

CHFEN 3553: Chemical Reaction Engineering

Assignment 1: Due January 20, 2006

1. List the top three chemicals produced (on an annual basis) in the United States and Worldwide. Provide a brief description of the processes used to make these chemicals – feedstocks used, the main reactions and product separation methods. List your sources. (Problem P1-12 has 2002 and 1995 data; your task is to update this to 2004, if possible).
2. If the reaction described in example 1-1 is to be carried out in a CSTR, how large would be the CSTR volume? Is it larger than the PFR volume? Why?
3. The reaction A to B is carried out isothermally in a continuous flow reactor. Calculate both the CSTR and PFR volumes necessary to consume 90% A when the entering molar rate is 5 mol/h. Solve the problem for zero, first and second order reactions with the given rate constant.

$$-r_A = k \text{ with } k = 0.075 \frac{\text{mol}}{\text{h-lit}}$$

$$-r_A = kC_A \text{ with } k = 0.01 \text{s}^{-1}$$

$$-r_A = kC_A^2 \text{ with } k = 15 \frac{\text{lit}}{\text{mol-h}}$$

The entering flow rate is 10 liters/hour.

4. A 200 liter reactor is pressurized to 25 atmospheres with a mixture of 60% A and the rest inert. The gas-phase reaction $A \rightarrow B + C$ is carried out at 177°C.
 - a. Assuming ideal gas law, determine the initial number of moles of A and the initial concentration of A.
 - b. Determine the time required for the consumption of 75% A if the rate constant is 0.15/min.
 - c. If the reaction is second order with a rate constant of 0.75 lit/mol-min and is carried out at 177°C find the time required to consume 60% of A and the pressure in the reactor at that time.