EPRI
Electric Power
Research Institute

Topics:
Groundwater
Water quality
Dispersions
Solid wastes
Leachate migration

EPRI EA-4229
Project 2280-2
Final Report
September 1985

Feasibility of Physical Hydraulic Modeling of Groundwater Pollutant Transport

Prepared by
Clemson University
Clemson, South Carolina

REPORT SUMMARY

SUBJECTS: Solid-waste studies / Solid by-product disposal/reuse / Water quality/aquatic resources / Water quality control

TOPICS: Groundwater; Water quality; Dispersions; Solid wastes; Leachate migration

AUDIENCE: Environmental and R&D scientists and engineers

Feasibility of Physical Hydraulic Modeling of Groundwater Pollutant Transport

Although physical modeling for groundwater hydraulics has received very little attention, it may offer a cost-effective method for obtaining values for transport parameters. Preliminary hydraulic performance and pollution-dispersion test results of a model aquifer made from cement mortar compared well to theoretical values.

BACKGROUND

Land disposal of solid wastes can lead to groundwater pollution through the release and migration of solutes. Because these movements are not fully understood in the field, scientists cannot make valid, reliable, or long-term predictions about groundwater effects. EPRI initiated the solid-waste environmental studies project (RP2485) to improve methods for predicting the fate of constituents in the subsurface environment. As part of this effort, researchers examined the feasibility of constructing a laboratory-scale-model aquifer for groundwater transport investigations.

OBJECTIVES

To establish the feasibility of and develop cost-effective methods for physical modeling of groundwater flows.

APPROACH

After reviewing the literature on physical hydraulic modeling, researchers focused on defining the advantages and disadvantages of various materials for construction simplicity and aquifer performance. Following this evaluation, they selected cement mortar for this research and tested mixes of mortar material for permeability range. The research team then constructed several prototype aquifer models to simulate specific yield and dispersion phenomena. Only one-dimensional tests were performed in this research.

RESULTS

Laboratory test results verified the performance of cement mortar as a model aquifer material. By varying the mortar compaction during aquifer preparation, one can construct a laboratory-scale model to simulate different geohydrological formations. It appeared that the physical model's hydraulic conductivity decreased with time when it exceeded 5 m/d.

EPRI PERSPECTIVE

This study provided a cost-effective physical method for simulating simple aquifers in the laboratory. The initial results are quite promising. However, natural aquifer systems are quite complex and include chemical

characteristics. Therefore, at this stage of the research we can rely on this approach to be effective only for relatively simple groundwater systems. This work is valuable to continuing research under EPRI project RP2485. Other relevant EPRI reports are EA-3417, EA-3356, EA-4082, EA-4118, and CS-3901.

PROJECT RP2280-2
EPRI Project Manager: Ishwar P. Murarka
Energy Analysis and Environment Division
Contractor: Clemson University

ABSTRACT

A number of laboratory tests were performed to examine the feasibility of developing a simple and cost-effective technique for physical hydraulic modeling of groundwater pollutant transport. Instead of using conventional sand-tank models, rigid cement/mortar was considered for the model aquifer. Unsieved field sand of uniformity coefficient 2.5 was used for model aquifers and cylinder specimens. Initial tests on cylindrical specimens of mortar proved its potential usefulness as an aquifer material. Control over different geohydrological parameters was achieved by controlling mortar proportions and initial compaction. Using simple flow situations, hydraulic performance and pollution dispersion phenomena were tested and results compared well with theoretical values.