CE 329 Fall 2015

Class 31 Worksheet

Consider the irreversible, liquid phase reaction A → B 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, and the rate coefficient obeys Arrhenius' law with a pre-exponential factor of 6.37×10^9 L mol^{-1} min^{-1} and an activation energy of 14.3 kcal mol^{-1}. It is desired to convert 90% of the reactant to product adiabatically. Consider the following reactor networks: (a) a single CSTR, (b) a single PFR, (c) two CSTRs in series, (d) a CSTR followed in series by a PFR, and (e) a PFR followed in series by a CSTR. Determine which reactor network requires the smallest total reactor volume. (In each of the reactor networks, the two reactors are not required to have equal volumes.)

Read through the problem statement and make a sketch of the network in which each flow stream, reactor, stream split and stream merge is labeled

Read through the problem statement a second time and (a) assign each quantity given in the problem statement to the appropriate variable symbol (b) choose a basis, if necessary and (c) determine what quantities the problem asks for and assign appropriate variable symbols to them

Write the design equations for each reactor in the network

For each network, set up the equations needed to answer the question