國立高雄大學 112 學年度研究所碩士班招生考試試題

科目：化工動力學
考試時間：100 分鐘
系所：化學工程及材料工程學系
(無組別)
是否使用計算機：是
本科原始成績：100 分

1. Gaseous reactant A decomposes as follows: $A \rightarrow 3R$, $-r_A = (0.6\ min^{-1})C_A$

Find the conversion of A in a 60% A-40% inert feed (ν_0 = 100 liters/min, C_{A0} = 1 mol/liter) to a $1m^3$ continuous stirred tank reactor (CSTR). (24%)

2. Dibutyl phthalate (DBP) is produced from mono-n-butyl phthalate (MBP) with butanol in liquid phase and catalyzed with H_2SO_4 in a continuous stirred tank reactor (CSTR), according to the following reaction:

$$MBP + butanol \rightarrow DBP + H_2O$$

It is assumed as elementary reaction. The reactants are in separate tanks, with 4 mol/liter of NMP and 2 mol/liter butanol, and they are fed at a rate of 20 and 60 liters/h, respectively. Both are mixed before entering the reactor. The specific rate is equal to 4.4×10^{-2} liter/(mol.h). Calculate the volume and space time (τ) of the reactor to a conversion of 60% of limiting reactant. (26%)

3. Determine the rate of formation of Hydrogen bromide (HBr) considering the mechanism of chain reaction: (25%)
(a) Initiation:

$$Br_2 \xrightarrow{k_1} 2Br^*$$

(b) Propagation of the chain:

$$Br^* + H_2 \underset{k_2'}{\overset{k_2}{\rightleftharpoons}} HBr + H^*$$

$$H^* + Br_2 \xrightarrow{K_3} HBr + Br^*$$

….

(c) Termination:

$$2Br^* \xrightarrow{K_4} Br_2$$

4. We wish to treat 10 liters/min of liquid feed containing 1 mol A/liter to 99% conversion. The stoichiometry and kinetics of the reaction are given by

$$A \rightarrow R, \qquad -r_A = \frac{C_A}{0.2 + C_A} \frac{mol}{liter.min}$$

Suggest a good arrangement or method for doing this using two continuous stirred tank reactors (CSTR), and find the size of the two reactors needed. (25%)