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CHEMICAL ENGINEERING REGULAR PROGRAM
FILTRATION, DISTILLATION AND GAS ABSORPTION
SET 2

1. This unit expresses fiber thickness of individual threads of filter cloth.
 - a. tenacity
 - b. tex
 - c. denier
 - d. yield

2. Which of the following is not true regarding washing for a filtration process?
 - a. Washing conditions are the same as those at the end of filtration.
 - b. The cake structure is not affected when the wash liquid replaces the slurry liquid.
 - c. Washing removes residual insoluble solids in cake.
 - d. The final filtering rate of a leaf filter is its predicted washing rate.

3. Which of the following process can filter particles with a size less than 5 nm?
 - a. microfiltration
 - b. macrofiltration
 - c. nanofiltration
 - d. ultrafiltration

4. This material is used to filter gelatinous particles from paints, spinning solutions, and other viscous liquids.
 - a. pressed felt
 - b. granular bed
 - c. filter paper
 - d. metal screen

5. Most continuous filters use vacuum as driving force for filtration. When is pressure as driving force required?
 - a. cake moisture content higher than vacuum
 - b. slurry with volatile liquid
 - c. slurry with liquid far from normal boiling point
 - d. slurry with cold, unsaturated liquid

6. Calculate the specific cake resistance in ft/lb_m from the following CaCO_3 slurry in water filtration data at 20°C at a constant pressure of 30 kPa abs. The area of the plate-and-frame press is 0.045 m^2 and the slurry concentration was $25\text{ kg solid}/\text{m}^3$ filtrate.

V (L)	0.5	1.0	1.5	2.0	2.5	3.0
t (s)	17.3	41.3	72.0	108.3	152.0	201.7

 - a. 2.49×10^{10}
 - b. 1.65×10^{11}
 - c. 5.61×10^{11}
 - d. 9.42×10^{10}

7. This is the drainpipe of a tray where liquid flows from one tray to the tray below.
 - a. inlet weir
 - b. seal pan
 - c. outlet weir
 - d. downcomer

8. Which of the following factors generally favor trays compared to random packings?
- | | |
|------------------------|-----------------------------|
| a. washing and purging | c. material of construction |
| b. low liquid rates | d. corrosive systems |
9. Which among the following tray columns has the lowest installed cost in USD/tray?
- | | |
|-------------------------------|-----------------------|
| a. stainless steel turbogrid | c. carbon steel valve |
| b. stainless steel bubble-cap | d. carbon steel sieve |

10-11. Gas, from a petroleum distillation column, has a concentration of H_2S reduced from 0.03 (kmol H_2S /kmol of inert hydrocarbon gas) to 1% of this value by scrubbing with a triethanolamine-water solvent in a countercurrent tower, operating at 300 K and atmospheric pressure. The equilibrium relation for the solution may be taken as $Y_e = 2X$. The solvent enters the tower free of H_2S and leaves containing 0.013 kmol H_2S /kmol solvent. The flow of inert gas is 0.015 kmol/ $\text{m}^2\text{-s}$ and the overall coefficient for absorption K_{Ga} may be taken as 0.04 kmol/ $\text{m}^3\text{-s}$ (unit mole fraction driving force).

10. What is the total height of the absorber?
- | | |
|----------|----------|
| a. 5.9 m | c. 2.4 m |
| b. 4.2 m | d. 7.8 m |
11. What is the number of overall gas-phase mass-transfer units?
- | | |
|-------|-------|
| a. 21 | c. 15 |
| b. 20 | d. 12 |

12-13. A tower packed with Flexipac Type 2y structured packing (FP2Y) is to be used to remove 99.5% of the ammonia from an air stream containing an ammonia mole fraction of 0.005. The tower is to operate isothermally at 100 °F and 1 atm. The ammonia is to be absorbed in an aqueous solution of nitric acid. The tower diameter has been selected to give an F factor of 2.0 (ft/s)(lb_m/ft^3)^{1/2} and a liquid loading of 15 gal/min. The density of air stream is 0.0709 lb_m/ft^3 and that of water is 62 lb_m/ft^3 . The height transfer units of the gas and liquid are 0.84 ft and 0.58 ft, respectively.

12. What is the liquid to gas ratio (L/G) from calculating the molar fluxes of the gas and liquid?
- | | |
|---------|---------|
| a. 7.25 | c. 5.25 |
| b. 6.25 | d. 4.25 |
13. If Henry's constant for ammonia is 1.72 atm, what is the height of the packing for physical absorption at the same conditions?
- | | |
|------------|------------|
| a. 6.78 ft | c. 6.86 ft |
| b. 6.96 ft | d. 6.68 ft |
14. This is the most common operating regime in distillation where each perforation bubbles vigorously.
- | | |
|--------------------|-----------------|
| a. drop regime | c. froth regime |
| b. emulsion regime | d. spray regime |
15. Which of the following is the appropriate solvent for the extractive distillation of benzene and cyclohexane?
- | | |
|------------------|--------------|
| a. acrylonitrile | c. bisphenol |
| b. phenol | d. aniline |
16. Which of the following is the appropriate entrainer for the azeotropic distillation of nitric acid and water?
- | | |
|------------------|------------|
| a. sulfuric acid | c. benzene |
| b. hexane | d. none |
17. What temperature will form an azeotrope for a mixture of chloroform and acetone at 1 atm?
- | | |
|-----------|-----------|
| a. 823 °R | c. 154 °R |
| b. 608 °R | d. 147 °R |

18-20. 450 lbmol/hr of mixture of 60% mol benzene and 40% mol toluene is to be separated at 1 atm into a liquid distillate and a liquid bottoms product of 95% and 5% mol, respectively. The feed enters the column with a molar percent vaporization equal to the distillate-to-feed ratio.

18. What is the slope of the q-line?
- | | |
|---------|---------|
| a. 0.46 | c. 0.39 |
| b. 0.93 | d. 0.64 |
19. If $R/R_{\min} = 1.3$, what is the slope of the rectifying-section operating line?
- | | |
|---------|---------|
| a. 4.16 | c. 1.59 |
| b. 0.62 | d. 0.41 |
20. Determine the number of equilibrium stages to achieve the desired separation.
- | | |
|-------|-------|
| a. 14 | c. 12 |
| b. 13 | d. 11 |

