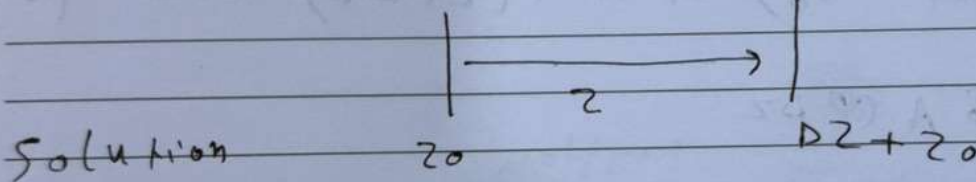
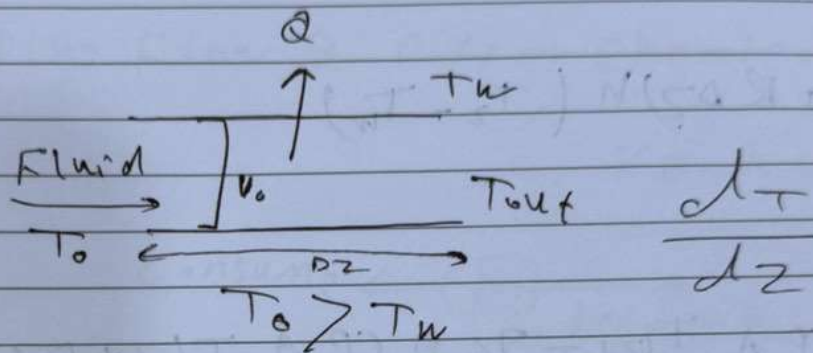


Distributed models ORE/PDE

Case 1: Plug flow with Heat Transfer (steady-state)

cost P_{cph} 

Q = heat in - heat out

heat in

$$(M c_p \Delta T)_{in}$$

↓

 P_F

↓

$$\frac{A v}{m^2 \cdot m/s}$$

cross-sectional

$$(v_0 A \rho c_p T(z)) - v_0 A \rho c_p (T(z + dz)) - Q$$

التاريخ
Newton law of cooling

$$Q = h A_r D T$$

circle

$$A_r = 2 \pi R \Delta z$$

$$Q = (2 \pi R \Delta z) h (T_2 - T_w)$$

$$V_0 \rho C_p A T(z) - V_0 \rho C_p A T(z + \Delta z) - 2 \pi R \Delta z h (T_2 - T_w) = 0$$

$$\div V_0 A C_p \Delta z$$

$$-\frac{(T(z) - T(z + \Delta z))}{\Delta z} - \frac{2 \pi R h}{V_0 A \rho C_p} (T(z) - T_w) = 0$$

$$\frac{dy}{dx} \approx \lim_{\Delta x \rightarrow 0} \frac{y_{x+\Delta x} - y_x}{\Delta x}$$

$$-\frac{(T(z) - T(z + \Delta z))}{\Delta z} - \frac{2 \pi R h}{V_0 A \rho C_p} (T(z) - T_w) = 0$$

~~no matter~~
no mater

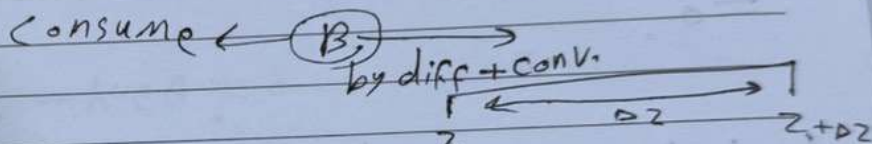
how many fish in the sea
cause feel so empty without me.

موضوع الدرس

$$\frac{-dT_z}{dz} = \frac{2\pi R h (T_z - T_w)}{\rho C_p v_0 A}$$

Case 2 Plug Flow & Diff + Chemical Reaction

$$r_B = -k C_B$$



$$\text{mol/time} \leftarrow F_{CB} = \text{conv.} \frac{\text{Vol}}{\text{time}} \times \frac{\text{mol}}{\text{Vol}}$$

~~$J = -D_{AB} \frac{dC_B}{dz}$~~

$$J = -D \frac{dC_B}{dz}$$

$$\frac{\text{Mol}}{\text{Area} \times \text{time}}$$

M.B on Element DZ (thickness)

in - out - consumption = 0



لأنه V_B ثابتة

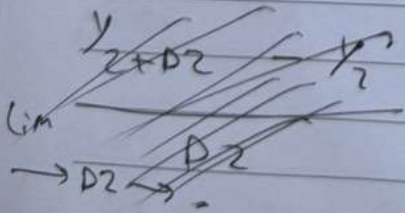
diff in - diff out + conv in - conv out - consumption

= 0

$$\left(\frac{A|E|}{z} - \frac{A|E|}{z+DZ} \right) + \frac{v_0 A|CB|}{z} - \frac{v_0 A|CB|}{z+DZ}$$

$$- \frac{(A|DZ|)(K|CB|)}{z} \Big] \div A|DZ|$$

\uparrow
 V_B



$$\frac{J_E|_2 - J_E|_{2+DZ}}{DZ} + v_0 \frac{c_B|_2 - c_B|_{2+DZ}}{DZ} - R_B = 0$$

$$-\frac{dJ_E}{dz} - v_0 \frac{dc_B}{dz} - R_{CB} = 0 \Rightarrow \cancel{D \frac{d^2 c_B}{dz^2}} - R_{CB} = 0$$

$$D \frac{d^2 c_B}{dz^2} - v_0 \frac{dc_B}{dz} - R_{CB} = 0$$

$$J_E = -D \frac{dc_B}{dz} \Rightarrow \frac{dJ_E}{dz} = -D \frac{d^2 c_B}{dz^2}$$