CHE 402
Kinetics & Reactor Design

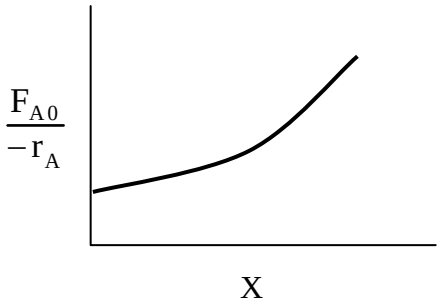
Dr. Eid Al-Mutairi

Chapter 3: Rate Laws and Stoichiometry

Dr. Eid Al-Mutairi

Why Stoichiometry?

- If we have



- Then we can size a number of CSTR and PFR reaction systems

- To find $-r_A = f(X)$
  1) Need the rate law, $-r_A = f(C_A, C_B)$ **!!**
  2) Need the reaction stoichiometry, $C_A = C_{A0}(1-X)$ [Liquid Phase]

Batch Stoichiometric Table

$$A + \frac{b}{a}B \rightarrow \frac{c}{a}C + \frac{d}{a}D$$

Species	Symbol	Initial	Change	Remaining
A	A	N_{A0}	$-N_{A0}X$	$N_A = N_{A0}(1-X)$
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C	C	$N_{C0} = N_{A0}\Theta_C$	$+\frac{c}{a}N_{A0}X$	$N_C = N_{A0}\left(\Theta_C + \frac{c}{a}X\right)$
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D	D	$N_{D0} = N_{A0}\Theta_D$	$+\frac{d}{a}N_{A0}X$	$N_D = N_{A0}\left(\Theta_D + \frac{d}{a}X\right)$

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		N_{T0}		$N_T = N_{T0} + \delta N_{A0}X$

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where $\Theta_i = \frac{N_{i0}}{N_{A0}} = \frac{C_{i0}}{C_{A0}} = \frac{y_{i0}}{y_{A0}}$ and $\delta = \frac{d}{a} + \frac{c}{a} - \frac{b}{a} - 1$

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etc.

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etc.

If $-r_a = k_a C_a^2 C_b$ **then**

$$-r_a = C_{ao}^3(1-X)^2\left(\Theta_b - \frac{b}{a}X\right)$$

And we have $-r_A$=f(X)