Numerical Simulation of Unsaturated Water Flow and Pollutant Transport in Soil-Based Wastewater Treatment Systems with Clogged Infiltrative Surfaces

D. Huntzinger1, J. McCray2, S. Van Cuyk3
1. M.S. student, Department of Geology and Geological Engineering, Colorado School of Mines, 1500 Illinois St, Golden, CO 80401-1887, Tel. 303.384-2011, Fax. 303.372.3859. E-mail: dhuntzin@mines.edu
2. Department of Geology and Geological Engineering, Colorado School of Mines, Golden, CO 80401

Abstract. It is common practice in the United States to use on-site septic systems to manage and treat domestic household wastewater. These systems are expected to provide efficient, long-term removal of septic related contaminants from wastewater prior to groundwater recharge. Soil clogging by the accumulation of suspended solids and organic matter at the infiltrative surface of soil-based wastewater treatment (SBWWT) systems is a phenomenon known to occur as a result of continued wastewater infiltration. This clogging zone creates a barrier to flow, restricting the hydraulic conductivity and rate of infiltration. A small degree of clogging may improve the treatment of wastewater by enhancing purification processes. However, excessive clogging can hamper system performance, diminish wastewater treatment, and lead to eventual system failure. Crust development at the infiltrative surface of SBWWT systems strongly influences the unsaturated flow regime within sand filters, and therefore plays a critical role in the treatment of wastewater pollutants. Numerical simulations of unsaturated flow and transport within SBWWT systems are conducted to understand the effect of clogged zones on solute transport and biochemical treatment of wastewater. Using field and laboratory data to obtain model input parameters, spatial and temporal variations in solute transport and transformation as a function of infiltrative surface conditions are simulated under various stages of system life, as well as varied effluent application methods and rates. These model simulations are used to assess the influence of differing infiltrative surface and application conditions on wastewater contaminant treatment.