AFCoKaRE Practice Problem 30.1

Purpose: This problem will allow you to practice the quantitative analysis of a thermally back-mixed PFR.

Problem Statement: Liquid phase reaction (1) is exothermic with a constant heat of reaction of -75.6 kJ mol-1. The second order (in A) rate coefficient has a pre-exponential factor of 5.22×10^3 m^3 mol^{-1} min^{-1} and an activation energy of 62.8 kJ mol^{-1}. A solution of 1 M A at 20 °C is fed to a counter-current heat exchanger at a rate of 1.25 L min^{-1}; after passing through the heat exchanger it is fed to a 0.5 m^3 PFR operating adiabatically. The product of the heat transfer coefficient and the heat transfer area, UA, based on the arithmetic average temperature change is 5210 J K^{-1} min^{-1}. If the heat capacity of the solution is constant and equal to 2 J mL K^{-1}, what percentage of the A in the feed will be converted and at what temperature will the final process stream leave the reactor?

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