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12MTP31

Third Semester M.Tech. Degree Examination, Dec.2013/Jan.2014

Design of Heat Transfer Equipments for Thermal Power Plant

Time: 3 hrs. Max. Marks: 100

Note: 1. ***Answer any TWO full questions from PART-A and ONE full question form PART-B.***
2. ***Use of design data handbook, charts and standards is permitted.***

PART – A

1 20, 160 lb/hr of a 30% K_3PO_4 solution, specific gravity at 120°F = 1.3, is to be coded from 150 to 90°F using well water from 68 to 90°F.Pressure drops of 10 psi are allowable on both streams, ϕ a total dirt factor of 0.002 is required. Available for this service is a 10.02 in ID 1.2 exchanger having 52, 3/4 in OD, 16 BWG tubes 16'0" long laid out on 1 in square pitch. The bundle is arranged for two passes and baffles are spaced 2 in apart. Will the exchanger be suitable? **(25 Marks)**

2 6,900 lb/hr of 26° API lube oil must be cooled from 450 to 350°F by 72,500 lb/hr of 34° API mid-continent crude oil. The crude oil will be heated from 300 to 310°F. A fouling factor of 0.003 should be provided on each stream and allowable pressure drop on each stream in 10 psi. A number of 20-ft hairpins of 3 by 2 in IPS pipe are available. How many must be used and how shall they be arranged? For lube oil, viscosities of 1.4 C_p at 500°F and 3.0 C_p at 400°F may be assumed. **(25 Marks)**

3 a. Flue gas from a boiler leave at 700°F. As quantity is 5,00,000 lb/hr. It is proposed to install an economizer to heat 4,00,000 lb/hr of feed water from 220°F to 350°F; using waste gas. If energy costs $2/MM BTU and an economizer costs $15/ft^2 of surface. Find annual savings for 1000 hr of operation. **(10 Marks)**

b. Find exit air and flue gas temperature in an air pre-heater for the following operating conditions:

Air and flue gas inlet temperature = 620°F and 80°F
Quantity of flue gas = 300000 lb/hr
Quantity of air = 250000 lb/hr
Area of air preheater = 23,640 ft^2
Overall heat transfer coefficient 'W' = 4.2 BTU/ft^{2}hr°F.

Use NTU method for calculation. **(06 Marks)**

c. In a coal fired furnace, the furnace exit wall temperature is 1366°K. Beam length of upper furnace is 4.5 m. The area to radiant superheater is 480 ft^2. Excess air used is 25% and ash content is 20% HHV = 10,000 BTU/lb. Let the number of tubes be 36 and ST/d = 8, flue gas quantity 'Wg' = 10.3 kg/kg of fuel. Ash concentration 'μ' = 20.2 g/Nm^3. Find emissivity of gas. **(09 Marks)**

PART – B

4 a. What are cooling towers? What are the factors that affect cooling of water in a cooling tower? **(05 Marks)**

b. Explain any two types of cooling tower. **(10 Marks)**

c. A plant is laid out in a restricted water locality. The total heat load to be removed by the cooling tower is 26,000,000 Btu/hr. The locality has a 5 percent WBT or 75°F. The water will leave the tower with 10° approach to WBT or 85°F. The water emerge from the equipment at a temperature of 120°F. The water equivalent to this range is 1500 gpm. A tower 24 × 24 ft has been erected and fan capacity is 187,000 cfm. How many diffusion units the tower be capable of performing to fill the requirements? **(35 Marks)**

5 A quantity of 220,000 lb/hr of steam at 1.5 in.Hg has to be condensed using cooling water at 60°F. Cupronickel tube (90-10) of 1 in OD and ¾ in OD of thickness 14, 18 and 20 BWG are available. The exit cooling water temperature is 75°F. Study the alternatives and suggest the optimum choice. Assume A value of 1041 BTU/lb for latent heat. **(50 Marks)**

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