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B. M. S. College of Engineering, Bengaluru - 560019

Autonomous Institute Affiliated to VTU

August 2024 Supplementary Examinations

Programme: B.E.   Semester: VII
Branch: Chemical Engineering   Duration: 3 hrs.
Course Code: 19CH7DELE2   Max Marks: 100
Course: Pilot Plant and Scale up Studies

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

UNIT - I

1. a) How is process development carried out in practice? Explain. **10**

   b) What are prototypes, pilot plants, and models? **04**

   c) Explain the quantities that enter into a rate equation and how they contribute to possible errors in scaling. How are these errors avoided? **06**

UNIT - II

2. a) In the orifice meters a flat disk with a central opening of diameter D_0 is set across a pipe of diameter D, and the pressure drop Δp across the opening is measured. It is postulated that Δp is function of the average fluid velocity in the pipe $\bar{V}$, the density of the fluid ρ, the fluid viscosity μ, and the diameters of the pipe and the opening, D and D_0, respectively. Thus, $\Delta p = \Phi\left(\bar{V}, \rho, \mu, D, D_0\right)$. Find an acceptable set of dimensionless groups which relate these various factors. (use Rayleigh's method) **10**

   b) How can similarity criteria be obtained from differential equations? What are the advantages? **10**

UNIT - III

3. a) Discuss the importance of static, dynamic and mixed regimes. **10**

   b) What is 10° temperature coefficient? How it can be used in controlling regime? **10**

UNIT - IV

4. a) Discuss the generalized dimensionless equation for fluid motion in mixers. **05**

   b) What are the applications of mixing equipment? **05**

   c) A heavy tar-oil emulsion is to be prepared batch-wise in a steam-jacketed pan fitted with a stirrer. The procedure is to charge the pan with **10**

cold water, heat it to 60°C, using the stirrer to accelerate heat transfer, then run in the correct quantity of hot tar-oil mixed with emulsifying agent from a separate tank. Pilot-scale experiments were conducted in a jacketed pan 10 inch in diameter having a propeller stirrer running at 1500 rpm. The heating-up time for a batch was 2.4 minutes, and the measured power consumption was 0.004 hp. The full-sized unit is a geometrically similar jacketed pan 5 feet in diameter having a geometrically similar stirrer. What should the stirrer speed be to give a degree of dispersion equal to that obtained in the small unit, what will be the power consumption, and how long will a charge of water take to heat up? Assume Reynolds index as 0.6.

OR

5. a) Discuss the scale up equations of packed bed absorbers. **10**

b) A petroleum thermal cracking still contains 68 tubes of 30 ft. long by 3 in. ID followed by 78 tubes of 30 ft. long by 4 in. ID, arranged to carry two streams of oil in parallel. The throughput is 3000 barrels/day of oil preheated to 300°F. It is desired to construct a model still having a throughput of 10 barrels/day and capable of reproducing the effects of variations in charging stock and operating conditions in the large still. Calculate the diameter and length of the tube required in model. **10**

UNIT - V

6. a) Classify the heat transfer equipment used in model studies. **05**

b) Discuss the differences between distillation and absorption. **05**

c) Briefly discuss the scale-up of momentum transfer system. **10**

OR

7. a) Deduce the scale up equations for forced convection heat transfer equipment. **12**

b) Explain the scale up procedure for distillation and gas absorption units for the effect of packing diameter on HETP or HTU. **08**

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