

淡江大學 110 學年度日間學制寒假轉學生招生考試試題

系別：化學工程與材料工程學系三年 科目：質能均衡

19-1

考試日期：1月19日(星期三) 第1節

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1. A liquid stream flowing at 100 g/min contains 0.3 mole fraction benzene ($M_w=78$ g/mol) and the balance 0.7 mole fraction toluene ($M_w=92$ g/mol).
 - (a) Calculate the average molecular weight. (10%)
 - (b) Calculate the molar flow rate of benzene in the stream. (15%)

2. A liquid mixture of benzene and toluene contains 55% benzene by mass. The mixture is to be partially evaporated to yield a vapor containing 85% benzene and a residual liquid containing 10.6% benzene by mass. Suppose that the process is to be carried out continuously and under steady state, with a feed rate of 100 kg/h of the 55% mixture. Let V (kg/h) and L (kg/h) be the mass flow rates of the vapor and liquid product streams, respectively. Calculate the mass flow rates of the vapor (V) and liquid (L). (10%)

3. 100 mol/min C_4H_8 is fed into a reactor, and 50% reacts. Consider the below reaction:

$$C_4H_8 + 6O_2 \rightarrow 4CO_2 + 4H_2O$$

At what rate is water formed? (10%)

4. 500 kg/h steam drives a turbine. The steam enters the turbine at 44 atm and 450°C at a linear velocity of 60 m/s and leaves at a point 5 m below the turbine inlet at atmospheric pressure and a velocity of 360 m/s. The turbine delivers shaft work at a rate of 70 kW, and the heat loss from the turbine is estimated to be 10000 kcal/h. Calculate the specific enthalpy change associated with the process and draw a process flowchart. ($1J=0.239 \times 10^{-3} \text{kcal}$) (20%)

5. Strawberries contain about 15 wt.% solids and 85 wt% water. To make strawberry jam, crushed strawberries and sugar are mixed in a 45:55 mass ratio, and the mixture is heated to evaporate water until the residue contains one-third water by mass.
 - (a) Draw and label a flowchart of this process. (10%)
 - (b) Do the degree-of freedom analysis and show that the system has zero degrees of freedom (i.e., the number of unknown process variable equals the number of equations relating them). If you have too many unknowns, think about what you might have forgotten to do. (10%)
 - (c) Calculate how many pounds of strawberries are needed to make a pound of jam. (15%)