淡江大學 101 學年度碩士班招生考試試題

系別：化學工程與材料工程學系　　科目：化工熱力學 50%

考試日期：2 月 26 日(星期日) 第 3 節　　本試題共 3 大題，1 頁

本試題雙面印刷

Problem 1 (15 points)

Fifty kmol per hour of air is compressed from $P_1 = 1.2$ bar to $P_2 = 6.0$ bar in a steady-flow compressor. Delivered mechanical power is 98.8 kW. Temperatures and velocities are $T_1 = 300$ K, $u_1 = 10$ m/s, $T_2 = 520$ K and $u_2 = 3.5$ m/s. Estimate the rate of heat transfer from the compressor. Assume for air that $C_p = 3.5$ R and the enthalpy is independent of pressure.

Problem 2 (15 points)

Explain the following terminologies: (a) the efficiency of a heat engine, (b) the coefficient of performance of a refrigerator, (c) fugacity?

Problem 3 (20 points)

The molar volume (cm^3/mol) of a binary liquid mixture at T and P is given by:

$$V = 120x_1 + 70x_2 + (15x_1 + 8x_2)x_1x_2$$

(a) Find expressions for the partial molar volumes of species 1 and 2 at T and P.

(b) Show that those expressions obtained in part (a) satisfy the Gibbs/Duhem equation.

(c) Plot values of V, $\overline{V}_1$ (the partial molar volume of species 1), and $\overline{V}_2$ vs. x_1. Label points V_1, V_2, $\overline{V}_1^{\infty}$ (the infinite-dilution value of $\overline{V}_1$), and $\overline{V}_2^{\infty}$, and show their values.

背面尚有試題

淡江大學 101 學年度碩士班招生考試試題

系別：化學工程與材料工程學系　　科目：反應工程 50%

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1. The elementary liquid phase series reaction

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C$$
$$A \xrightarrow{k_3} D$$

is carried out in an isothermal batch reactor. The initial concentration of A is C_{A0}. B, C and D are not present in the reactor initially.

(a) Derive a relationship that will express C_B as a function of reaction time. (15%)

(b) Derive the reaction time for which C_B is a maximum. (10%)

2. The first order irreversible gas phase reaction A → B is to be carried out in a packed bed reactor isothermally. Currently 1000 kg of catalyst are packed in a 4 cm diameter pipe. The catalyst particles are 0.5 cm in diameter and the bulk density of the packed catalyst is 1000 kg/m^3. Currently 15.0 % conversion of A is realized. The entering pressure is 20 atm and the pressure at the exit of the reactor is 9 atm.

(a) Calculate the pressure parameter in the given equation, α, in the present system.. (5 %)

(b) What conversion could be achieved in a CSTR with the same catalyst weight and no pressure drop? (20 %)

$$\frac{P}{P_0} = \sqrt{1 - \alpha W}$$ for isothermal system with fixed total number of moles.

Where P is the pressure of the stream entering the packed bed reactor

P_0 is the pressure of the stream leaving the packed bed reactor

α is the pressure parameter

W is the weight of catalyst in the packed bed reactor

Given integral $\int_0^W (1-\alpha W)^{1/2}\, dW = \frac{2}{3\alpha}\left[1-(1-\alpha W)^{3/2}\right]$

背面尚有試題