Desiccation of Homogeneous and Heterogeneous Porous Media Systems: Intermediate-scale Experiments and Numerical Simulation

M. Oostrom, T.W. Wietsma, M.A. Covert, and T.E. Queen
Pacific Northwest National Laboratory

Abstract. Traditional remediation techniques are not applicable at locations where contaminants in the unsaturated zone are located too deep and spread over a large area. Soil desiccation has been recognized as a potentially robust remediation process for the deep vadose zone because it is based on a physical phenomena, i.e., evaporation, that can be induced by air injection and extraction. As part of developing and applying soil desiccation as a viable technique for deep vadose zone treatment, several technical issues need to be addressed before the technique could be used in the field. The issues are related to energy limitations on the volume of water that can be removed, osmotic effects during soil drying, and, potential remobilization of contaminants after cessation of the drying process. To address some of these issues, a series of desiccation experiments were conducted in wedge-shaped, intermediate scale flow cells, with various degrees of insulation. The objectives of the experiments are to demonstrate the desiccation process at the intermediate experimental scale, to develop a detailed temperature and relative humidity data set, and to test and verify the water-air-energy mode of a numerical multiphase simulator. The results show that with an explicit description of the thermal properties of the insulation materials, the simulator is able to predict drying fronts and evaporative cooling well in both homogeneous and heterogeneous systems.