

Code No: R05312305

R05**Set No. 2**

III B.Tech I Semester Examinations, November 2010
MASS TRANSFER AND SEPARATION
Bio-Technology

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. A gas mixture A-air is fed into an absorption tower where absorption of component A in water is taking place at 298 K and 2 std atm. Given that $k_L = 0.122 \text{ kmol A / (hr.m}^2 \text{ (mol A/m}^3\text{))}$. $K_G = 1.32 \text{ k mol A / hr.m}^2 \text{ atm}$, the equilibrium partial pressure of gas A over dilute solution of A in the water is given $p_{Ai} = 0.28(C_{Ai})$ is in atm while C_{Ai} is expressed in terms of mol A/m³. Determine the values of the following mass transfer coefficients. [16]
 - (a) K_Y
 - (b) K_G for gas film
 - (c) K_L
2. (a) Draw and explain apparent adsorption equilibrium diagram when adsorption occurs from concentrated solution.
 (b) Explain contact filtration with neat sketch. [8+8]
3. A ten-plate distillation column with re-boiler and total condenser is available for use. An equimolar liquid mixture of A and B at its boiling point is to be separated to get a distillate containing 90% A (mole%). The relative volatility of mixture is 2.6.
 Calculate:
 - (a) Minimum reflux ratio
 - (b) The yield of distillate and residue for $R = 1.2$. [16]
4. (a) Describe the basic principles of operations of reverse osmosis.
 (b) Explain briefly various modules used in the dialysis process. [8+8]
5. A mixture weighing 1000 kg contains 23.5 wt% acetone and 76.5 wt% is to be extracted by 500 kg methyl isobutyl ketone in a single stage extraction. Determine the amounts and compositions of the extract and raffinate phases. Equilibrium Data: [16]

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Composition data (wt%)			Acetone distribution data(wt%)	
MIK	Acetone	water	Water phase	MIK phase
98.0	0	2.00	2.5	4.5
93.2	4.6	2.33	5.5	10.0
77.3	18.95	3.86	7.5	13.5
71.0	24.4	4.66	10.0	17.5
65.5	28.9	5.53	12.5	21.3
54.7	37.6	7.82	15.5	25.5
46.2	43.2	10.7	17.5	28.2
12.4	42.7	45.0	20.0	31.2
5.01	30.9	64.2	22.5	34.0
3.23	20.9	75.8	25.0	36.5
2.12	3.73	94.2	26.0	37.5
2.20	0	97.8		

6. (a) A large volume of pure water at 26.1°C is flowing parallel to flat plate of solid benzoic acid, where $L=0.244\text{ m}$ in the direction of flow. The velocity is 0.061m/s . The solubility of benzoic acid is $1.245 \times 10^{-9}\text{m}^2/\text{s}$. Calculate the mass transfer coefficient k'_c and N_A .
(b) Describe the wetted wall tower with neat sketch. [8+8]
7. Carbon disulphide is to be removed from $\text{CS}_2 - \text{N}_2$ mixture by absorption. It is carried out at 1 std pressure and 24°C and the partial pressure of CS_2 in the gas entering is 50 mm of Hg. The gas is blown into the tower at a rate of $2000\text{m}^3/\text{hr}$ and gas coming out will contain 0.5% CS_2 by volume. Average mole wt of oil is 180. The oil enters the tower essentially stripped off all CS_2 and solution of oil and CS_2 are ideal. The vapor pressure of CS_2 at 24°C is 345mm of Hg. Determine.
(a) The minimum L/G ratio.
(b) The number of theoretical plates for L/G of 1.5 times the minimum. [16]
8. Explain in detail the classification of mass transfer operations based on the separating agent required. [16]

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R05**Set No. 4****III B.Tech I Semester Examinations, November 2010****MASS TRANSFER AND SEPARATION****Bio-Technology****Time: 3 hours****Max Marks: 80**

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1. A mixture weighing 1000 kg contains 23.5 wt% acetone and 76.5 wt% is to be extracted by 500 kg methyl isobutyl ketone in a single stage extraction. Determine the amounts and compositions of the extract and raffinate phases. Equilibrium Data: [16]

Composition data (wt%)			Acetone distribution data (wt%)	
MIK	Acetone	water	Water phase	MIK phase
98.0	0	2.00	2.5	4.5
93.2	4.6	2.33	5.5	10.0
77.3	18.95	3.86	7.5	13.5
71.0	24.4	4.66	10.0	17.5
65.5	28.9	5.53	12.5	21.3
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46.2	43.2	10.7	17.5	28.2
12.4	42.7	45.0	20.0	31.2
5.01	30.9	64.2	22.5	34.0
3.23	20.9	75.8	25.0	36.5
2.12	3.73	94.2	26.0	37.5
2.20	0	97.8		

2. A ten-plate distillation column with re-boiler and total condenser is available for use. An equimolar liquid mixture of A and B at its boiling point is to be separated to get a distillate containing 90% A (mole%). The relative volatility of mixture is 2.6. Calculate:
- (a) Minimum reflux ratio
- (b) The yield of distillate and residue for $R = 1.2$. [16]
3. (a) Draw and explain apparent adsorption equilibrium diagram when adsorption occurs from concentrated solution.
- (b) Explain contact filtration with neat sketch. [8+8]
4. Explain in detail the classification of mass transfer operations based on the separating agent required. [16]
5. Carbon disulphide is to be removed from $CS_2 - N_2$ mixture by absorption. It is carried out at 1 std pressure and $24^\circ C$ and the partial pressure of CS_2 in the gas

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entering is 50 mm of Hg. The gas is blown into the tower at a rate of $2000\text{m}^3/\text{hr}$ and gas coming out will contain 0.5% CS_2 by volume. Average mole wt of oil is 180. The oil enters the tower essentially stripped off all CS_2 and solution of oil and CS_2 are ideal. The vapor pressure of CS_2 at 24°C is 345mm of Hg. Determine.

(a) The minimum L/G ratio.

(b) The number of theoretical plates for L/G of 1.5 times the minimum. [16]

6. A gas mixture A-air is fed into an absorption tower where absorption of component A in water is taking place at 298 K and 2 std atm. Given that $k_L = 0.122 \text{ kmol A}/(\text{hr.m}^2) (\text{mol A}/\text{m}^3)$. $K_G = 1.32 \text{ k mol A} / \text{hr.m}^2 \text{ atm}$, the equilibrium partial pressure of gas A over dilute solution of A in the water is given $p_{Ai} = 0.28(C_{Ai})$ is in atm while C_{Ai} is expressed in terms of $\text{mol A}/\text{m}^3$. Determine the values of the following mass transfer coefficients. [16]

(a) K_Y

(b) K_C for gas film

(c) K_L

7. (a) Describe the basic principles of operations of reverse osmosis.

(b) Explain briefly various modules used in the dialysis process. [8+8]

8. (a) A large volume of pure water at 26.1°C is flowing parallel to flat plate of solid benzoic acid, where $L=0.244 \text{ m}$ in the direction of flow. The velocity is 0.061m/s . The solubility of benzoic acid is $1.245 \times 10^{-9}\text{m}^2/\text{s}$. Calculate the mass transfer coefficient k'_c and N_A .

(b) Describe the wetted wall tower with neat sketch. [8+8]

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R05**Set No. 1****III B.Tech I Semester Examinations, November 2010****MASS TRANSFER AND SEPARATION****Bio-Technology****Time: 3 hours****Max Marks: 80**

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1. A mixture weighing 1000 kg contains 23.5 wt% acetone and 76.5 wt% is to be extracted by 500 kg methyl isobutyl ketone in a single stage extraction. Determine the amounts and compositions of the extract and raffinate phases. Equilibrium Data: [16]

Composition data (wt%)			Acetone distribution data (wt%)	
MIK	Acetone	water	Water phase	MIK phase
98.0	0	2.00	2.5	4.5
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2. (a) Draw and explain apparent adsorption equilibrium diagram when adsorption occurs from concentrated solution.
 (b) Explain contact filtration with neat sketch. [8+8]
3. Explain in detail the classification of mass transfer operations based on the separating agent required. [16]
4. A gas mixture A-air is fed into an absorption tower where absorption of component A in water is taking place at 298 K and 2 std atm. Given that $k_L = 0.122 \text{ kmol A}/(\text{hr.m}^2) (\text{mol A}/\text{m}^3)$. $K_G = 1.32 \text{ k mol A} / \text{hr.m}^2 \text{ atm}$, the equilibrium partial pressure of gas A over dilute solution of A in the water is given $p_{Ai} = 0.28(C_{Ai})$ is in atm while C_{Ai} is expressed in terms of $\text{mol A}/\text{m}^3$. Determine the values of the following mass transfer coefficients. [16]
- (a) K_Y
 (b) K_C for gas film
 (c) K_L

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5. A ten-plate distillation column with re-boiler and total condenser is available for use. An equimolar liquid mixture of A and B at its boiling point is to be separated to get a distillate containing 90% A (mole%). The relative volatility of mixture is 2.6.

Calculate:

- (a) Minimum reflux ratio
(b) The yield of distillate and residue for $R = 1.2$. [16]

6. (a) Describe the basic principles of operations of reverse osmosis.
(b) Explain briefly various modules used in the dialysis process. [8+8]

7. (a) A large volume of pure water at 26.1°C is flowing parallel to flat plate of solid benzoic acid, where $L=0.244$ m in the direction of flow. The velocity is 0.061m/s . The solubility of benzoic acid is $1.245 \times 10^{-9}\text{m}^2/\text{s}$. Calculate the mass transfer coefficient k'_c and N_A .
(b) Describe the wetted wall tower with neat sketch. [8+8]

8. Carbon disulphide is to be removed from $\text{CS}_2 - \text{N}_2$ mixture by absorption. It is carried out at 1 std pressure and 24°C and the partial pressure of CS_2 in the gas entering is 50 mm of Hg. The gas is blown into the tower at a rate of $2000\text{m}^3/\text{hr}$ and gas coming out will contain 0.5% CS_2 by volume. Average mole wt of oil is 180. The oil enters the tower essentially stripped off all CS_2 and solution of oil and CS_2 are ideal. The vapor pressure of CS_2 at 24°C is 345mm of Hg. Determine.

- (a) The minimum L/G ratio.
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2. (a) A large volume of pure water at 26.1°C is flowing parallel to flat plate of solid benzoic acid, where $L=0.244 \text{ m}$ in the direction of flow. The velocity is 0.061 m/s . The solubility of benzoic acid is $1.245 \times 10^{-9} \text{ m}^2/\text{s}$. Calculate the mass transfer coefficient k'_c and N_A .
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