortars and concrete. The field data evaluated include leachate from field lysimeters, porewater from landfill or use applications, eluates from leaching tests conducted on sample cores taken from field sites, and leachate collected from landfills. Principal uncertainties for field data in many cases include the extent of preferential flow or dilution that may have occurred in sampling of landfill leachate, and the exact exposure and aging conditions that contribute to the field data.

The LEAF laboratory leaching tests in the above comparisons are shown to be effective for estimating the field leaching behavior for a wide range of materials under both disposal and use conditions. However, interpretation of laboratory leaching test results to the field must be conducted within the context of the controlling physical and chemical mechanisms of the field scenario (e.g., pH, redox conditions, L/S, mode of water contact). The effects of field conditions that are beyond the physical-chemical domain of the laboratory test conditions can be evaluated through a combination of both direct calculations to extrapolate laboratory results as a screening basis, and using chemical speciation and reactive mass transport simulations that are calibrated based on LEAF testing results to provide more extensive sensitivity analysis. Both direct laboratory testing results and outcomes from chemical speciation and reactive mass transport simulations can be used provide a source term for subsequent fate and transport and risk assessment evaluations.