FEM Analysis of Contaminant Transport in a Loamy Desert Soil

Basavaraju N Agasanapura*, Carl Nesbitt, and Mano Misra

Chemical and Metallurgical Engineering, University of Nevada, Reno
Nevada 89557, USA

Abstract

In the present work, transport and adsorption of contaminants (lead, cesium) on loamy desert soil was modeled using the Finite Element Method (FEM). The Advective dispersion reaction mechanism was employed to describe the contaminant transport in soil medium. A partial differential equation (PDE) obtained from unsteady mass balance was developed using convective diffusion, solute adsorption, and dispersion terms. Initial batch adsorption experiments revealed that the system follows a Langmuir adsorption isotherm relationship. The required parameters for the model such as Langmuir constant and maximum adsorption capacity of the adsorbent were evaluated from batch experiments. The adsorption isotherm equation was coupled with an Advective Dispersion Reaction (ADR) equation and the resulting unsteady nonlinear PDE was solved using "*COMSOL MULTIPHYSICS - 3.2*".

The modeling was intended to simulate contaminate transport in a soil packed column. The model was solved for a single component adsorption with a continuous feed at the bottom of the column. Breakthrough profiles for adsorption that were obtained from modeling agree well with the experimental results. Effects of adsorption coefficient and velocity of the feed solution on beak-through curves were studied.

Keywords: adsorption, advective, dispersion, Langmuir, isotherm,

* Email: agasanapur@gmail.com, Phone: (775) 247 7809