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## **CHEMICAL ENGINEERING REFRESHER COURSE**

# **UNIT OPERATIONS PART 2**

## Problems 1 and 2 are based on the following information:

A packed countercurrent cooling tower experiment has humid air flow rate of 1700 gpm, diameter of 1.5-ft, and humid air inlet temperature of 60 °F at 10% RH. The value of K'<sub>y</sub>a is 1.70 kg/m³-s while the slope of the tie line is 9 kJ/kg for a liquid to gas ratio of 1.0.

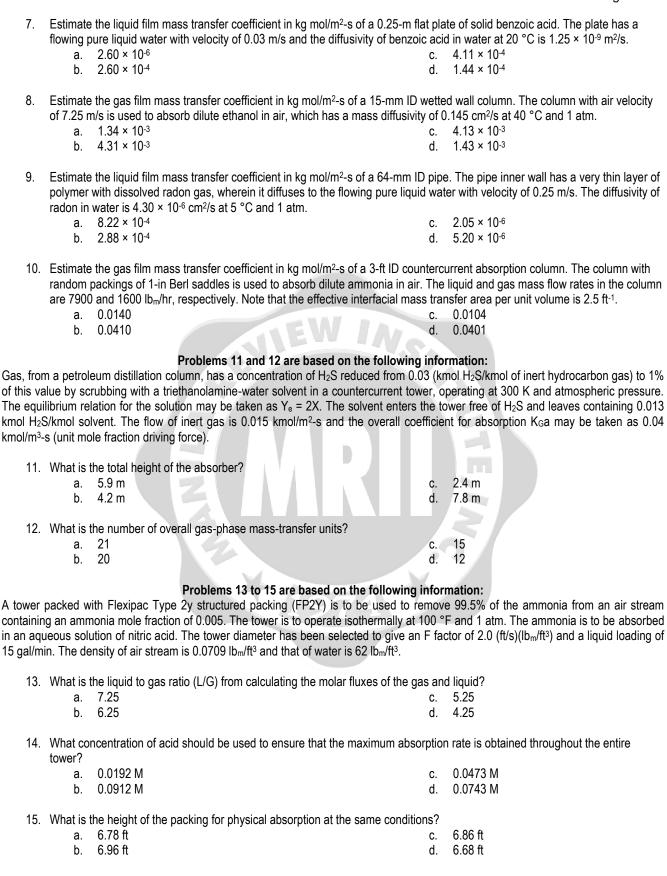
1.	Determine the NTU of the tower.			
	a. 1.47		C.	3.47
	b. 2.47		d.	4.47
2.	Calculate the height of the packed t	tower.		
	a. 3.55 ft		C.	4.47 ft
	b. 5.89 ft		d.	2.26 ft

#### Problems 3 to 5 are based on the following information:

A dryer produces 450 lb<sub>m</sub>/hr of product containing 8% wt water in wet basis when the feed contains 126% wt water in dry basis. Supply air to the dryer is at 212 °F, 100 °F dew point while leaving air is at 150 °F, 60% RH. Part of the leaving air is mixed with the fresh air supplied at 70 °F, 50% RH ahead of the heater. Neglecting the heat lost by radiation and used in heating the solid, conveyor trays, etc.

3.	What is the air requirement of the dryer (dry basis) in lb <sub>m</sub> /hr?  a. 5000  b. 5700	c. d.	6000 6700
4.	What is the heat requirement in BTU/hr of the dryer only? a. 347,400 b. 733,400	c. d.	344,700 433,700
5.	How much heat in BTU/hr is supplied to the heater only? a. 275,200 b. 525,700	c. d.	252,700 725,200

- 6. Which of the following materials and configurations in a through-circulation dryer will have the longest drying time?
  - a. granular silica gal from 82% to 18% wt moisture at 52 °C with an air velocity of 91 m/s
  - b. extruded kaolin from 31% to 0.8% wt moisture at 102 °C with an air velocity of 101.6 m/s
  - c. granulated lead arsenate from 56% to 5% wt moisture at 132 °C with an air velocity of 220 m/s
  - d. scored filter cake of starch potato from 46% to 6% wt moisture at 127 °C with an air velocity of 102 m/s



#### Problems 16 to 18 are based on the following information:

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.

16. What is the slope of the q-line?

a.	0.46	•	C.	0.39
b.	0.93		d.	0.64

17. If R/R<sub>min</sub> = 1.3, what is the slope of the rectifying-section operating line?

a.	4.16	C.	1.59
h	0.62	d	0.41

18. Determine the number of equilibrium stages to achieve the desired separation.

a.	14	C.	12
b.	13	d.	11

19. What temperature will form an azeotrope for a mixture of chloroform and acetone at 1 atm?

a.	823 °R	C.	154 °R
b.	758 °R	d.	147 °R

- 20. Is it possible for Murphree vapor efficiency to be greater than 100%?
  - a. Yes, small column diameter promotes more stream mixing
  - b. Yes, mixing of liquid and gas streams is less in each tray
  - c. Yes, some components may be entrained in the gas phase
  - d. No, equilibrium concentration is the maximum concentration

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