Why is Coal Ash of Concern and how to assess potential impacts?

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Thorneloe S., Kosson D., Sanchez, F., Garrabrants A., Helms G., Evaluating the Fate of Metals in Air Pollution Control Residues from Coal-Fired Power Plants. ES&T, 201- 44, 7351 -7356.,

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Changes at Coal-Fired Power Plants

- U.S. power plants are adopting new air pollution controls in response to past and future Clean Air Act regulations.
- Changes in air pollution control result in pollutants in flue gas being transferred to coal combustion residues (CCRs).
- Air pollution control can result in concentrating pollutants such as Hg, Cr, As, Se, and B in the CCRs.
- Historically fly ash and other CCRs were used in engineering and construction industries.
- In 2012, 47% (52 million tons) of fly ash and other CCRs were utilized in engineering, construction, and commercial sectors.
- In 2014, EPA announced support for beneficial use (BU) of fly ash as input to cementitious materials and BU of flue-gas desulfurization gypsum in wallboard. A report is available that details the assessment of these two high-volume encapsulated uses.

~53% (or 58 million tons) of ash and other CCRs are land disposed.

This is an example of wet handling of coal ash.

How to determine potential environmental impact?

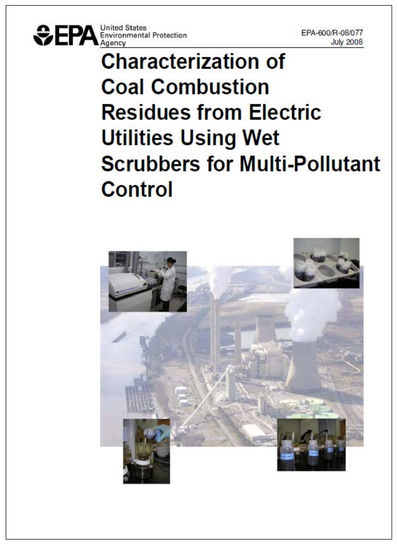
- The Leaching Environmental Assessment Framework (LEAF) is a collection of four test methods that determine the potential source term and constituent release rate for a range of materials.
- The LEAF methods take into account management conditions and changes in environmental conditions that affect leaching.
- Groundwater contamination is a key management concern.
- The LEAF methods account for parameters known to affect leaching such as rainfall, pH, and particle size or physical form of the waste.
- Fate and transport modeling is conducted using the LEAF source term to predict environment release including geochemical speciation modeling to determine fate of constituents of potential concern (COPCs)

Use of LEAF To Evaluate Leaching from CCRs

CCRs collected from ~30 Facilities
- Fly Ash – 34
- FGD Gypsum – 20
- Scrubber Sludge – 7
- Fixated Stabilized Sludge – 8

Evaluation conducted using LEAF using Methods 1313 and 1316

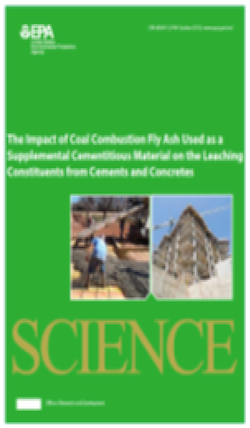
Published in series of 3 EPA report



Evaluation of Cement & Concrete

H. van der Sloot, D.S. Kosson, A. Garrabrants and J. Arnold
(EPA-600/R-12/704, 2012)
- Review of available world-wide data of cement mortars and concrete containing coal fly ash
- 31 mortars and concrete with fly ash, 21 mortars and concretes without fly ash

D.S. Kosson, A. Garrabrants, R. DeLapp, H. van der Sloot
(***Chemosphere***, 2014, 2 papers)
- 2 Concrete formulations x 4 fly ashes with controls, and mortars reflecting commercial usage in US
- Methods 1313 and 1315 used to characterize fly ash, reference materials without fly ash and materials with fly ash



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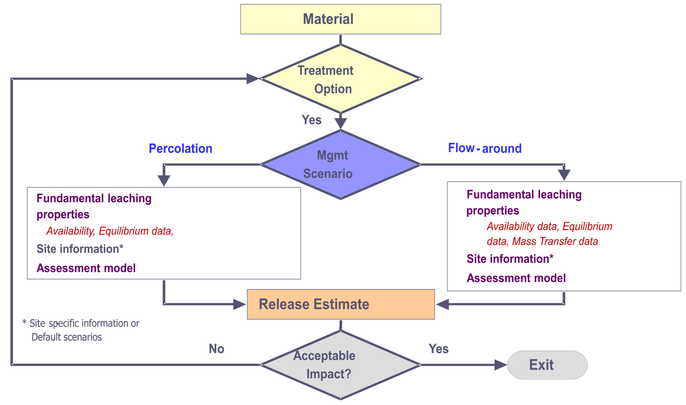
Decision Tree for Assessing Potential Impacts



- Leaching can occur through percolation of flow-around which dictate which LEAF methods to use.
- Guidance is being developed on how LEAF methods are to be used in decision making.
- The goal is to minimize testing, identify materials safe to use for different beneficial use applications, and to ensure no unintended consequences of using coal ash or other CCRs.

Key Concepts

- Leaching rates are dependent on environmental conditions
- Simplified testing after characterization allow for cost effective applications
- Chemical speciation and mass transfer modeling supports evaluation of cases beyond testing conditions
- LEAF is applicable to a wide range of materials, field scenarios and treatment process decisions
- Focus on fundamental leaching properties allows use of a single data set for evaluation of multiple options
- A tiered approach balances the level of information needed and the testing requirements