

系所:化材系

科目: 化工動力學

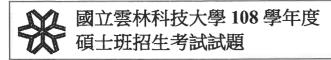
1. The reaction (A \rightarrow B) is carried out in a CSTR, wherein the reaction data is listed as • following. The species A enters the reactor at a molar flow rate of 0.5 mol/s. The entering volumetric flow rate is 0.002 m³/s.

Conversion of A (%)	Reaction rate (mol/m ³ -s)
0	0.45
10	0.37
20	0.30
40	0.195
60	0.113
70	0.079
80	0.040

- (a) Please calculate the volume of CSTR to achieve 80% conversion of A. (13%)
- (b) Please calculate the space time in hour to achieve 80% conversion of A. (6%)
- (c) Please calculate the space velocity to achieve 80% conversion of A. (6%)
- 2. The reaction (A→C) is carried out in a CSTR, wherein the reaction data is listed as following. The species A enters the reactor at a concentration of 1.0 mol/L.

Reaction time (min)	Concentration of A in the reactor (mol/L)
0	1.000
0.5	0.855
1.0	0.730
1.5	0.624
2.0	0.533
3.0	0.390
4.0	0.285
6.0	0.152
10.0	0.043

- (a) If the rate equation obeys first order $(-\gamma_A = kC_A)$, please derive <u>reaction time</u> (t) as a function of <u>conversion of A</u> (χ) and evaluate the rate constant. (17%)
- (b) If the rate equation obeys second order $(-\gamma_A = kC_A^2)$, please derive <u>reaction time</u> (t) as a function of <u>conversion of A (χ)</u>. (8%)



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- 3. (25%) The gaseous reaction $A \rightarrow B$ is carried out in a tubular reactor system consisting of 10 parallel 10m long tubes with a 20cm inside diameter. Preliminary experiments have determined the reaction rate constant for this first-order reaction as $0.001 \, \mathrm{s}^{-1}$ at 300K and $0.003 \, \mathrm{s}^{-1}$ at 350K. A has a molecular weight of 100. Assuming ideal gas behavior is followed and no reverse reaction is happened. At what temperature the reaction rate constant can reached $0.01 \, \mathrm{s}^{-1}$ and what conversion of A can be reached at this temperature with a feed rate of 3.14 ton/h of pure A and an operating pressure of 8.2 atm?
- 4. (15%) It is known that

$$A \longrightarrow B$$
 $r_B = k_B C_A^2$
 $A + B \longrightarrow 2C$ $r_C = k_C C_A C_B$

If C is the desired product, what is the instantaneous selectivity of C to B? What kind of reactor or reactor combinations and at what temperatures would you use for the reaction system?

$$C_{A0} = 4 \text{ mol/dm}^3 \text{ k}_B = 1 \text{ dm}^3/\text{mol} \cdot \text{min at } 300 \text{K with } E = 4000 \text{ cal/mol}$$

 $k_C = 1 \text{ dm}^3/\text{mol} \cdot \text{min at } 300 \text{K with } E = 12000 \text{ cal/mol}$

5. (10%) Please briefly describe the characteristics, usage, advantages, and disadvantages of Plug Flow reactors (PFR) and Batch reactor.