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10MTP31

Third Semester M.Tech. Degree Examination, December 2012
Design of Heat Transfer Equipment for Thermal Power Plant

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer any TWO full questions from Part – A and any One full question from Part – B.***
2. ***Use of design data hand book is permitted.***
3. ***Missing data, if any, may be suitably assumed.***

Part – A

1 7000 lb/hr of aniline is to be heated from 100 to 150°F by cooling 10000 lb/hr of toluene with an initial temperature of 185°F in 2×1.25 inch. IPS double pipe hairpin exchangers 15 ft long. Pressure drops of 10 psi are allowable, and a dirt factor of 0.005 is required.
a) How many hairpin sections are required?
b) What is the final dirt factor?
Assume final temperature of toluene 160°F. **(25 Marks)**

2 43800 lb/hr of a 42° API kerosene leaves the bottom of a distilling column at 390°F and will be cooled to 200°F by 149000 lb/hr of 34° API mid continent crude coming from the storage at 100°F and heated to 170°F. A 10 psi pressure drop is permissible on both streams. A combined dirt factor of 0.003 should be provided. Available for this service $21\frac{1}{4}$ inch ID exchanger having 158 number of tubes, 1 inch OD, 13 BWG, 16 ft long and layed out on $1\frac{1}{4}$ inch square pitch. The bundle is arranged for 4 passes and baffle plates are spaced 5 inch apart. Will the exchanger be suitable? What is the dirt factor? **(25 Marks)**

3 A quantity of 500000 lb/hr of flue gas from a boiler is cooled from 700°F, 400000 lb/hr of air at 80°F is heated up to 400°F. Design a suitable air preheater 2 inch OD $\times$ 0.087 inch thick carbon steel tubes are available. Assume $\frac{S_T}{d} = 1.5$ and $\frac{S_L}{d} = 1.25$ having in line arrangement.
(25 Marks)

Part - B

4 A quantity of 220000 lb/hr of steam at 1.5 inch Hg has to be condensed using cooling water at 60°F cupronickel tubes of 1 inch OD and $\frac{3}{4}$ inch OD of thickness 14, 16, 18 BWG are available. It is desirable to limit exit cooling water temperature to 75°F from cooling tower performance consideration. A value of 950 Btu/lb may be used for latent heat. Study the alternative and suggest the optimum design. **(50 Marks)**

5 a. Explain the influence of following process conditions on the design of cooling tower:
   i) Unsaturation of inlet air.
   ii) Close approach.
   iii) Changing the L/G ratio.
   iv) Location of the operating range. **(20 Marks)**

   b. A plant is being layed out in a restricted water locality. The total heat load to be removed from the several process in a cooling tower is 26×10^6 Btu/hr. The locality has a 5% WBT of 75°F. The water will live the tower with a 10% approach to the wet bulb are 85°F. Being water of ordinary air and mineral content it will emerge from equipment at a maximum temperature of 120°F. The water equivalent to this range is 1500 GPM. A tower 24 by 24 ft has been erected with a fan capacity of 187000 ft^3/min. How many diffusion units must tower be capable of performing to fulfill the process requirement. (1GPM = 500 lb/hr) **(30 Marks)**

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