

# RMRC



## Recycled Materials Resource Center



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## Research Project 77

# Assessing Groundwater Impacts from Coal Combustion Products Used in Highways

### Project Objectives

- Development of a model that can be used to assess potential groundwater impacts caused by leaching from CCP's
- To validate the model using laboratory tests and field data collected from highway test sections constructed with CCPs

### Project Summary

Over 120 million Mg of coal combustion products (CCPs) are produced each year by coal-burning electric utilities in the US. CCPs include fly ash, bottom ash, boiler slag, FGD material, and scrubber residues. In 2003, fly ash constituted 60% of the total mass of CCPs produced in the US, and bottom ash constituted 20%. Approximately 38% of CCPs are re-used in various applications. The rest is sent to landfills and impoundments.

There is considerable interest in finding uses for CCPs. In fact, federal and state legislation is encouraging, or even mandating the reuse of byproducts. Many of the CCPs that are being disposed have desirable properties, and finding methods to use them is consistent with sustainable construction and development. Highways are of interest, because highway construction has potential for large volume use of CCPs. For example, fly ash can be used in concrete pavement, for stabilization of base course and subgrades, and for structural fill and embankments. Bottom ash can be used in structural fills, embankments, road base, and subbase. Using CCPs in highway construction can reduce CCP disposal costs and reduce the need for natural resources use in construction.

This report describes a computer application that was developed to assess impacts to groundwater caused by leaching of trace elements from CCPs used in highway construction. Laboratory and field experiments conducted to verify the application are also described. The application, referred to as WiscLEACH, is based on three analytical solutions to the advection-dispersion-reaction equation that describe transport in the vadose zone and groundwater. The application was designed to be computationally efficient and can be used without experience in numerical modeling.

WiscLEACH was calibrated using predictions from HYDRUS-2D, a widely used and carefully verified numerical model for simulating flow and transport in variably saturated media. Identical simulations were conducted with both models, and the disparities in WiscLEACH were adjusted until similar distributions of concentration were predicted. Field and laboratory experiments were also conducted on CCPs to provide data for verifying WiscLEACH. Comparison of measured concentrations of trace elements with those predicted by WiscLEACH indicate that the application over predicts concentrations slightly, which is a conservative error.

### Project Partners

Recycling Demonstration Grant Program, Wisconsin Department of Natural Resources, Aliant Energy Inc.

### End Results

Predictions made with WiscLEACH indicate that maximum groundwater concentrations of trace elements leached from CCPs typically occur close to the groundwater table and near the centerline of the pavement structure. Peak groundwater concentrations decrease as the depth to groundwater increases, the thickness of the byproducts layer decreases, the seepage velocity in the vadose zone decreases, or the seepage velocity in groundwater increases.

### 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