DEPARTMENT OF MECHANICAL ENGINEERING
Purdue School of Engineering and Technology

FALL 2002 SEMINAR SERIES

Date: Thursday, October 31, 2002
Time: 11:00 - 12:00 pm
Room: SL 165

Reception at 10:45 am (cookies and coffee served)
Everyone is invited

Stochastic Finite Element Analysis of Transient Unsaturated Flow and Contaminant Transport in Porous Media

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A stochastic perturbation-based formulation for transient unsaturated flow and contaminant transport in porous media was developed and implemented. The stochastic model is expressed in a form of partial differential equations that predicts the large-scale flow and transport characteristics. The proposed methodology provides an efficient way to incorporate the small-scale variability of media properties into large-scale models using effective parameters. A finite element solution of the stochastic differential equations for flow and transport was formulated. The advantage of the proposed approach is that only few media parameters are required to describe the variability of its stochastic properties. In addition, the proposed approach is not site-specific. Several example problems and scenarios were simulated and the mean flow and concentration values and their variances were evaluated. The stochastic results were compared to deterministic and experimental results. The stochastic perturbation-based formulation predicted the velocity of propagation of the wetting front very close to experimental measurements whereas the deterministic approach predicted a much higher one. In addition, the stochastic approach predicted the velocity of spreading of the contaminant much closer to the experimental measurements, as compared to the deterministic approach. The stochastic perturbation-based finite element formulation is a very attractive alternative to deterministic approaches in terms of cost, efficiency, and accuracy of the results.