Geophysical Research Abstracts
Vol. 14, EGU2012-4629, 2012
EGU General Assembly 2012

Overview of Current Simulation Capacities of Coupled Thermohaline – Variably Saturated Flow Using HydroGeoSphere

T. Graf

Leibniz Universität Hannover, Institute of Fluid Mechanics in Civil Engineering, Hannover, Germany
(graf@hydromech.uni-hannover.de)

Accidentally spilled leachate from sanitary landfills can have total dissolved solid concentrations up to 40,000 mg/L. As a result, leachate fluids have a significantly higher density than water found in both the unsaturated and saturated subsurface. Leachate spilled on the soil or released at the bottom of disposal sites will therefore be transported by variable-density flow through the unsaturated soil zone, and eventually reach the saturated groundwater zone. To better understand plume transport in the unsaturated subsurface, the HydroGeoSphere model has been extended in the last 10 years to simulate thermohaline fluid flow under variably saturated conditions. The model is tested against an unsaturated version of the Elder problem presented by Boufadel et al. (1999, J Contam Hydrol) and validated using experimental results presented by Simmons et al. (2002, Transp Porous Media).

In summary, recent simulation capacities of HydroGeoSphere include: (i) homogeneous and heterogeneous porous media, (ii) discretely-fractured porous media, (iii) variably saturated flow conditions, (iii) constant- and variable-viscosity flow, (iv) multi-species transport including salt and heat (e.g. Na+, Cl-, T), (v) individual definition of impact of each species on fluid density, (vi) non-linear density- and viscosity-functions, (vii) use of a number of common units for solute concentration (kg/L, mol/L, etc.), and (viii) Pitzer model to calculate viscosity from individual salt concentrations.

Ongoing simulation enhancements of HydroGeoSphere focus (a) on the significance of the Oberbeck-Boussinesq (OB) assumption, (b) on non-iterative time-stepping for variable-density flow simulations, and (c) on a fully-integrated surface-subsurface approach to simulate coastal flow dynamics including seawater intrusion, floods and storm surges.