淡江大學 107 學年度碩士班招生考試試題

15-1

系別：化學工程與材料工程學系 A 組　科目：輸送現象與單元操作

考試日期：3 月 11 日(星期日) 第 1 節　本試題共 5 大題， 1 頁

1. Define the following physical quantities and describe their physical significances:
   (a) Viscosity for Newtonian fluid [5 pts]
   (b) Reynolds number [5 pts]
   (c) Sherwood number [5 pts]
   (d) Efficiency for a fin [5 pts]
   (e) Thermal diffusivity [5 pts]

2. An incompressible fluid involving strong exothermic chemical reactions and moving in a circular tube has density ρ and velocity $\vec{v} = v_r \underline{i}_r + v_z \underline{i}_z$. ***Derive*** the equation of continuity for this fluid. [15 pts]

3. A fluid flows at steady state in a vertical tube under the action of an applied pressure gradient and gravity. The density of the fluid is ρ. The tube has a length L and a diameter D. The inlet and outlet pressures of the fluid are P_o and P_L, respectively. Develop the momentum equation of this fluid. [15 pts]

4. A double-pipe heat exchanger uses water (W), which is available at 40 °C, to cool ethylene glycol (EG) from 100 to 60 °C. The flow rates of water and ethylene glycol are each 0.5 kg/s. (Average specific heat: $\tilde{c}_{p,EG} = 2650$ J/(kg·K) and $\tilde{c}_{p,W} = 4178$ J/(kg·K).)
   (a) What are the maximum possible heat rate ($q_{max.}$) and the effectiveness (ε) of the exchanger? [10 pts]
   (b) Which is preferred, a parallel-flow or counter-flow mode of operation? Show relative calculation to support your answer. [10 pts]

5. Acetone (CH_3COCH_3) is removed from a 1.5 mol% acetone-air mixture by scrubbing with water in packed tower, so that 90 mol% of the acetone is removed. The gas mixture enters at 0.035 kmoles/(m^2·s) and the water enters at 0.09 kmoles/(m^2·s). The system obeys Henry's law and $y_e = 1.80x$, where y_e is the equilibrium molar fraction of acetone in the vapor with a molar fraction x in the liquid. The system operates at 101.3 kPa and $K_G a$ may be taken as 1.5×10^{-4} kmol/(m^3·s·kPa). What should be the height of the tower? [25 pts]