

CSTR – Back-Mixed Reactor

- 1.10 An irreversible reaction is carried out in a back-mixed reactor at 300 °C. Concentration of A in the feed is 2.2 lbmol/ft³. The reactor volume is 3.0 ft³. A number of experiments result in the following set of data. Estimate the value of k for the first order reaction kinetics

$v_o/(ft^3/s)$	0.003	0.006	0.009	0.012	0.015	0.018
$C_A/(lbmol/ft^3)$	0.263	0.469	0.636	0.773	0.889	0.987

- First-order, constant density, mixed reactor
- $C_{A0} = 2.2 \text{ lbmol/ft}^3$
- Equation (1.69) First order constant density mixed flow reactor
- $k\tau_m = \frac{X_A}{1-X_A} = \frac{C_{A0}-C_A}{C_A}$

$v_o/(ft^3/s)$	$C_A/$ (lbmol/ft ³)	$Y =$ $(C_{A0} - C_A)/C_A$	$Y =$ $(C_{A0} - C_A)/C_A$
0.003	0.263	7.38	1000
0.006	0.469	3.69	500
0.009	0.636	2.46	333.3
0.012	0.773	1.845	250
0.015	0.889	1.476	200
0.018	0.987	1.23	166.7

- A plot of $[Y =](C_{A0} - C_A)/C_A$ versus $\tau_m = V/v_o$ yields a straight line with slope $k = 0.00738 \text{ s}^{-1}$