Plug Flow Reactor

- 1.8 Pure propylene oxide is entering the reactor at a rate of 1 mol/s.
- The reaction rate constant is estimated to be

$4.84 \times 10^{-3}\ s^{-1}$.

- Initial concentration of propylene oxide is 0.07 mol/L.
  Reaction is conducted at 500 °C.
- If reactor is operated at constant volume and 80 % conversion is required, what should be the size of the plug flow reactor (PFR)?

- Fractional volume change, ε = 0.
- Conversion, X_A = 0.8
- Reaction rate constant, $k = 4.84 \times 10^{-3}\ s^{-1}$
- $k\tau_P = \int_0^{0.8} \frac{1}{1-x} dx = 1.609$
- Residence time in plug flow reactor, τ_p = $1.609/(4.84 \times 10^{-3}) = 324$ s.

- Molar flow rate of reactant A, F_{Ao} = 1 mol/s
- Concentration of A in the feed, C_{Ao} = 0.07 mol/L
- Volumetric flow rate, υ (Equation 1.48):
- $\upsilon = \frac{F_{A0}}{C_{A0}} = \frac{1}{0.07} = 14.29$ L/s
- Reactor volume, V (Equation 1.49):
- $V = \upsilon\tau_P = 14.29(323.57) = 4.75 \times 103$ L