CHE318 L03
Jan-09 2026

Slide 7

$$N_A = \frac{C_T D_{AB}}{z_2 - z_1} \boxed{\left(\frac{N_A}{N_A + N_B}\right)}^{\nearrow S} \ln\left(\frac{\frac{N_A}{N_A+N_B} - x_{A2}}{\frac{N_A}{N_A+N_B} - x_{A1}}\right)$$

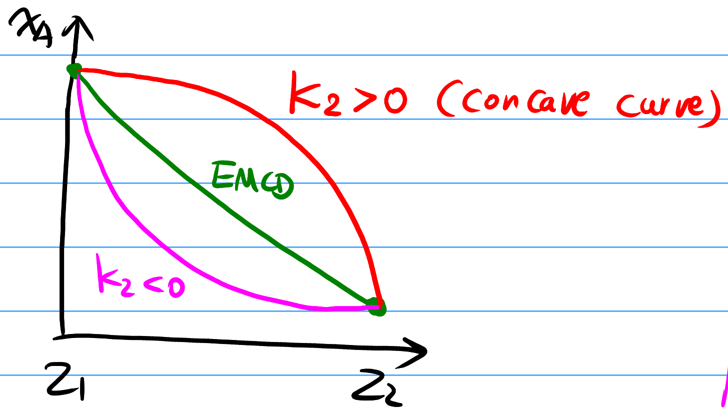
$$= \frac{C_T D_{AB}}{z_2 - z_1} \cdot S \cdot \ln\left(\frac{S - x_{A2}}{S - x_{A1}}\right)$$

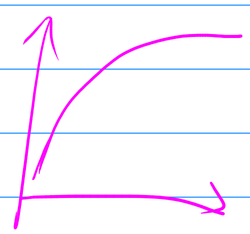
Stagnant B $S=1$ $\Rightarrow$ See L02

Slide 12 General solution of $x_A(z)$
See Homework 1

$$x_A = S - k_1 e^{k_2 z}$$

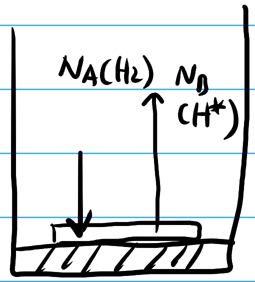
what it looks like





Slide 14

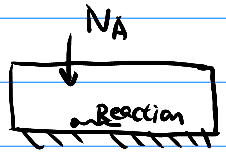
Case 1 Catalyst at bottom



Mass Balance

Mass Balance

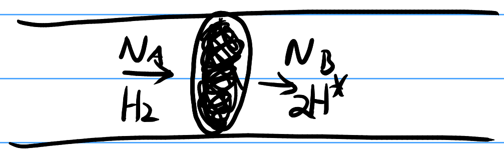
At catalyst surface



In	− Out	+ Gen	= Acc	
N_A	0	$-r_{H_2}$ (assumption rate)	0	for H_2
0	N_B	$r_H = 2r_{H_2}$ (generation rate)		for H^*

$$\left.\begin{aligned} N_A &= r_{H_2} \\ N_B &= -2r_{H_2} \end{aligned}\right\} \Rightarrow N_B = -2N_A$$

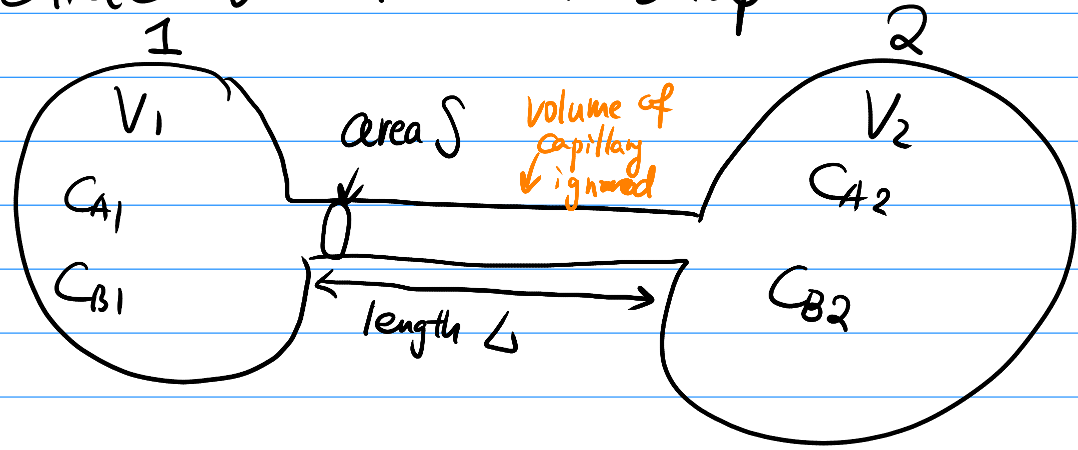
Case 2 Gas pass through porous catalyst in tube



Similarly $N_B = 2N_A$

N_B / N_A ratio must be predetermined to solve N_A !

Slide 16 Two Bulb setup



Before opening valve

$C_{A1} = C_A^\circ \qquad C_{B1} = C_B^\circ$

Average conc

$$C_{av} = \frac{V_1 C_A^\circ + V_2 C_A^\circ}{V_1 + V_2}$$

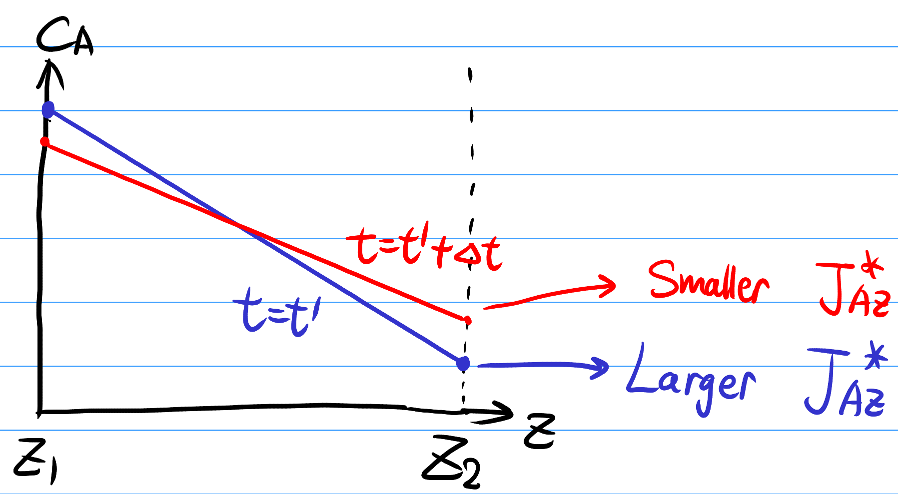
$$= \frac{V_1 C_{A1} + V_2 C_{A2}}{V_1 + V_2}$$

at any time

Pseudo-Steady State (P.S.S)

At each t $\Rightarrow$ $C_A(z)$ is linear $\Rightarrow$ $J_{Az}^* = D_{AB} \dfrac{C_{A1} - C_{A2}}{L}$

But C_{A1}, C_{A2} change over time !



Mass Balance for B

In − Out + Gen = Acc

$S \cdot N_A \qquad 0 \qquad 0 \qquad \frac{dC_{A2}}{dt} \cdot V_2$

$$S \cdot D_{AB} \frac{C_{A1} - C_{A2}}{L} = \frac{dC_{A2}}{dt} V_2$$

Integrate over $t \Rightarrow \ln\left(\frac{C_{A,av} - C_{A2}(t=t_e)}{C_{A,av} - C_{A2}(t=0)}\right) = -D_{AB} \cdot \frac{V_T S}{V_1 V_2 L} \cdot t$

Are we correct? Check unit

$\ln(\boxed{}) \rightarrow$ Dimensionless

$D_{AB} \cdots \left[\frac{m^2}{s}\right]$

$\frac{V_T S}{V_1 V_2 L} \cdots \left[\frac{\cancel{m^3} \cdot m^2}{\cancel{m^3} \cdot m^3 \cdot m}\right] \cdots \left[\frac{1}{m^2}\right]$

R.H.S $\cdots \left[\frac{m^2}{s}\right]\left[\frac{1}{m^2}\right][s] \cdots$ Dimensionless ✓