



## Recycled Materials Resource Center



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## Research Project 53

# Reconstruction of Railroads and Highways with In-situ Reclamation Materials

### Project Objectives

- Recognize sustainable construction of highways and railroads for increasing freight capacity of the transportation systems in the US.

- pH-dependent leaching tests were conducted to investigate the leaching behavior of soil fly ash mixtures used in roadway construction.

### Project Summary

This research project consists of two theses written by students at the University of Wisconsin-Madison. The reports are titled, “Leaching of Trace Elements From Roadway Materials Stabilized With Fly Ash” written by Jonathan O’Donnell and “Leaching From Soil Stabilized With Fly Ash: Behavior and Mechanisms” written by Kanokwan Komonweeraket.

In O’Donnell’s report, analysis was performed on five field sites with stabilized materials and three sites with control materials used as base course or subgrade were constructed with pan lysimeters to collect leachate discharging from the bottom of the roadway layers. Pore volumes of flow from the layers was calculated from the volume of leachate collected, pH and Eh of the leachate was measured, and samples were collected for chemical analysis. Laboratory column leach tests (CLTs) and water leach tests (WLTs) were also conducted. The type, concentration, and pattern of elemental leaching from field and laboratory specimens were determined, and

concentrations were compared to those from control materials and relevant groundwater maximum contaminant levels (MCLs).

In Komonweeraket’s report, leachate analysis of soils used in roadway construction was conducted. The soils included organic clay, silt, clay, and sand. The fly ashes included Class C and off-specification high-carbon fly ashes. Modeling results from MINTEQA2 indicated that release of the elements, except As and Se are solubility-controlled. For a given element, the solubility-controlling solids were found to be very consistent. Oxide and hydroxide minerals control leaching of Al, Fe, Cr, and Zn, whereas carbonate minerals control leaching of Mg and Cd. Leaching of Cu is controlled by oxide and/or carbonate minerals. Both carbonate and sulfate minerals are controlling solids for Ca, Ba, and Sr depending on pH of the leachate. The difference and inconsistency between the release behavior for As and Se and the other elements are probably due to different controlling mechanisms, such as sorption, or solid-solution formation.

### Project Partners

National Center for Freight and Infrastructure Research and Education, Coal Combustion Products Partnership

### End Products

Elements that exceeded MCLs in field leachate from stabilized materials were As, B, Cd, Cr, Mo, Ni, Pb, Sb, Se, Tl, and V.

Despite different types and composition of soil and fly ash investigated, the study reveals the similarity in leaching behavior as a function of pH for a given element from soil, fly ash, and soil-fly ash mixtures. The similarity is most likely due to similar controlling mechanisms.

### Further Information

The Recycled Materials Resource Center (RMRC) is a national center that promotes the appropriate use of recycled materials in the highway environment. It focuses on the long-term performance and environmental implications of using recycled materials