Bioremediation and Sustainable Environmental Technologies—2017. Fourth International Symposium on Bioremediation and Sustainable Environmental Technologies (Miami, FL; May 2017). ©2017 Battelle Memorial Institute, Columbus, OH, www.battelle.org/biosymp. A. Barton and S. Rosansky (Chairs)

Experimental and Modeling Study on Light Gas Transport in a Soil Column

Chiu-Shia Fen, Yu-Ro Lin, and Chia-Yu Chen
(Feng Chia University, Taichung, Taiwan, ROC)

Background/Objectives. Volatile organic compounds (VOCs) are often found in contaminated soil zones and groundwater in developed and underdeveloped countries. Their vapors volatilize to ground surface or dissolve into groundwater from subsurface nonaqueous phase liquid (NAPL) making them a significant driver of health risk. Landfill gas, such as methane, emitted from the subsurface is recognized as one of the main greenhouse gases contributing to global warming. Various transport mechanisms of these gas phase chemicals in unsaturated soils need to be assessed rigorously for the purposes of health risk and natural attenuation assessment. Contaminant vapors and hazardous gases usually have great differences in molar weight from those of soil gases, mainly oxygen and nitrogen; as a result density-driven migration may be significant, in addition to external pressure variation (e.g., fluctuation of the atmosphere) and component concentration variation. Modeling transport of these vapors and gases mixed with the soil air in unsaturated soils conventionally employs advective-dispersive (diffusive) transport with different forms of Fick's law of diffusion. Dusty gas model (DGM) equations have also been suggested for multicomponent gas transport in porous systems. These various formulations for assessing gas phase transport need to be experimentally verified.

Approach/Acitivites. This study aims at investigating the transport of methane-nitrogen gas mixture at different densities in a porous system experimentally and comparing the experimental results with different modeling approaches to assess their adequacy in predicting the density-driven transport.

Results/Lessons Learned. Results show that the model-predicted methane density profiles are consistent with the measured results for horizontal and vertically upward transport at the late measurement times as the initial methane density ranges from 0.0116 to 0.0543 kg/m^3. However, for the earlier time period, both the DGM and Fickian-based models under predict the methane density in the column.