Recycled Materials Resource Center

University of New Hampshire

Federal Highway Administration

Research Project 29

Leaching from Granular Waste Materials Used in Highway Infrastructures During Infiltration Coupled with Freezing and Thawing

Project Objectives

- Determine the effect of material moisture content at the time of freezing on constituent release during percolation flow controlled scenarios and on material integrity (i.e., change in particle size distribution).
- Examine the effect of the number of freeze/thaw cycles on constituent release during percolation flow controlled scenarios and on material integrity.
- Examine the interaction between material integrity and environmental performance.
- Determine the critical parameters that impact flow mechanisms and control mass transfer of constituents to the environment during wetting coupled with freezing and thawing.
- Develop guidelines for simplified test methods and accelerated aging procedures that can be used by end-users to assess the potential impact of freezing and thawing processes on constituent leaching during percolation flow controlled scenarios.

Project Description

The work of RMRC Project 11 focused on the role of intermittent wetting and geochemical aging in leaching behavior of recycled materials. This new project expands on that work by considering the physical degradation of recycled materials due to freeze/thaw (F/T) processes and how that may change the leaching behavior. The durability of aggregate materials, or their resistance to the forces of weathering, is one of the most important considerations in the selection of a material for highway construction. One of the primary exposures of concern is alternate freezing and thawing. During the design life of the construction application, materials are exposed to freezing and thawing coupled with intermittent infiltration/wetting as a consequence of precipitation events so the leaching of material constituents is a primary pathway for environmental impact. The effect of freezing and thawing processes may be significant enough to impact the environmental acceptability of a proposed application. Therefore, there is a need for test methods and aging procedures that can be used by design engineers and regulators for evaluating granular waste material leaching performance relative to exposure to freezing and thawing.

One of the 250 mm long columns used for the leaching experiments.

The first material used in this work was laboratory formulated concrete (LFC), created by mixing metal oxides (arsenic, cadmium, copper, lead, and zinc) with cement, sand, and water. The formula used was as follows: 36 wt% ordinary Portland cement, 49.1% sand, 12.7% water, 0.29% sodium chloride, and approximately 0.3 wt% each of arsenic, cadmium, copper, lead, and zinc cations. The material was prepared as blocks, then crushed to less than 9.5 mm. Initial material characterization and preliminary freeze/thaw (F/T) testing have been completed. The initial material characterization included particle size distribution, material initial moisture content and moisture content at optimum packing density, material buffering capacity, and constituent solubility and release as a function of pH and liquid to solid (LS) ratio. The level of F/T (i.e., temperature, duration and number of cycles) to be used has been determined based on preliminary testing and information from the literature. Column leaching experiments on new LFC and LFC that has been aged by freeze/thaw cycles has been initated.

Project Partners

Tennessee DOT

End Products

Guidelines for simplified test methods and aging procedures that can be used by end-users to assess the potential impact of freezing and thawing processes on constituent leaching during percolation flow controlled scenarios

Further Information

The Recycled Materials Resource Center (RMRC), a cooperative agreement between the University of New Hampshire and the Federal Highway Administration, is a national center that promotes the appropriate use of recycled materials in the highway environment. Its focus is on the long-term performance and environmental implications of using recycled materials.

For detailed quarterly progress reports for Project 29, as well as all RMRC-funded research projects, please see: http://www.rmrc.unh.edu/Research/researchlevel2.asp.

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