AFCoKaRE Practice Problem 26.1 Solution

Purpose: This problem will allow you to practice the quantitative analysis of a steady state PFR.

Problem Statement: Gas phase reaction (1) occurs with negligible pressure drop in a 10 foot long tubular reactor with a 1 inch inside diameter. The heat of reaction (1) is -24.7 kcal mol^{-1}, and the reaction is first order in A with a pre-exponential factor of 8.38×10^8 min^{-1} and an activation energy of 30.8 kcal mol^{-1}. The steady state feed to the adiabatic reactor is at 350 ºC and 30 psia and contains 5% A and 13% B, the balance being an inert gas, I. The heat capacity of the gas is essentially equal to that of I: 7.12 cal mol^{-1} K^{-1} (independent of temperature). Calculate the conversion and outlet temperature if the space time is 10 min.

$$A + B \rightarrow Y + Z \qquad (1)$$