RMRC

Recycled Materials Resource Center

Research Project 52

Evaluation of the Environmental Performance of CCPS in Roadway Applications

Project Objectives

- Evaluation of the leaching of trace elements from roadway materials physically stabilized with fly ash from coal combustion.
- 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

Project Principle Investigators
Craig Benson, Ph.D.
Tel: (608) 263-9490
Email: chbenson@wisc.edu
Tuncer Edil, Ph.D.
Tel: (608) 262-3225
Email: tbedil@wisc.edu
Department of Civil Engineering
University of Wisconsin-Madison
Madison, WI 53706

RMRC
University of Wisconsin-Madison
Engineering Centers Building
1550 Engineering Drive
Madison, WI 53706
Tel: (608) 890-4966
Email: angela.pakes@wisc.edu
http://www.rmrc.wisc.edu