Guide for HW 9

Tuesday, March 28, 2017 11:07 AM

1. Recall Henry's Law

$$H = \frac{C_g}{C_w}$$ — concentration of gaseous phase; — concentration of aqueous phase

$$H' = \frac{P_v}{C_w}$$ — $P_v = \rho \frac{\bar{R}}{M} T$

$\bar{R}$: universal ideal gas constant; T: Temperature in K; M: formula weight (mass/mol)

$$H' = \frac{\rho}{M C_w}(\bar{R}T)$$

$$C_g = \frac{\rho}{M}$$

$$\boxed{H' = H\bar{R}T} \Rightarrow H = \frac{H'}{\bar{R}T} \Rightarrow \begin{cases} H_{TCE} = \dfrac{9.1\times10^{-3}}{\bar{R}\,T} \\ H_{TCB} = \dfrac{2.3\times10^{-3}}{\bar{R}\,T} \end{cases}$$

	TCE	TCB
H' (atm, m^3/mol)	9.1×10^{-3}	2.3×10^{-3}
solubility (mg/L)	1100	19
Formula wt. g/mol	131.4	181.45

$$\boxed{\begin{aligned} C_w &= x_i S_i \\ C_g &= H C_w \\ C_s &= K_d C_w \end{aligned}}$$

C_w: aqueous concentration; C_g: gaseous concentration; C_s: solid concentration

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	?
			$\Sigma(\ )$			

Effective Solubility; given (L/kg)

	$C_w = S_e$	$C_g = HC_w$	$C_s = K_d C_w$
TCE			
TCB			

TCB

2. $n = 0.25$

$S_{w0} = 0.2$ $\qquad \theta_w = n S_{w0} = 0.05$

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Infiltration $\quad 0.5\,m/year = q_w$

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

water penetration per year? $\quad \dfrac{q_w}{\theta_w}$

DNAPL - - - - - - - ?

DNAPL movement in 10 years?

has it reached water table?

Assume: all water-table load is aqueous

$R_{TCE} = (1 + \frac{\rho_d}{\theta} K_d) = ?$

$R_{TCB} = ?$

	Aqueous Vel	time ($t = \frac{Depth}{v}$)	Retardation ↑ R	$t = (\frac{Depth \cdot R}{v})$ Time (retarded)
TCE		?	?	?
TCB		?	?	?

How much time does it take to wash out spills?

Volumetric Flux $0.5\,m/year \times (10 \times 10\ m^2) = ?$

	Vol Flux (V_x)	Effective Solubility (S_e')	Loading $= (V_x \cdot S_e')$
TCE	?	?	? (kg/y)
TCB	?	?	?

also removal rate

	Volume (1000 L)	P	M
TCE	8000 L	1464 kg/m³	?
TCB	2000 L	1454	?

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

3. Air-stripping

$400\,m^3/month \Rightarrow ?\ L/y$

	C_g (mg/L)	Removal Rate $= Q_{Air} \cdot C_g$	Time
TCE	Calculated in Q1	?	?
TCB	- - - -	?	?