國立雲林科技大學 108 學年度 碩士班招生考試試題

系所:化材系

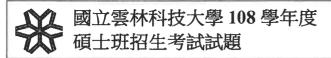
科目:單元操作與輸送現象

1. Please explain the following terms:

- (a) incompressible fluid (3%)
- (b) hydraulic radius (3%)
- (c) kinematic viscosity (3%)
- (d) Newtonian fluid (3%)
- (e) friction factor (3%)
- 2. A packed bed is composed of cylinders having a radius R = 0.01 m and a length h = 0.02 m. The bulk density of the overall packed bed is 950 kg/m³ and the density of the solid cylinders is 1600 kg/m³.
 - (a) What is the void fraction? (3%)
 - (b) What is the effective diameter of the particles? (6%)
 - (c) What is the ratio of total surface area in the bed to total volume of bed (void volume plus particle volume)? (6%)
- 3. In a process in which A is used as a solvent, it is evaporated into dry nitrogen. At 300 K and 101.3 kPa, the resulting mixture has a percentage relative humidity of 50. It is required to recover 85 % of the A present by cooling to 285 K and compressing to a suitable pressure. What should this pressure be? (20%) Vapor pressure of A at 300 K = 12.3 kPa; at 285 K = 6 kPa

Molecular weight of A = 80 g/mole

- 4. A copper sphere of radius R and thermal conductivity k is initially in equilibrium at 500 K in a hot oil bath. It is suddenly removed from the bath and cooling in air at 300 K. The convection heat transfer coefficient for this cooling process is h.
 - (a) Write the conservation equation of the transient conduction occurs in the sphere. (6%)
 - (b) What are the initial condition and the boundary conditions of this system? (3%)
 - (c) Under what physical condition the temperature in the sphere can be regarded as uniform? (5%)
 - (d) Write the approximate energy balance equation for the transient conduction in this solid sphere if the lumped capacitance method can be applied. (6%)



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5. Gas A diffuses through a stagnant film of gas surrounding a catalyst particle. A undergoes the following reaction 2A → B at the particle surface, instantaneously, B diffuses back through the stagnant film into the bulk. The catalytic surface is considered as a flat surface. Assuming isothermal conditions,

(a) obtain an expression for the local reaction rate in terms of the effective gas-film thickness (δ) and the bulk gas stream compositions X_{Ao} and X_{Bo} (7%)

(b) evaluate the concentration profiles of A in the stagnant film. (8%)

- 6. Please give the SI units of the following terms:
 - (a) thermal conductivity (3%)
 - (b) heat transfer coefficient (3%)
 - (c) thermal diffusivity (3%)
 - (d) mass transfer coefficient (3%)
 - (e) Nusselt number (3%)