Research Project 51

Assessment of U.S. EPA's IWEM Model

Recycled Materials Resource Center

University of New Hampshire

Federal Highway Administration

University of Wisconsin Madison

Project Objectives

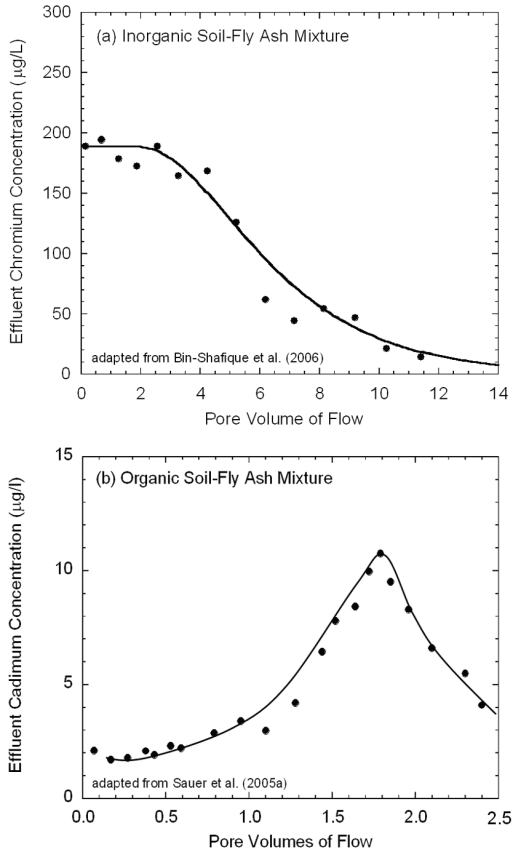
The objective of this project is to evaluate the roadway module of the Industrial Waste Management Evaluation Model (IWEM) version2 (beta) and to compare predictions made with IWEM to predictions obtained with WiscLEACH.

Research Progress

This module was developed for assessing the potential for groundwater impacts caused by leaching from industrial material resources (IMRs) used as pavement materials in roadway construction. A roadway is idealized as a series of "roadway-source columns" that include materials from the top of the subgrade to the ground surface and represent the paved section, the road shoulder, or a ditch. The vadose and saturated zones are below the source columns. Each roadway-source column is treated as a three-dimensional linear strip simulating a portion of the roadway. Flow and transport are simulated within each strip and in the underlying unsaturated and saturated zones. Concentrations contributed by each of the strips are aggregated to determine total impact by the system. Monte Carlo simulation is used to estimate 90th percentile concentrations at a receptor.

Comparison with field data showed that 90th percentile concentrations predicted by IWEM at a monitoring well adjacent to a highway test section constructed with IMRs were higher than measured concentrations, which suggests that the prediction by IWEM is conservative. Parametric analysis showed that concentrations at an adjacent monitoring well decrease as the depth to groundwater increases and the initial leachate concentration decreases. Similar tendencies have been reported by others using physically based models. However, predicted concentrations were insensitive to the thickness of the IMR layer, the initial total concentration, or the exposure duration (at least for 5 yr). The insensitivity to layer thickness and exposure duration may be related to unrealistic assumptions used to describe the source within the pavement profile. Parametric analysis also showed that concentrations predicted by IWEM are relatively insensitive to the aquifer hydraulic conductivity for the case that was studied, but very sensitive to the aquifer thickness. Insensitivity to the aquifer hydraulic conductivity was unanticipated. Sensitivity to aquifer thickness occurs because concentrations in groundwater typically diminish with depth, and IWEM reports a depth-averaged concentration.

Comparison of predictions from IWEM and WiscLEACH showed that WiscLEACH generally predicts higher concentrations because peak concentrations are realized over longer time frames than the 5-yr exposure period available in IWEM. The depth-averaging used in IWEM also contributes to a lower concentration than the peak concentration reported by WiscLEACH.



Examples of first-flush (a) and lagged response (b) leaching patterns. The smooth lines in (a) correspond to predictions made with the advection-dispersion-reaction equation with linear, instantaneous, and reversible sorption.

Partners & End Products

This project provides an asssement of a model US EPA is proposing for evaluation of the environmental impacts associated with using industrial material resources (IMRs) in highway applications. The findings from this assessment help define the advantages and limitations of the model.

Further Information

The Recycled Materials Resource Center (RMRC), a cooperative agreement among the University of New Hampshire, the University of Wisconsin-Madison, and the Federal Highway Administration, is a national center that serves as a research and outreach facility for the highway community and is a catalyst for the beneficial use of recycled materials. For more information about this and all RMRC-funded research projects, please visit www.recycledmaterials.org/research.

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