Process Equipment Design-II (ChBC-61)
Assignment I

2nd May 2020

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1. Design an exchanger to subcool condensate from a methanol condenser from 95°C to 40°C. Flow rate of methanol 100,000 kg/h. Brackish water will be used as the coolant, with a temperature rise from 25° to 40°C.
2. Gas oil at 200°C is to be cooled to 40°C. The oil flow rate is 22,500 kg/h. Cooling water is available at 30°C and the temperature rise is to be limited to 20°C. The pressure drop allowance for each stream is 100 kN/m^2.
3. What is the significance of log mean temperature difference?
4. Estimate the heat transfer coefficient for steam condensing on the outside, and on the inside, of a 25mm o.d., 21mm i.d. vertical tube 3.66m long. The steam condensate rate is 0.015 kg/s per tube, and condensation takes place at 3 bar. The steam will flow down the tube.
5. Design a condenser for the following duty: 45,000 kg/h of mixed light hydrocarbon vapors to be condensed. The condenser to operate at 10 bar. The vapor will enter the condenser saturated at 60°C, and the condensation will be complete at 45°C. The average molecular weight of the vapors is 52. The enthalpy of the vapor is 596.5 kJ/kg and the condensate 247.0 kJ/kg. Cooling water is available at 30°C, and the temperature rise is to be limited to 10°C. Plant standards require tubes of 20mm o.d., 6.8mm i.d., 4.88m (16 ft) long, of admiralty brass. The vapors are to be totally condensed and no subcooling is required.
6. What are the three types of reboilers?
7. Estimate the heat transfer coefficient for the pool boiling of water at 2.1 bar, from a surface at 125°C. Check that the critical flux is not exceeded.
8. A fluid whose properties are essentially those of o-dichlorobenzene is vaporized in the tubes of a forced convection reboiler. Estimate the local heat transfer coefficient at a point where 5% of the liquid has been vaporized. The liquid velocity at the tube inlet is 2 m/s and the operating pressure is 0.3 bar. The tube inside diameter is 16 mm, and the local wall temperature is estimated to be 120°C.
9. What are single and multiple-effect evaporators?
10. A single-effect evaporator is to concentrate 9070 kg/h of a 20% solution of sodium hydroxide to 50% solids. The gauge pressure of the steam is to be 1.37 atm, the absolute pressure in vapor space is to be 100 mmHg. The overall coefficient is estimated to be 1400 W/m^2-°C. The feed temperature is 37.8°C. Calculate the amount of steam consumed, the economy and the heating surface required.

Due Date: 12th May 2020

Assignment should be handwritten, scanned and emailed at fatima@nitsri.ac.in.