Use of SiO_2 Cage Structures to Evaluate Affects of Intraparticle PSD on VOC Transport

D.L WASHINGTON[1] AND D. YONGE[2]

Washington State University, Dept of Civil and Environmental Engineering, Pullman, WA, USA;
[1]dianaw@mail.wsu.edu [2]yonge@wsu.edu

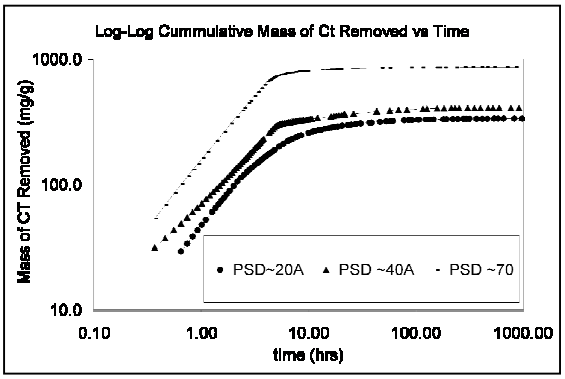
Abstract

The transport of volatile organic compounds (VOCs) through the unsaturated subsurface is poorly understood and difficult to predict. Aochi and Farmer (2005) state that the implications of the heterogeneous, anisotropic structure of soil materials are overlooked when evaluating transport processes [1]. Predicting where a contaminant will be is essential to developing technologies with which to treat and or remove the contaminants; currently this cannot be accurately determined. This research utilizes recent developments in mesoporous materials and anylitical techniques to investigate the effects of hysterisis during adsorption and desorption of VOCs.

Three silicate particles with narrow pore size distributions (PSD) of 20Å, 40Å, and 70Å and well defined surface chemistry were synthesized. A magnetically coupled microbalance was used to develop carbon tetrachloride (CT) adsorption and desorption isotherms for each particle. A continuous flow column system was used to produce concentration-time data. CT concentrations from saturation (~12%) to 0.01 ppbv were quantified using a GC equipped with a uECD and FID.

We have found that the PSD of the silicate was key with respect to the transport of VOCs into and out of the intraparticle spaces. Additionally we found that it takes much longer to reach adsorption/desorption equilibrium than previously thought. Much of the literature reports equilibrium times in hours, we have found it to be days to weeks. This is also believed to be a function of the intraparticle PSD.

The following figure represnts the mass of CT removed during continuous flow studies for each of the three particles During the first 5 hrs 80% of the CT is removed. Current models fail to adiquately predict the removal rates of the remaining 20% of the sorbed material.



References

[1] Aochi Y.O. (2005) *Geoderma* **127,** 137-153.