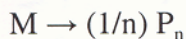


SOLUTION

I. 60 points

A certain liquid-phase polymerization reaction can be represented:



where n is the average number of monomer molecules in the polymer chain. The reaction is $3/2$ order in monomer (M) concentration. The rate constant at 25°C (298 K) is $0.7 \text{ lt}^{1/2}\text{mole}^{-1/2}\text{min}^{-1}$ and the activation energy is 25,000 cal/mole (note: the gas constant in calories is $R=1.987 \text{ cal/mole-K}$). The initial concentration of M is 2.0 moles/lt, and the reaction may assumed to be constant density. An energy balance on an adiabatic flow reactor leads to:

$$T = T_0 + 3180 f_M / (600 - 35 f_M)$$

Where f_M is the fractional conversion of monomer.

In all cases, a 1000 lt/min feedstock enters a 2500 lt flow reactor.

A. 10 points

Find the conversion if an **isothermal PFR** at 30°C (303 K) is used.

B. 25 points

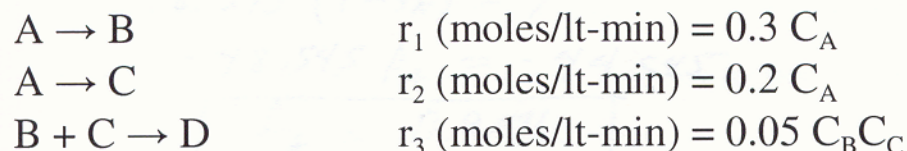
Find the conversion if an **adiabatic CSTR** with feedstock temperature $T_0 = 25^\circ\text{C}$ (298 K) is used. Look for only one $T_{\text{out}}, f_{\text{m,out}}$ solution.

C. 25 points

Find the conversion if an **adiabatic PFR** with feedstock temperature $T_0 = 25^\circ\text{C}$ (298 K) is used.

II. 40 points

An isothermal 100 lt CSTR is fed with an aqueous solution containing reactant at $C_A = 3 \text{ moles/lt}$ and flowrate $\mathcal{V}_0 = 25 \text{ lt/min}$. The following reactions take place:



where all concentrations are in moles/lt.

Find the product distribution (C_A, C_B, C_C , and C_D) leaving the reactor given $C_{B0} = C_{C0} = C_{D0} = 0$.