

AFCoKaRE Practice Problem 22.2

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

Problem Statement: A 150 °C solution containing 2 mol L⁻¹ of A is fed to a 500 L CSTR at a rate of 250 L h⁻¹. A jacket surrounding the CSTR contains a fluid at a constant temperature of 180 °C. The contact area between the CSTR contents and the jacket is 2 m² and the overall heat transfer coefficient is equal to 500 kcal m⁻² h⁻¹ K⁻¹. Within the reactor reaction (1) occurs at a rate given by equation (2). The pre-exponential factor for the rate coefficient in equation (2) is 1.14 × 10⁹ L mol⁻¹ h⁻¹ and the activation energy is 16.2 kcal mol⁻¹. The reacting solution has a constant density and a constant heat capacity of 1.17 cal mL⁻¹ K⁻¹. The heat of reaction is 18.2 kcal mol⁻¹ and is independent of temperature. At steady state, what are the outlet temperature and the conversion of A?



$$r_1 = k_1 C_A^2 \quad (2)$$