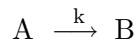


This problem is based on Example 7.5.

Estimate the mass of catalyst required in an isothermal fixed-bed reactor for the second-order, heterogeneous reaction.



$$r = kc_A^2 \quad k = 2.25 \times 10^5 \text{ cm}^3/\text{mol s}$$

The gas feed consists of A and an inert, each with molar flowrate of 10 mol/s, the total pressure is 4.0 atm and the temperature is 550 °K. The desired conversion of A is 75%. The catalyst is a spherical pellet with a radius of 0.45 cm. The pellet density is $\rho_p = 0.68 \text{ g/cm}^3$ and the bed density is $\rho_B = 0.60 \text{ g/cm}^3$. The effective diffusivity of A is $0.008 \text{ cm}^2/\text{s}$ and may be assumed constant. The external mass transfer coefficient is $k_m = 1.0 \text{ cm/s}$.

- (a) Estimate the mass of catalyst if you assume the fluid and pellet surface concentrations are equal.
- (b) Estimate the mass of catalyst if you account for a possible gradient between the fluid concentration and the external surface concentration.