CHL 203: Transport Processes
MAJOR EXAM (30.11.2006)
Timings 10:30 – 12:30, Block II - 378

Time: 2 hour **Total Marks: 48**

Q.1. Discuss the following:
(a) Mixing in low and high viscosity liquids;
(b) Shear dependent and Viscoelastic behaviour
(c) Explain heat transfer coefficients for heat transfer with phase change.
(d) Condition that justify the use of fin for heat transfer
(e) Heat transfer coefficients in forced convection

(10 marks)

Q.2. Hot oil (C_p = 0.5 Btn/1b°F) flows through a shell and tube heat exchanger (U= 135 Btn/hr-1t^{2o}F) at a rate of 50,000 lb/hr with an inlet temperature of 330°F and an outlet temperature of 150°F. Cold oil (C_p = 0.4 Btn/1b°F) flows at a rate of 80,000 lb/hr and leaves at 300°F. Determine the area needed in the heat exchanger.

(6 marks)

Q.3. A double pipe heat exchanger has a total surface area of 17.5m^2 and is used for cooling oil at 200°C with a mass flow rate of 10,000 kg/hr having a specific heat of 1900 J/(kg.k). Water (specific heat of 4182 J/Kg.k) at a flow rate of 3000 kg/hr is available at 20°C as cooling agent. If overall heat transfer coefficient is 300 W/m^2.k, estimate the temperature of oil at the exit if it is operated a) in a parallel flow mode and b) in a counter flow mode.

(8 marks)

Q.4. Write the significance of the following in heat exchanger:
i) Floating head tube sheet.
ii) Tube pitch
iii) Pressure drop

(6 marks)

Answer any three of the following:

Q.5. A sphere (25 mm dia) and a cube (25 mm size) both made of copper (ρ = 950 kg/m^3, C_p = 0.38 KJ/Kg K, k = 385 W/mK)are heated in a furnace to 650^0 C and are then annealed in air at 95^0 C. If the external heat transfer coefficient is 75 W/m^2 K, what will be the temperature of the sphere after 5 mins?

(6 marks)

Q.6. A solution (ρ= 1500 kg/m^3, μ = 100 cp) is agitated in a mixing tank of 0.5m in diameter, fitted with two baffles (10% of tank diameter) and provided with a flat blade turbine. To achieve the required degree of mixing the rotor speed is maintained at 1000 rpm.
a) Determine the power input required.
b) What would be the % change in power input if the viscosity is increased by 100 times?

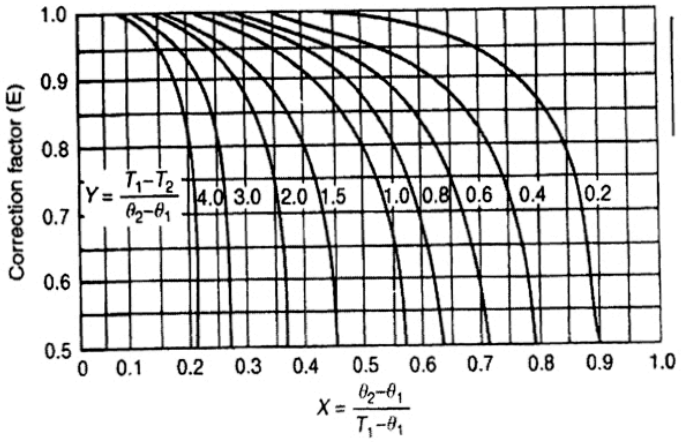
(6 marks)

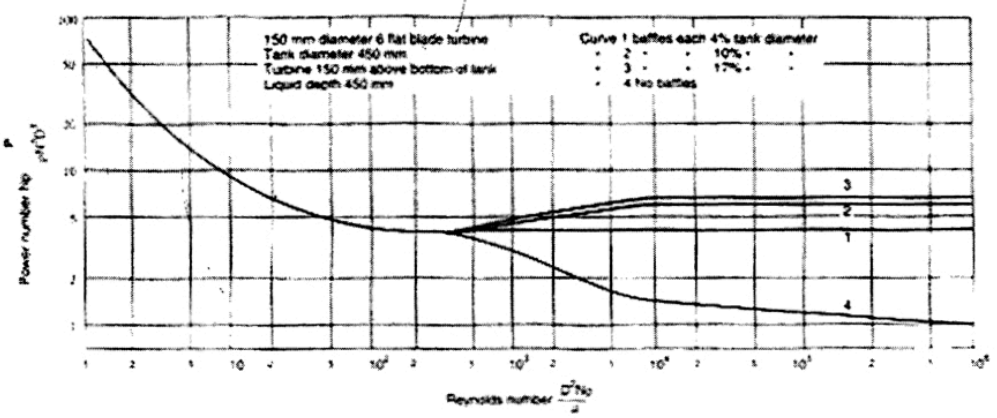
Q.7. An insulated steel pipe is being used to transport steam ($K_{steel} >> K_{insulation}$) having D_p = dia of pipe, D_1 = inside dia of insulation, D_2 = outside dia of insulation and h as the convective heat transfer coefficient on outside surface of insulation. Derive the relationship between insulation radius and quantity of heat flow.

(6 marks)

Q.8. The difference in water surface elevations in two reservoirs A and B is 10 m and the gauge pressure of the air space in A is 50kN/m^2. They are connected by a single pipe 200 m long and 20 cm in diameter. If the friction factor for the pipe is 0.02, calculate the discharge.

(6 marks)





Power number versus Reynolds number