LECTURE 4-17-2018

THERMAL PROBLEM

PRANDTL NUMBER → $Pr = \frac{C\mu}{K} = \frac{C\mu S}{KS} = \frac{\frac{\mu}{S}}{\frac{K}{SC}} = \frac{\nu}{\alpha}$

ν ← Kinematic viscosity

α ← thermal diffusivity

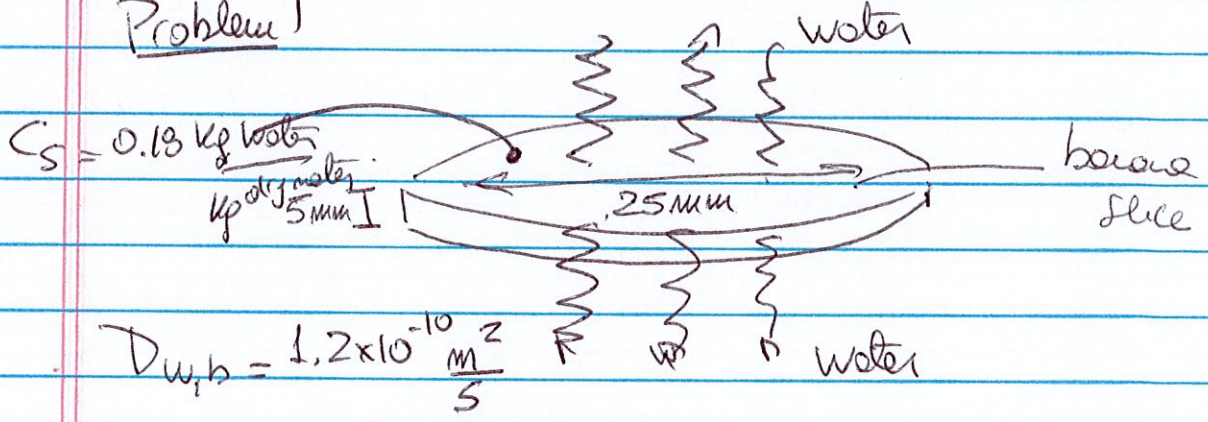
MASS TRANSFER PROBLEM

Schmidt $Sc = \frac{\nu}{D_{AB}}$

ν ← Kinematic viscosity

D_{AB} ← Mass diffusivity.

Problem 1



$C_i = 3 \frac{Kg\ water}{Kg\ dry\ matter}$ $C_f = 0.2 \frac{Kg\ water}{Kg\ dry\ matter}$

Average concentrations, there is no information on the location.

$$\ln \frac{C_{avg}(t) - C_s}{C_i - C_s} = \ln \frac{8}{\pi^2} - D\left(\frac{\pi}{2L}\right)^2 t \quad (2)$$

0.2 → $C_{avg}(t)$; 0.18 → C_s; 3 → C_i; 0.18 → C_s; $D_{w,b}$; $L = ?$; t → To calculate

$$L = \frac{5}{2} \times 10^{-3}\ m.$$

$$\ln\left[\frac{(C_{avg} - C_s)}{C_i - C_s} \cdot \frac{\pi^2}{8}\right] = -D\left(\frac{\pi}{2L}\right)^2 t$$

$$t = -\frac{1}{D}\left(\frac{2L}{\pi}\right)^2 \ln\left[\frac{C_{avg} - C_s}{C_i - C_s} \cdot \frac{\pi^2}{8}\right]$$

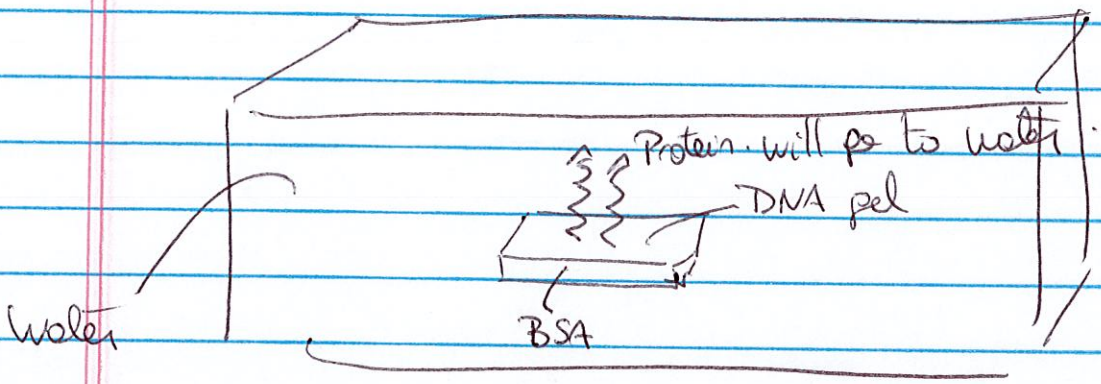
$$t = 36018 \text{ seconds} = 10 \text{ hr}$$

(c)

Thickness $= 0.6 \times 5$ mm

$t = 3$ hours

Problem 2



$$\frac{C_{avg} - C_s}{C_i - C_s} = \frac{8}{\pi^2} e^{-D\left(\frac{\pi}{2L}\right)^2 t}$$

($C_s \to 0$)

$$\frac{C_{avg}}{C_i} = \frac{8}{\pi^2} e^{-D\left(\frac{\pi}{2L}\right)^2 t}$$

Mass → grams

$$M_{avg} = C_{avg} \cdot V\,[m^3]$$

C_{avg}: $\frac{grams}{m^3}$

$$M_r(t) = M_i - M_{avg}(t)$$

$$M_{avg}(t) = M_i - M_r(t)$$

Date. (To be continued)