國立雲林科技大學 112 學年度 碩士班招生考試試題

系所：化材系

科目：化工動力學

1. Please show how to obtain the designed equations for batch reactor, continuous stirred-tank reactor (CSTR), and tubular flow reactor, respectively. (21%)

2. 100 moles of B are to be produced hourly from a feed consisting of a saturated solution of A (C_{A0}= 0.1 mol/liter) in a mixed flow reactor. The reaction is

$$A \rightarrow B, \text{ and}$$

reaction rate of B $r_B = (0.2/hr) \bullet C_A$

Cost of reactant at C_{A0}= 0.1 mol/liter is

NT$ 0.5/mole A.

Cost of reactor including instillation, auxiliary equipment, instrumentation, overhead, labor, etc., is

NT$ 0.01/(hr·liter).

What reactor size, feed rate, and conversion shall be used for optimum operations? What is the unit cost of B for these conditions if unreacted A is discarded? (19%)

3. Acetaldehyde vapor is decomposed in an ideal tubular-flow reactor according to the reaction:

$$CH_3CHO \rightarrow CH_4 + CO$$

The reactor is 3.3 cm ID and 80 cm long and maintained at a constant temperature 518℃. The acetaldehyde vapor is measured at room temperature and slightly above atmospheric pressure. For consistency, the measured flow rate is corrected to the standard condition (0℃, 1atm). In one run, 35% of the acetaldehyde is decomposed in the reactor. The second-order specific rate constant is 0.33 liter/(s)(g mol) at 518 ℃, and the reaction is irreversible. The pressure is essential atmospheric. Calculate the actual residence time. (10%)

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4. Consider the following complex reactions in a reactor:

$3A \rightarrow B + 2C$ $\quad -r_{1A} = k_{1A}C_A$

$A + 2B \rightarrow 3D$ $\quad r_{2D} = k_{2D}C_AC_B^2$

What are the net rates of reaction for A, B, C, and D (r_A, r_B, r_C, and r_D)? (16 %)

5. A liquid-phase irreversible reaction $A \rightarrow B, -r_A = kC_A^n$, was carried out in a constant-volume batch reactor where the variation of concentration was recorded as follows:

t, min	0	10	20	30	40
C_A, M	1	0.16	0.0625	0.0331	0.0204

Determine the reaction order (n) and the rate constant (k). (20%)

6. Substance A in a liquid-phase reactor produces B and C by the following parallel reactions:

$$A \rightarrow B, \quad r_B = k_1C_A, \quad k_1 = \alpha_1 e^{-\frac{E_1}{RT}}$$

$$A \rightarrow C, \quad r_C = k_2C_A, \quad k_2 = \alpha_2 e^{-\frac{E_2}{RT}}$$

where $\alpha_1 = 10^{15}\ s^{-1}$, $\alpha_2 = 5 \times 10^{16}\ s^{-1}$, $E_1 = 89\ \frac{kJ}{mol}$, and $E_2 = 100\ \frac{kJ}{mol}$. What temperature makes that $r_B = r_C$? (14%)