AFCoKaRE Practice Problem 28.1

Purpose: This problem will allow you to practice both the qualitative and quantitative analysis PFRs and CSTRs.

Problem Statement: Consider the irreversible, liquid phase reaction A → Z, equation (1) which occurs at constant density. Reactant A is supplied at a rate of 4 L min^{-1} in a concentration of 2 mol L^{-1} and at a temperature of 43 ºC. The heat capacity of the fluid is 0.87 cal mL^{-1} K^{-1} and the heat of reaction is -27.2 kcal mol^{-1}. The reaction is second order in the concentration of A, equation (2), and the rate coefficient obeys Arrhenius' law with a pre-exponential factor of 6.37 x 10^9 L mol^{-1} min^{-1} and an activation energy of 14.3 kcal mol^{-1}. (a) Using a qualitative analysis, predict whether the required reactor volume of an adiabatic PFR or of an adiabatic CSTR would be larger assuming the conversion to be 50%, then perform a quantitative analysis to check your prediction. (b) Repeat part (a) assuming the conversion to be 95%.

$$A \rightarrow Z \tag{1}$$

$$r = kC_A^2 \tag{2}$$