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SF-7031

B. E. - III (Sem - VI) (Chemical) Examination

May / June – 2011

Mass Transfer - II

Time : **3** Hours] [Total Marks : **100**

Instructions :

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fillup strictly the details of ☛ signs on your answer book.

Name of the Examination :

☛ B. E. - III (Sem - VI) (Chemical)

Name of the Subject :

☛ Mass Transfer - II

☛ Subject Code No. : 7 0 3 1 ☛ Section No. (1, 2,.....) : Nil

Seat No. :

Student's Signature

(2) Figures to the right indicate full marks.

(3) All notations carry their usual meanings.

(4) Make suitable assumptions whenever necessary and mention them clearly.

1 (a) Attempt the following : **6×2=12**

(1) Define unsaturated Vapour-gas mixture.

(2) State working principle of vacuum crystalizer.

(3) List the methods used to bring supersaturation.

(4) Define wet blub temperature.

(5) Why flights are incorporated in rotary dryer.

(6) Define equilibrium moisture content.

(b) Derive an equation involving time in drying. 8

2 Attempt the following. (any **two**) **8×2=16**

(a) Derive an equation for adiabatic saturation.

(b) A humidifier is conditioning 15000 kg air per hour at $49°C$ dry bulb and $32°C$ wet bulb temperature by heating outside air, passing it through an adiabatic spray chamber in which it readies 90% humidity and then reheating to the desired temperature. The outside air is at $4.5°C$ and is foggy carrying 0.006 kg of liquid

water per m^3. To what temperature must the air be heated in the first heating operation ? What is the temp. of air as it emerges from the spray chamber before the final heating operation ? Calculate the heat supplied in first and final heating.

(c) It is desired to dry a certain type of fibre board in sheets 0.131 m by 0.162 m by 0.071 m from 58% to 5% moisture (wet basis) content. Initially from laboratory test data with this fibre board, the rate of drying at constant rate period was found to be $8.9 kg/m^2/hr$. The critical moisture content was 24.9% and the equilibrium moisture content was 1%. The fibre board is to be dried form one side only and has a bone dry density of $210 kg/m^3$. Determine the time required for drying. The falling rate may be assumed linear.

3 Attempt the following (any **three**) **14**

(a) Write in brief about Rotary drier.

(b) Describe Swenson-Walker crystalizer.

(c) Draw neat sketch of cooling tower arrangements.

(d) Why wet bulb temperature is less than dry bulb temperature ? Give justifications.

(e) Write a note : Significance of mass transfer operation technically.

4 (a) Answer the following : **5×2=10**

(1) List few adsolbents used for adsolption.

(2) HETP means ?

(3) Write down equation of Henry's law for dilute solution in gas absorber.

(4) Define heat of adsolption.

(5) Define decoction and elution.

(b) Discuss the theory for matistage cross current operation and derive the equation for operating line with the application of the Freundrich equation for two stage cross current adsorption. 8

5 Answer any **two** of the following. **8×2=16**

(1) An aqueous solution containing a valuable solute is cooled by small amounts of an impurity. Before crystallization the impurity is to be removed by adsorption on a decololizing carbon which adsorbs only insignificants amounts of the principal solute A series of laboratory tests was made by stirring various amounts of the adsorbent into batches of the original solution until equilibrium was established, yielding the following data at constant temperature

$\frac{kg\,carbon}{kg\,solution}$	0	0.001	0.004	0.008	0.02	0.04
Equilibrium colour	9.6	8.1	6.3	4.3	1.7	0.7

The original solution has a colour concentration of 9.6 measured on an arbitrary scale and it is desired to reduce the colour to 10%. Calculate the necessary dosage of fresh carbon per 1000 kg solution.

(a) For single stage process.

(b) For two stage counter current operation.

(2) Determine the height of an absorption column for dilute solution when Henry's law is applicable.

(3) A packed tower is designed to recover 98% Co_2 from a gas mixture containing 10% Co_2 and 90% air using water. A relation $y = 14X$ can be used for equilibrium conditions. where,

$$y = \frac{kg\,Co_2}{kg\,dry\,air}$$

$$x = \frac{kg\,Co_2}{kg\,water}$$

The water to gas rate is kept 30% more than the minimum value. Calculate the height of the tower if $(HTO)_{OG}$ is 1 meter.

6 Answer any **four** of the following. **4×4=16**

(1) Explain Rotaced for vegetable seed leaching.

(2) Adsorption Hysteresis.

(3) Continuous counter current decantation.

(4) Define adsorption factor (A) and give its significance.

(5) Write note on propertices of solvents for absorption.
