PRACTICE PROBLEMS.

$$2ZnS + 3O_2 = 2ZnO + 2SO_2$$

$T = 900C$ $R = 1mm$ 8% Oxygen

$k_s = 2 cm/s$ $D_e = 0.08 cm^2/s.$

$$\tau_R = \frac{\rho_B R}{b k_s C_{Ag}} \qquad k_s = 2 \text{ cm/s}$$

$$C_{Ag} = \frac{(0.08)(1.0)}{(0.083)(1173)} = (8) 10^{-4} \text{ mol/L}$$

$$= 8 \; 10^{-7} \text{ mol/mL}$$

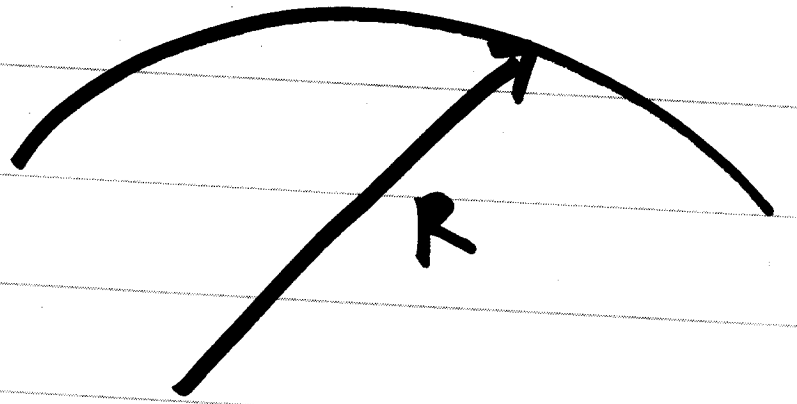
$$\tau_R = \frac{(0.0425)(0.1)}{(2)\, 8\, (10^{-7})\, 2/3} = (~~2.4~~)\, 10^{3} \text{ s.}$$

3.9

(bc)

$$\tau_D = \frac{\rho_B R^2}{6 D b C_{Ag}}$$

$$= \frac{(0.0425)(0.1)^2}{\frac{2}{3}(6)(0.08)\ 8\ 10^{-7}} = 1666\ s$$



$$\frac{d(R \cdot r/R)}{dt} = -0.05 \text{ / day}$$

$$r/R = -0.05t + \text{Constant}$$

$$\text{Constant} = 1$$

$$1 - y/R = 0.05t$$

$y = 0$ $\quad$ $t = 20$ days

d_p =	4 mm	12 mm
T	550 C	590 C
Time 50% Conv	15 Min	2 hrs.

$$X_B = 0.5 = 1 - \left(r_c/R\right)^3$$

$$r_c/R = (0.5)^{1/3} = 0.8$$

$$\tau = \tau_R \left(1 - \frac{r_c}{R}\right) + \tau_D \left(1 - \frac{3r_c^2}{R^2} + \frac{2r_c^3}{R^3}\right)$$

550C (4MM)

$$0.25 = \tau_{R1}(1-0.8) + \tau_{D1}\left(1 - 3(.8)^2 + 2(.8)^3\right)$$

$$0.25 \quad 0.2\tau_{R1} + 0.10\,\tau_{D1} \quad \text{— (1).}$$

12mm at 590C

$$2 = \tau_{R2}(1-0.8) + \tau_{D2}(0.1) \quad \text{— (2).}$$

$$\tau_{R2} = 3\tau_{R1}$$

$$\tau_{D2} = 9\tau_{D1}$$

$$2 = 3\tau_{R1}(0.2) + 9\tau_{D1}(0.1) \quad \text{— (2b)}$$

$$\tau_{R1} = 0.20\,hr \quad \tau_{D1} = 2.08\,hr.$$

~~Ebul Bed~~ Rotary Kiln

$\bar{X}_B = X_B^\circ = 0.98 = 1 - \frac{r_3^3}{R^3}$ 0.48 hr

$\left(\frac{r_c}{R}\right) = 0.27$

2MM
$t = 0.48$ hr

$t = \tau_{R1} \cdot (1 - r_c/R) + \tau_{D1} \left(1 - 3\frac{r_c^2}{R^2} + 2\frac{r_c^3}{R^3}\right)$

$\tau_{R1} = \frac{0.2}{2} = 0.1$

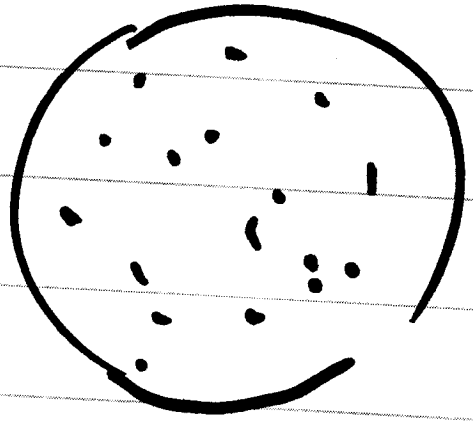
$\tau_{D1} = 0.5$ hr

$\tau_D = 0.5$ hr

(35)

Sponge Iron

$$4H_2 + Fe_3O_4 = 4H_2O + 3Fe$$



$$k_s = (1.93)10^{5} \exp\left[-\frac{12000}{(873)(2)}\right]$$

(2) cal/mol.

$= (1.93)10^{5}$ cm/s

$= 199$ cm/s $= 199 \frac{\text{cm}}{\text{s}}$

$$D_e = 0.03\ cm^2/s \qquad k_f = 10\ \frac{cm}{s}$$

$$t = \tau_R\left(1 - \frac{r_c}{R}\right) + \tau_F\left(1 - \frac{r_c^3}{R^3}\right) + \tau_S\left[1 - \frac{2r_c^2}{R^2} + \frac{3r_c^3}{R^3}\right].$$

$\tau_R =$

$\tau_F =$

$\tau_S =$

$$C_{A_g} = \frac{p}{RT} = \frac{1}{(0.082)(273)}$$

$$= (0.0136)\ \frac{mol.}{L}$$

$$(0.0136)\ \frac{mol.}{L}$$

$$(0.0136)10^{-3}\ \frac{mol.}{cm^3}$$

$$\tau_R = \frac{\rho_B R_\cdot}{b_f C_{Af}} = \frac{(4.3/225)\,5_\cdot}{\left(\frac{1}{4}\right)(195)(0.013)}$$

$$= 138 \text{ s} \qquad 10^{-3}$$

$$\tau_F = \rho_B R / 3 b_f C_{Af} = \frac{46}{923 \text{ s}}$$

$$\tau_D = \frac{\rho_B R^2}{6 b \Delta C_{AS}}$$

$$= \frac{\left(\frac{9.3}{22.4}\right)(5.)^2}{6\left(\frac{1}{4}\right)(0.03)(0.0138)10^{-3}}$$

$$= (7)10^5 \text{ s}$$

BIOCHEMICAL

ENVIRONMENTAL

REACTION

ENGG.

$$(CH_2ONPSK)_n$$

$$+ nO_2 + nH_2O$$

$$= nCO_2 + 2nH_2O$$

$$+ \text{Minerals} + \text{Energy}$$

$$N_2 + 2H_2O + \text{Energy} = NH_3 + O_2$$

MINERAL WEATHERING. (19)

Primary Mineral + CO_2

+ H_2O

= M^{+n} + $n\,HCO_3^-$

+ SOIL / CLAY / SAND

$NH_3 + H_2O = NH_4^+ + OH$ | Increase

$H_2S = HS^- + H^+$ | Water

$$CO_2 + H_2O = H^+ + HCO_3^-$$

$$HCO_3^- = H^+ + CO_3^=$$

$$H_2O + CO_2 = H_2CO_3$$

$$CO_2(g) = CO_2(liq)$$

$$H_2CO_3 = HCO_3^- + H^+$$

$$4C_3H_7O_2NS + \text{空} = \underline{CH_3COOH} + 6CO_2 + 4CH_4 + 4NH_3 + 4H_2S.$$

$$NH_4^+ + 2O_2 = NO_3^- + H_2O + 2H^+$$