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CHEMICAL ENGINEERING REGULAR PROGRAM

FILTRATION, DISTILLATION AND GAS ABSORPTION
SET 1

1. This batch filter is a tank with a false bottom, which supports a filter medium.
   a. plate filter
   b. nutsche filter
   c. filter press
   d. leaf filter

2. Of all continuous filters, this is the lowest in cost per unit area of filter when mild steel is used.
   a. disc filter
   b. pan filter
   c. belt filter
   d. drum filter

3. Which of the following is false regarding constant rate filtration?
   a. Slurry is fed by a positive displacement pump.
   b. Start at low inlet pressure then continuously increased to overcome cake resistance.
   c. The flow rate will drop as the cake thickness increases.
   d. Experiment is conducted to measure pressure drop at various time.

4. Which of the following batch filters cannot be used to process a 100-kL/hr slurry for recovery of untreated solids?
   a. vertical pressure filter
   b. horizontal pressure filter
   c. filter press
   d. variable-volume filter

5. Which of the following filter media cannot be used for an dilute aqueous mixture at near atmospheric boiling?
   a. acrylic
   b. fluorocarbon
   c. polyester
   d. polyethylene

6. In a laboratory experiment, a sample is pumped at a constant pressure drop of 5 psi through 0.25 ft^2 of filter medium with negligible resistance. After 3 minutes, 1 gallon of filtrate was collected. The slurry is then filtered using a plate-and-frame press with 16 frames, 4 ft^2 of filtering area per frame, and operating at constant flow rate of 30 gpm. It takes 15 minutes to disassemble, clean, and reassemble the press. The press must be shut down for disassembly when the pressure difference builds up to 10 psi. What is the net filtration rate in gpm for the plate-and-frame filter press?
   a. 26.0
   b. 12.9
   c. 16.7
   d. 20.4

7. Which of the following will increase HETP?
   a. increase channel size for structured packing
   b. decrease particle size for random packing
   c. increase packing surface area
   d. well distributed liquid and vapor

8. To reduce the required flow rate of stripping agent, which of the following operations can be done to optimize the stripping factor?
   a. low temperature, low pressure
   b. high temperature, high pressure
   c. high temperature, low pressure
   d. low temperature, high pressure

9. A packed absorption tower has straight operating line and equilibrium curve with a Henry's constant of 2.81 and without heat effects. What is the number of overall gas-phase mass transfer units if $Y_1 = 0.25$, $Y_2 = 0.05$, and $X_2 = 0.01$ if L_M/G_M is 4?
   a. 5.13
   b. 4.00
   c. 2.89
   d. 10.77

10. It is desired to absorb 90% of the acetone in a gas containing 1.0% mol acetone in air in a countercurrent stage tower. The total inlet gas flow to the tower is 30 kg mol/hr, and the total inlet pure water flow to be used to absorb the acetone is 90 kg mol H_2O/hr. The process is to operate isothermally at 300 K and a total pressure of 101.3 kPa. The equilibrium relation for the acetone in the gas-liquid is $y_A = 2.53x_A$. Determine the number of theoretical stages required for this separation.
   a. 5
   b. 4
   c. 7
   d. 6

11-13. Ammonia in air is being absorbed using pure water at 25 °C and 1 atm abs in a tower with 1-in metal Pall rings. The feed rate is 1440 lb_m/h and contains 0.03 mol fraction of ammonia in air. The liquid to gas mass flow rate ratio is 2.

11. Calculate the flooding velocity.
   a. 7.77 ft/s
   b. 5.55 ft/s
   c. 6.66 ft/s
   d. 3.48 ft/s

12. Determine the tower pressure drop at 50% of the flooding velocity.
   a. 0.35 in H_2O/ft
   b. 0.18 in H_2O/ft
   c. 0.53 in H_2O/ft
   d. 0.04 in H_2O/ft

13. Solve for the tower diameter at 50% of the flooding velocity.
   a. 2.57 ft
   b. 2.21 ft
   c. 0.44 ft
   d. 1.45 ft

14. Which of the following is not a consideration to use a partial condenser in a distillation process?
   a. very light species in the feed that require high pressure to condense
   b. avoid costly refrigeration in the condenser
   c. very low boiling point of the distillate
   d. liquid as desired distillate phase

15. For a T-x-y phase diagram, what is the horizontal line that defines the temperature and intercepts the equilibrium curves?
   a. dew point line
   b. tie line
   c. plait point
   d. bubble point line

16. Which of the following is true at minimum reflux ratio?
   a. The rectification operating line does not cross the equilibrium line.
   b. Separation can be achieved with a finite number of plates.
   c. The driving force for mass transfer is nonzero.
   d. The fixed cost is infinite.

17. The optimum feed-stage location will result to
   a. widest separation for a given number of stages
   b. lowest number of stages to accomplish a specified separation
   c. minimum energy consumption
   d. all of the above

18. What method considers variable molar overflow by employing energy balances with an enthalpy-concentration diagram?
   a. Ponchon-Savarit method
   b. Lewis-Matheson method
   c. Maxwell-Stefan approach
   d. Thiele and Geddes

19-20. A mixture of benzene and toluene is to be separated at 1 atm into a liquid distillate and a liquid bottoms product of 99.9% and 0.1% mol, respectively. At the top of the column, α is 2.53 with benzene as the lighter species, which has a K nearly equal to 1.

19. Using a reflux ratio of 1.88, determine the additional stages for the rectifying section from $y_{i+1} = 0.982$.
    a. 3
    b. 4
    c. 5
    d. 6

20. In the said section, what fraction of toluene in the entering vapor is not absorbed?
    a. 4.3%
    b. 3.4%
    c. 1.7%
    d. 7.1%