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RM-7031

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

May / June – 2010

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. 3 (Sem. 6) (Chemical)**

Name of the Subject :

☛ **Mass Transfer - 2**

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

Seat No. :

Student's Signature

(2) Answer to each section must be written in **separate** answer book.

(3) Figures to the **right** indicate full marks.

(4) All notations carry their usual meaning.

(5) Make suitable assumptions wherever **necessary** and state them clearly.

SECTION - I

1 (a) Answer as directed : **2×8=16**

(i) What is meant by webt-bulb depression? **2**

(ii) Explain constant rate period and falling rate period in drying. **2**

(iii) Write down the equation for the enthalpy of air explaining each term. **2**

(iv) Suggest type of dryer for paraffin wax and heat sensitive materials. **2**

(v) Explain humid heat and give the expression. **2**

(vi) Explain equilibrium moisture content. **2**

(vii) What is Distribution coefficient and give the expression. **2**

(viii) Give the examples of liquid-liquid extraction. **2**

(b) Answer as directed : **1×2=2**

(i) What is liquid-liquid extraction?

(ii) What will be the value of selectivity for all useful extractions operations.

2 Attempt any **two** : **2×8=16**

(i) An air (B) - water vapour (A) sample has a dry-bulb temperature 65°C and an absolute humidity 0.040 kg water /kg dry air at 1 std. atm pressure. Find molar humidity, saturation humidity, percentage humidity, dewpoint, humid volume, humid heat. Use the psychometric chart given.

(ii) Slabs of paper pulp 100 cm × 100 cm × 1.5 cm is to be dried under constant drying conditions from 67% to 30% moisture. The value of equilibrium moisture for the material is 0.5%. If the critical moisture content is 60% and the rate of drying at the critical point is 1.5 kg/cm^2 h), calculate the drying time. The dry weight of each slab is 2.5 kg. All moisture contents are on weight basis. The falling rate may be assumed to be linear.

(iii) A solution of nicotine in water containing 1% nicotine is to be extracted with kerosene at 293 K (20°C). Water and kerosene are essentially insoluble. Assume equilibrium relationship as :

$Y = 0.9\ X$

where Y = kg nicotine/kg kerosene

X = kg nicotine/kg water

Determine the percentage extraction of nicotine if 100 kg of feed solution is extracted with 150 kg of solvent.

3 Write short notes on (any **four**) **4×4=16**

(i) Centrifugal and pulsed column liquid extractors

(ii) Cooling tower arrangements

(iii) Calculations for total batch drying time considering falling rate to be linear.

(iv) Theory of adiabatic saturation curve.

(v) Explain the details about the minimum solvent to feed ratio for liquid extraction operation.

SECTION - II

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

(i) Choice of solvent for gas absorption.

(ii) Recovery of oil from vegetable seeds with organic solvent is an example of :

(a) Elution

(b) Dissolution

(c) Leaching.

(iii) Define Absorption factor.

(iv) Explain the mechanism of crystallization.

(v) Match the following adsorbents with their chemical names :

Fuller's Earth	-	Bentonite
Activated Clay	-	Sodium silicate solution
Bauxite	-	Magnesium aluminium silicates
Silica Gel	-	Hydrated alumina

(b) Explain multistage crosscurrent operation and the application of the Freundlich equation for the same. 8

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

(i) An aqueous solution containing a solute is coloured by small amounts of an impurity. Following data was obtained after series of laboratory tests of adsorption :

kg carbon/ kg soln. :	0.	0.001	0.004	0.008	0.02	0.04
Equilibrium colour/ kg soln. :	9.6	8.6	6.3	4.3	1.7	0.7

The colour is to be reduced by 10% of the original value 9.6. Determine the quantity of fresh carbon required per 1000 kg of solution for a single-stage operation and for a two-stage counter current process using the minimum total amount of carbon.

(ii) Gas from a petroleum distillation column has its concentration of H_2S reduced from 0.03 kmol H_2S per kmol-inert hydrocarbon gas to 1% of this value by scrubbing with a triethanolamine water solvent in a counter current tower of height 7.79 meter operating at 300 K. and atmospheric pressure. The equilibrium relation may be taken as Y = 2X where

$$Y = \frac{kmol\ H_2S}{kmol\ inest\ gas}$$

$$X = \frac{kmol\ H_2S}{kmol\ solvent}.$$

Pure solvent enters the tower and leaves containing 0.013 kmol H_2S per kmol solvent. If the flow of inert hydrocarbon gas is 0.015 kmol/m^2s and gas phase resistance controls the process, calculate the overall coefficient for absorption, K_{Ga}.

(iii) Discuss the effect of various operating parameters in gas-liquid operations. Also discuss the solvent solution criteria for absorption.

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

(i) Write a note on pressure swing adsorption.

(ii) Note on real trays and tray efficiency for gas absorption.

(iii) Shank system

(iv) Write a note on supercritical extraction.

(v) Explain the working of Swenson Walker crystalliser.

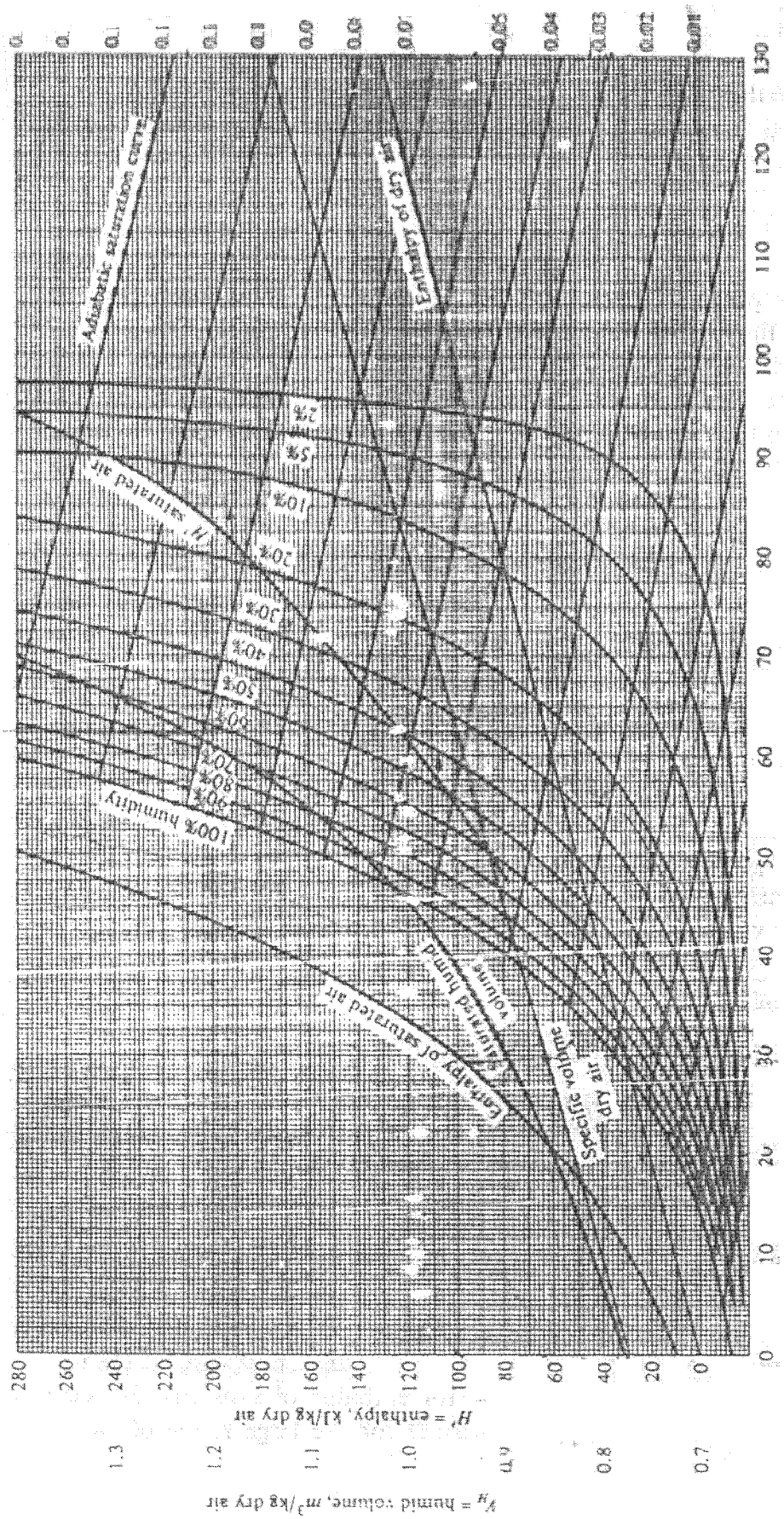

Figure 7.5 (*a*) Psychrometric chart for air-water vapor, 1 std atm abs, in SI units.

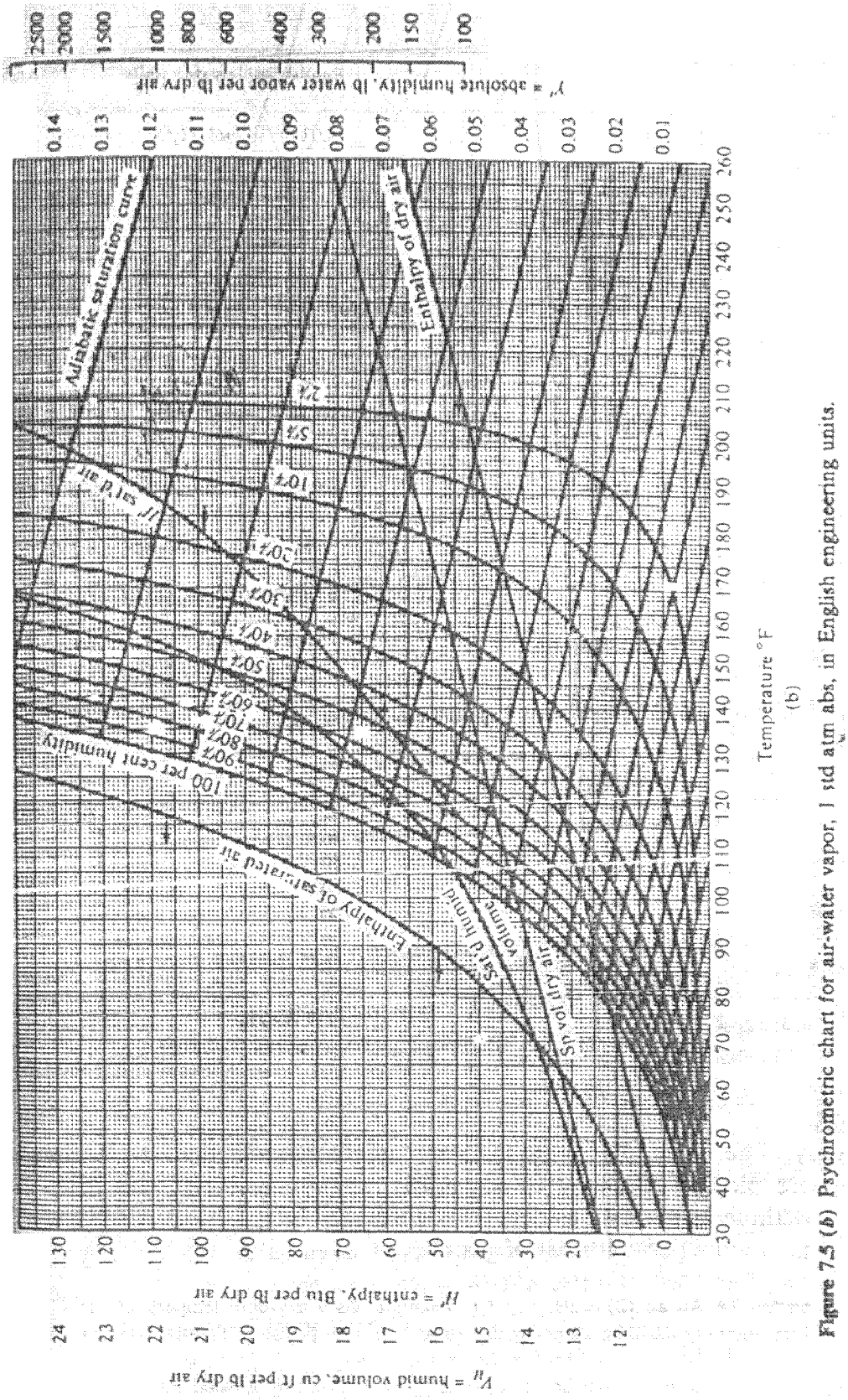

Figure 7.5 (*b*) Psychrometric chart for air-water vapor, 1 std atm abs, in English engineering units.