

Guide for HW 9

Tuesday, March 28, 2017 11:07 AM

1. Recall Henry's Law

$$H = \frac{C_g}{C_w} \quad \begin{array}{l} \text{concentration of gaseous phase} \\ \text{--- concentration of aqueous phase} \end{array}$$

$$H' = \frac{P_v}{C_w} \quad P_v = P \frac{\bar{R}}{M} T \quad \begin{array}{l} \text{universal ideal gas constant} \\ \text{Temperature in K} \\ \text{formula weight (mass/mol)} \end{array}$$

$$\downarrow \quad H' = \frac{P}{M C_w} (\bar{R} T)$$

$$\left(C_g = \frac{P}{M} \right) \Rightarrow \boxed{H' = H \bar{R} T}$$

$$\Rightarrow$$

$$H = \frac{H'}{\bar{R} T} \Rightarrow \begin{cases} H_{TCE} = \frac{9.1 \times 10^{-3}}{\bar{R} T} \\ H_{TCB} = \frac{2.3 \times 10^{-3}}{\bar{R} T} \end{cases}$$

$$H' (\text{atm, m}^3/\text{mol}) \quad \frac{TCE}{9.1 \times 10^{-3}} \quad \frac{TCB}{2.3 \times 10^{-3}}$$

$$\text{Solubility (mg/L)} \quad 1100 \quad 19$$

$$\text{Formula wt. g/mol} \quad 131.4 \quad 181.45$$

aqueous concentration

$C_w = \sum_i S_i$	gaseous concentration
$C_g = H C_w$	solid concentration
$C_s = k_d C_w$	

So Once we know C_w , we can calculate the rest..

Wt. fraction	Formula wt.	Mole per 100g.	Mole fraction.	Absolute/pure Solubility (mg/L)	Relative/Effective solubility
TCE 0.8	131.4	?	?	1100	?
TCB 0.2	181.45	?	?	19	?

$$\sum ()$$

Effective Solubility

given (L/kg)

$$C_w = S_e$$

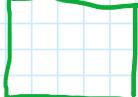
$$C_g = H C_w$$

$$C_s = k_d C_w$$

TCE

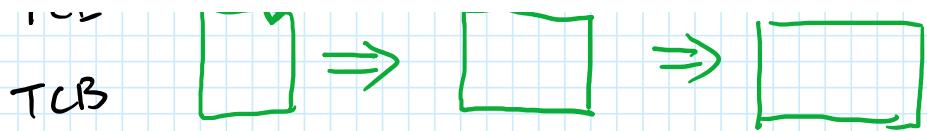


$$\Rightarrow$$



$$\Rightarrow$$





$$2. n = 0.25$$

$$S_{w_0} = 0.2 \quad \theta_w = n S_{w_0} = 0.05$$

$$S_{nw_0} = 0.2 \quad \theta_{nw} = n S_{nw_0} = 0.05$$

Infiltration $0.5 \text{ m/year} = q_w$

DNAPL Usage
rate $\frac{1000 \text{ L/year}}{10 \times 10 \text{ m}^2} (\text{m/year}) = q_{\text{DNAPL}}$

Water penetration per year? $\frac{q_w}{\theta_w}$

DNAPL - - - - - ?

DNAPL movement in 10 years?

has it reached water table?

Assume: all water-table load is aqueous

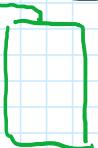
$$R_{TCE} = (1 + \frac{P_d}{\theta} k_d) = ?$$

$$R_{TCB} = ?$$

Aqueous Vel

$$\text{time } (t = \frac{\text{Depth}}{v})$$

TCE



TCB

Retardation

$$t = \left(\frac{\text{Depth} \cdot R}{v} \right)$$

Time (retarded)

?

?

?

?

?

?

How much time does it take to wash out spills?

$$\text{Volumetric Flux} \quad 0.5 \text{ m/year} \times (10 \times 10 \text{ m}^2) = ?$$

$$\text{Vol Flux}(V_x) \quad \text{Effective Solubility}(S_e^l) \quad \underline{\text{Loading} = (V_x \cdot S_e^l)}$$

TCE	?	?	?	kg/m^3
TCB	?	?	?	kg/m^3

also removal rate

	Volume (1000L)	P	M
TCE	8000L	1464 kg/m ³	?
TCB	2000L	1454	?

3. Air-stripping

$$400 \text{ m}^3/\text{month} \Rightarrow ? \text{ L/y}$$

	C _g (mg/L)	Removal Rate = Q _{Air} · C _g	Time
TCE	Calculated in Q1	?	?
TCB	- - - -	?	?

calculate the amount of time to remove all spills by aqueous washing