淡江大學97學年度轉學生招生考試試題

41

系別：化學工程與材料工程學系三年級　科目：質　能　均　衡

可否使用計算機			
可	√	否	

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1. (25%)

The following dimensionless equation correlates the values of variables in a system in which solid particles are suspended in a flowing gas.

$$\frac{k_g d_p y}{D} = 2.00 + 0.600(\mu/\rho D)^{1/3}(d_p v\rho/\mu)^{1/2}$$

Both $(\mu/\rho D)$ and $(d_p v\rho/\mu)$ are dimensionless groups. k_g is a coefficient that expresses the rate at which a particular species transfers from the gas to the solid particles.

The values of k_g is needed to design a catalytic reactor. Since this coefficient is difficult to determine directly, values of other variables are measured or estimated, and k_g is calculated from the given correlation. The variable values are as follows:

$d_p = 5.00mm$

$y = 0.100$ (dimensionless)

$D = 0.100cm^2/s$

$\mu = 1.00\times10^{-5} N\cdot s/m^2$

$\rho = 1.00\times10^{-3} g/cm^3$

$v = 10.0m/s$

What is the estimated value of k_g? (Show units)

2. (25%)

Acrylonitrile is produced in the reaction of propylene, ammonia, and oxygen:

$$C_3H_6 + NH_3 + \frac{3}{2}O_2 \rightarrow C_3H_3N + 3H_2O$$

The feed contains 12.0 mol% propylene, 15.0 mol% ammonia, and 73.0 mol% air. A fractional conversion of 40.0% of the limiting reactant is achieved. Taking 100 mol of feed as a basis, determine which reactant is limiting, the percentage by which each of the other reactants is in excess, and the molar amounts of all product gas constituents for a 40% conversion of the limiting reactant.

3. (25%)

Methane is burned with air in a continuous steady-state combustion reactor to yield a mixture of carbon monoxide, carbon dioxide, and water. The reactions taking place are

$$CH_4 + \frac{3}{2}O_2 \rightarrow CO + 2H_2O \quad (1)$$

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O \quad (2)$$

The feed to the reactor contains 8.20 mol% CH_4, 19.30 mol% O_2, and 72.50 mol% N_2. The percentage conversion of methane is 90.0%, and the gas leaving the reactor contains 8 mol CO_2/ mol CO. Carry out a degree-of–freedom analysis on the process. Then calculate the molar composition of the product stream.

本試題雙面印製

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4. (25%)

Fresh air containing 5.00 mol% water vapor is to be cooled and dehumidified to a water content of 2.50 mol% H_2O. A stream of fresh air is combined with a recycle stream of previously dehumidified air and passed through the cooler. The blended stream entering the unit contains 3.00 mol%H_2O. In the air conditioner, some of the water in the feed stream is condensed and removed as liquid. A fraction of the dehumidified air leaving the cooler is recycled and the remainder is delivered to a room. Taking 100 mol of dehumidified are delivered to the room as a basis of calculation, calculate the moles of fresh feed, moles of water condensed, and moles of dehumidified air recycled.