CE 329, Fall 2015

Assignment 23

Problem Statement

Suppose an adiabatic CSTR is being fed a reactant stream at a rate of 1 m³ ks⁻¹ and a temperature of 310 K. This constant-density fluid contains the reactant A at a concentration of 16 kmol m⁻³, and it has a heat capacity of 2 J cm⁻³ K⁻¹. Irreversible reaction (1) takes place with a rate given by equation (2). The reactor volume is 0.4 m³. The heat of reaction (1) is −21 kJ mol⁻¹, and may be taken to be constant. At these conditions three steady states are possible; determine the temperature and conversion for these steady states.

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

$$r_1 = 3.2 \times 10^9 \left(\frac{\text{m}^3}{\text{mol ks}} \right) \exp \left\{ \frac{-12{,}200 \text{ K}}{T} \right\} C_A^2 \tag{2}$$