Recycled Materials Resource Center

University of New Hampshire

Federal Highway Administration

COMPLETE!

Research Project 7/8

Development of a Risk Analysis Framework for Beneficial Use of Secondary Materials

The final report for Project 7/8 is available on-line at:

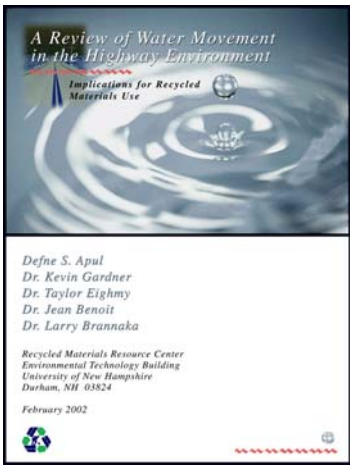
http://www.rmrc.unh.edu/Research/Rprojects/Project7/P7finalreport.asp

Project Objectives

- To identify state-of-the-art practices in Europe, the state agencies, and U.S. EPA for beneficial use determinations or related scenarios.
- To identify needs and use of applicable approaches.
- To synthesize and develop an appropriate mechanistic source term/fate/transport model that can be verified.
- To provide state agencies with a simplified model or approach that embodies the principles of the source term/fate/transport model. This model will be used first for looking at inorganic contaminants and may be modified later for organic contaminants.

Project Progress

The overall goal of this research project was to further the understanding of the leaching and transport of contaminants from pavement materials and to provide a tool for regulators to evaluate potential groundwater contamination from the use of virgin and secondary materials in road construction. To this end, a new probabilistic framework was introduced which provides structured guidance for selecting the appropriate model; incorporating uncertainty, variability, and expert opinion; and interpreting results for decision making. In addition to the framework, specific contributions were made in pavement, embankment hydrology, reactive transport, Bayesian statistics, and the aqueous geochemistry of leaching under local equilibrium conditions.



Contributions on water movement and reactive transport in highways included probabilistic prediction of leaching in an embankment and scenario analyses of leaching and transport in pavements using HYDRUS2D, a contaminant fate and transport model. Water flow in a Minnesota highway embank-ment was replicated by Bayesian calibration of hydro-logical parameters against water content data. Simulation results from hypothetical leaching of Cd from coal fly ash in the embankment were compared to a simpler model and field measurements. Two-dimensional model simulations of a pavement cross section showed that, in an intact pavement, advection is the dominant transport mechanism near the edge while diffusion dominates closer to the centerline. Scenario simulations also showed that salts in the base layer of pavements are depleted within the first year, whereas the metals may never reach the groundwater if the pavement is built on adsorbing soils.

Contributions to the understanding of the aqueous geochemistry of leaching included a new modeling approach for leaching of anions and cations from complex matrices such as weathered steel slag. The novelty of the method was the simultaneous inclusion of sorption and solubility controls for multiple analytes. The developed model showed that leaching of SO_4, Cr, As, Si, Ca, Mg, and V were controlled by corres-ponding soluble solids. Leaching of Pb was controlled by $Pb(VO_4)_3$ solubility at low pHs and by surface precipitation reactions at high pHs. Leaching of Cd and Zn were controlled by surface complexation and surface precipitation, respectively.

Project Partners

Minnesota DOT (Mn/ROAD), New York State Dept. of Environmental Conservation, Laboratoire Centrale des Ponts et Chausees (LCPC)

End Products

A modeling approach that will allow decision makers to determine what down-gradient impacts to receptors might be for a variety of recycled materials and applications. Second, general guidance about appropriate and inappropriate uses of various recycled materials in various applications based on use of the model. These products will be used by the U.S. EPA, FHWA, State EPAs, and State DOT Environmental division personnel.

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.

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