

## Problem Set 3

### SORPTION KINETICS & FUGACITY APPLICATIONS Chapters 3 and 7 Related Problems

#### Chapter 3 Related Problem

1. Engineering Applications of Sorption Dynamics of Organic Compounds for Soil Remediation. Consider a soil that has 1% organic carbon by weight and has polycyclic aromatic hydrocarbon contamination, i.e., the PAH class of compounds as listed in the U.S. EPA Subsurface Contamination Reference Guide.

Determine the relationship between  $K_d$  and  $D_{eff}$  (sec-1) - show a plot and show your calculations and all assumptions.

#### Chapter 7 - Fugacity

2. Consider an “evaluative environment” contaminated with 1,300 grams Trichloroethylene (TCE) in a total environment volume of 1,000,000 cubic meters. Use Fugacity analysis for characterization and problem definition for the evaluative environment.

#### Given:

- The relative volumes of air, water, soil, and NAPL phases are assumed to be 60%, 20%, 18%, and 2%, respectively
- Consider the water or aquifer subsurface phase environment at 11 C.
- Assume an organic carbon content of 0.5% in the aquifer soil phase.

#### Find:

- Calculate the percent distribution of TCE in each phase
  - Calculate the mass, in grams, of TCE in each phase
  - Determine the concentration of TCE in the water (aquifer) phase
  - Does the aquifer phase concentration exceed the MCL for TCE?
  - Calculate the mass of TCE that would be consumed in one day through ingesting 2 liters of water and divide by a 70-kilogram person to determine the daily dose.
3. Consider that some person takes a shower using the aquifer water described in Problem 1 above. Determine or find the temperature of the water in a typical shower scenario, duration, and volume of water used.
- Calculate the mass of TCE in the water phase in one shower episode
  - Calculate the mass of TCE in the vapor phase in one shower episode
  - If the gas phase in the shower were evenly contaminated with the TCE, evaluate the amount (in grams) of TCE that would be taken in through inhalation in the air phase into the lungs
  - Evaluate the amount (grams) that would be exposed on the surface of the skin in the water phase in the shower scenario.