

ALEXANDRIA UNIVERSITY

FACULTY OF ENGINEERING

CHEMICAL ENGINEERING DEPARTMENT

Chemical Processes Industries

Fourth year

January 2015

Time: one and half an hour

Answer the following:

1- Write short notes on the following:

- a-Pilling of Polyester.
- b-Production of ethyl alcohol from molasses.
- c-Rubber processing chemicals(additives).

2-Give reason for the following:

- a-Static charges in synthetic fibers.
- b-Soaping of dyed fabrics .
- c- Water used for dyeing must be soft .
- d- Affinity of viscose rayon to dyes is higher than normal cellulose.
- e- Draw-stretching of synthetic fiber in the spinning process.

3- a- Write the main steps of manufacturing of anionic detergent from benzene

Write reactions involved and chemical processes present .

b-With equations write how you can change a direct dye to a reactive dye.

c- Draw the main steps of dyeing cellulosic fabric with an azoic dye, write reactions that take place .



تعليمات هامة: نظم ووضوح الإجابة ضرورة

Q1: A prison is trying to decide what to feed its prisoners. They would like to offer some combination of milk, beans, and oranges. Their goal is to minimize cost, subject to meeting the minimum nutritional requirements imposed by law. The cost and nutritional content of each food, along with the minimum nutritional requirements are shown below.

[Marks 7]

	Milk (Gallons)	Beans (Cups)	Oranges	Minimum Daily Requirements
Niacin (mg)	3.2	4.9	0.8	13
Thiamin (mg)	1.12	1.3	0.19	1.5
Vitamin C (mg)	32	0.0	93.0	45
Cost	\$2	\$0.2	\$0.25	

ONLY formulate the problem as Linear Programming Model.

Q2: A Medical Supply company produces catheters in packs at three productions facilities. The company ships the packs from the production facilities to four warehouses. The packs are distributed directly to hospitals from the warehouses. The table below shows the costs per pack to ship to the four warehouses with the associated plant capacities and corresponding demand at each warehouse.

[Marks 15]

To Plant	From Warehouse				
	Seattle	New York	Phoenix	Miami	Capacity
Juarez	19	7	3	21	100
Seoul	15	21	18	6	300
Hong Kong	11	14	15	22	200
Demand	150	100	200	150	600

Construct a transportation model and find the optimal solution using Vogel approximation method and MODI test for optimality.

Q3: The coach of a swim team needs to assign swimmers to a 200-yard medley relay team (four swimmers, each swims 50 yards of one of the four strokes). Since most of the best swimmers are very fast in more than one stroke, it is not clear which swimmer should be assigned to each of the four strokes. The five fastest swimmers and their best times (in seconds) they have achieved in each of the strokes (for 50 yards) are:

[Marks 15]

	Backstroke	Breaststroke	Butterfly	Freestyle
Aser	37.7	43.4	33.3	29.2
Ahmed	32.9	33.1	28.5	26.4
Karam	33.8	42.2	38.9	29.6
Mina	37.0	34.7	30.4	28.5
Maged	34.4	41.8	32.8	31.1

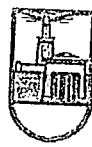
How should the swimmers be assigned to make the fastest relay team?

Q4: ONLY "state" the types of organizational structure [without drawing].

[Marks 7.5]

Q5: Illustrate, ONLY with a neat sketch drawing, the difference between Mechanistic Design and Organic Design.

[Marks 7.5]



Alexandria University
Faculty of Engineering
Chemical Engineering Department

جامعة الإسكندرية
كلية الهندسة
قسم الهندسة الكيميائية
العمليات المشتركة الميكانيكية
الفرقة الرابعة
الزمن: ثلاث ساعات
التاريخ: ٢٠١٥/١/١١

Mechanical Unit Operations
Fourth Year

Time: Three Hours

Date: 11/1/2015

Final Examination

Answer the following questions: (Total degrees = 5 x 18 = 90 degrees)

- 1-a) What is meant by the following:
- i) A colloid mill
 - ii) The viscous filter
 - iii) Vibrating conveyors
 - iv) The Dorrco sizer
 - v) Particulate fluidization.
- b) A flat-blade turbine with six blades is installed centrally in a vertical tank. The tank is 6 ft in diameter; the turbine is 2 ft in diameter and is positioned 2 ft from the bottom of the tank. The tank is filled to a depth of 6 ft with a solution of 50 % caustic soda, at 150 °F, which has a viscosity of 12 cP and a density of 93.5 lb/ft³. The turbine is operated at 90 r/min. The tank is unbaffled. What power will be required to operate the mixer?.
- 2-a) " The choice of machine for a given crushing operation will be influenced by the nature of the product required and the quantity and size of material to be handled ". Discuss this statement.
- b) Deduce a mathematical expression for describing the shape of the liquid surface in a centrifuge basket in which the axis of rotation is vertical.
- c) What is the cross-sectional area of a continuous thickener (in m²), that can treat 22 ton/h of dilute suspension from a concentration of 10 % to 50 % (by weight). The liquid upward velocity in the clarifying section is 5 m/h. What do you expect if the concentration of the feed is changed to 5 % ?. Taking density of liquid as 1000 kg/m³.
- 3-a) Explore clearly the features, description and operation of the following equipment with the aid of neat sketches:
- i) The push type centrifuge.
 - ii) The Calder-Fox scrubber.
 - iii) The bowl classifier.
- b) Compare between the following with the help of neat schematic diagrams:
- i) Propellers and turbines used in the agitated vessels.
 - ii) The plate and frame press and the recessed plate press.
 - iii) A simple gravity settling process and a centrifugal separation of solid particles from a liquid.

- 4-a) Write short notes on the following with the aid of neat sketches whenever possible:
- Screening method as a measuring technique used for determining particle size.
 - Recent developments in rotary filters.
 - The chief factors which affect the sedimentation process.
- b) A packed bed of spherical particles of diameter 1 mm and density 1500 kg/m^3 is to be fluidized by air at 2.5 atm and room temperature. If the porosity and the height of the fluidized bed at minimum fluidization conditions are 0.4 and 0.883 m, respectively, find the pressure drop and the minimum fluidization velocity. Assume properties of air: density = 2.4 kg/m^3 and viscosity = $1.8 \times 10^{-5} \text{ Pa.s}$.
-

- 5-a) Give reasons for each of the following statements:
- The reverse-jet filter can deal with difficult mixtures in an economic and compact unit.
 - The Spitzkasten combines the principles used in the settling tank and in the elutriator.
 - A multi-tube cyclone separator is rather more flexible than the simple cyclone.
 - The Dodge jaw crusher is usually made in smaller sizes than the Blake jaw crusher.
 - The usual cross section of the bars in the grizzly is trapezoidal.
 - There may be some discrepancy between the calculated and measured minimum velocities for fluidization.
- b) A leaf filter with 15 ft^2 of filtering area gave the following data during constant-pressure filtration at $(-\Delta P) = 50 \text{ psi}$:
- | | | | | | |
|--------------------------------|----|-----|-----|-----|-----|
| Time, min. | 15 | 30 | 45 | 60 | 90 |
| Filtrate volume, ft^3 | 90 | 156 | 198 | 243 | 325 |
- The total time required for draining, dumping, and reassembling the filter is 15 min each cycle. The cake is to be washed with a volume of water equal to the filtrate volume. What volume of filtrate would be collected every 24 hr with the optimum operating cycle using constant-pressure filtration with $(-\Delta P) = 50 \text{ psi}$?
-

Supplementary Data

$$\begin{aligned}
 1 \text{ ft} &= 12 \text{ in.} = 30.48 \text{ cm} & g &= 980.66 \text{ cm/s}^2 \\
 1 \text{ lb}_m &= 5 \times 10^{-4} \text{ ton} = 453.593 \text{ grams} & 1 \text{ hp} &= 550 \text{ ft.lbf/s} \\
 1 \text{ atm} &= 1.01325 \times 10^5 \text{ Pa} = 14.696 \text{ psi} = 760 \text{ mm Hg} \\
 N_p &= 0.245 (N_{Re})^{-0.26} \cdot (N_{Fr})^{-0.55} & 1 \text{ ft}^3 &= 7.4805 \text{ gal}
 \end{aligned}$$

$$u = \frac{1}{A} \frac{dV}{dt} = \frac{e^3}{5(1-e)^2 S^2} \frac{-\Delta P}{\mu l}$$

$$\frac{-\Delta P}{l} = 150 \frac{(1-e)^2 \mu u}{e^3 d^2} + 1.75 \frac{(1-e) \rho u^2}{e^3 d}$$

Best Wishes
Prof. Dr. Mahmoud A. Zarraa



January 2015

يناير 2015

Chemical Process Industries
FINAL EXAM

صناعات العمليات الكيميائية
امتحان نهائي

Time allowed: 3 Hours

الزمن: ٣ ساعات

Part I: Inorganic Industries

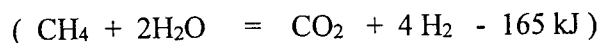
Answer all questions:

Question 1

- Draw a flow diagram showing the manufacture of carbon dioxide produced from fermentation processes.
- Discuss the effect of space velocity in the manufacture of ammonia.

Question 2

- In the process of methane reforming with steam:



, discuss the effect of the following:

- Pressure
- Temperature

- Write briefly on the manufacture chlorine by electrolysis of brine.

Question 3 :

- Draw a simplified flow diagram for the contact sulfuric acid process.
- Comment on the temperature of transfer of liquid sulfur.
- Compare between the different raw materials for sulfuric acid manufacture.
- Explain the use of 98-99% H_2SO_4 and not pure water in absorption of SO_3 .
- Explain the advantages of spray burner over rotary burner in sulfur burning.

Question 4 :

- Discuss the integration between H_2SO_4 manufacture and power generation in sulfuric acid plants with reference to the new chemical complex at Fayoum.
- Drive the relation between K_p and degree of conversion for the conversion of SO_2 to SO_3 . Discuss the factors affecting degree of conversion.



I- Write short notes about each of the following:-

1. BOD lag in test determination.
2. Back mixing, axial dispersion and ideality of plug flow reactor.
3. Stabilization of water.
4. Iron and Manganese removal from ground water.
5. Effect of zeta potential, coagulant dose on stabilization & destabilization of colloidal particles in wastewater.
6. Filter Media design and selection on operating pressure and media backwashing.
7. Aeration tank dead zones, tank flow pattern and oxygen mass transfer.
8. High rate aeration & high purity oxygen wastewater treatment systems.
9. Biofilm carriers, reactions in activated sludge and biological filtration systems.
10. polymeric wastewater flocculation, types and mechanisms.

- II- a) A new disinfection process destroys E.Coli in water. The reaction is first order, with $k = 1.0 \text{ day}^{-1}$. The influent concentration of coliforms is $C_0 = 100 \text{ coliforms/ml}$. The reactor volume, $V = 500 \text{ L}$ and $Q_{in} \text{ and out} = 1500 \text{ L/day}$. What is the effluent concentration of coliforms?
- b) In-series treatment plant has the following sized units: rapid mixing chamber with volume 100 m^3 , flocculation tank 35 m wide and 18 m long, and 4 m water depth; and sedimentation tank 20 m wide, 40 m long, and 5 m water depth. Calculate the major parameters used in sizing these units, based on 90% efficiency.
- III – a) A high purity oxygen aeration system, is being considered for treatment of industrial wastewater. Since the industrial wastewater is high in soluble BOD and low in suspended solids, primary clarification is not included in the processing scheme. The design flow is $3000 \text{ m}^3/\text{d}$ with an average BOD of 300 mg/l , $F/M = 0.25$ and $MLSS = 3000 \text{ mg/l}$. Calculate, aeration tank volume, BOD loading, aeration period and sludge age.
- b) A city is to install rapid sand filters downstream of clarifiers. The design filtration rate is $4 \text{ m}^3/\text{m}^2.\text{h}$ and water feed is $0.4 \text{ m}^3/\text{s}$. Propose the filter design geometry, considering filtration media depth consists of three layers (gravel 20 cm , sand 40 cm , anthracite 20 cm). Repeat the calculations in case of rapid filtration and compare between results.

- IV- a) A tickling filter plant has the following: one rectangular clarifier with 20 m wide, 40 m long and 6 m side water depth and double weir; trickling filter with 30 m diameter and 5 m deep stone media filled bed; final 2 settling tanks with 20 m diameter, 4 m side water depth and double weir (one at diameter 14 m and the other at peripheral . The daily wastewater flow is 10000 m³/d with an average BOD of 300 mg/l. Calculate the loadings on all units.
- b) The aeration tank for a completely mixed aeration process is being sized for a design wastewater flow of 10000 m³. The influent total BOD is 250 mg/l with a soluble BOD of 130 mg/l. The design effluent total BOD is 20 mg/l with a soluble BOD of 5 mg/l. Recommended design parameters are sludge age of 7 days and volatile MLSS of 1400 mg/l. Selection of these values takes into account the anticipated variations in wastewater flow and strength. ($Y=0.55$, $k_d=0.05$ per day). Calculate Aeration tank volume, F/M , θ .

Best Wishes

Prof. Abdelaziz H. Konsowa



Answer the following questions

Question (1)

1. Compare between (5 marks)

1. Absorption and adsorption
2. Advantages and disadvantages of glycol and methanol injection
3. LNG and LPG
4. Storage tanks of LNG
5. Liquefaction cycles

2. Discuss using sketch (4 marks)

1. Adsorption using in gas sweetening and dehydration
2. Nozzle Placement and flow rate effect

3. What type of chemical you use to prevent hydrate formation in the following cases? Why? (4 marks)

1. Natural gas transmission in which recovery is not important.
2. Injected glycol contacts hydrocarbon liquids
3. Severe vapor losses
4. Severe vapor losses and injected glycol contacts hydrocarbon liquids

4. What are the problems caused by the following in the dehydration systems? (5 marks)

1. Free Water
2. Oils or Hydrocarbons
3. Entrained Brine
4. Downhole Additives
5. Solids

5. Give reasons (7 marks)

1. Mercury removal is a must in gas treatment.
2. Natural gas is transmitted from field to separators at elevated temperatures.
3. Gas sweetening is done before dehydration and after separation
4. Natural gas considered to be safe.
5. LNG kept liquid during storage.
6. Natural gas must be sweetened.
7. Liquefying natural gas

Question (2)

Solve the following

1. A natural gas containing H_2S is to be treated using pure MEA ($HOCH_2CH_2NH_2$, S.G.=1.015) fed to the top of a plate absorption tower containing 10 actual plates (overall plate efficiency is 30%), $Y_e = 0.5X$, $L_m/G_m=1.15$, and CO_2 mole fraction in the outlet gas from the tower top is 0.001. Find graphically the mole fraction of CO_2 in the feed stream. If MEA feed rate was $200m^3/h$, CO_2 -N.G. mixture is at 1.1 atm, $30^\circ C$ ($R=0.082 \text{ atm.liter}/(\text{mole.K})$) and the maximum allowable gas velocity in the tower is 1.5 m/s, calculate minimum tower diameter. (10 marks)
2. An aqueous solution of MEA of 55% concentration by weight is being used to remove CO_2 from natural gas. If the gas rate is $500m^3/hr$ ($25^\circ C$ and 2 atm.). CO_2 inlet concentration is 500 ppmv and that out is 10 ppmv, the outlet concentration of MEA solution is 25% by weight, Calculate the mass flow rate of feed MEA solution required in kg/hr. (5 marks)
3. Use the inlet conditions and the outlet pressure supplied in the following table to compute
 - a. The outlet temperature and work generated per lb of gas inlet. Assume the gas is pure methane, use P-H diagram. (5 marks)
 - b. COP of the cycle
 - i. Perform Calculations if turbo expander used for expansion (10 marks)
 - ii. Perform Calculations if J-T is used over same pressure drop and inlet temperature. (10 marks)

	Expander	Compressor
Inlet flow rate lb/hr (kg/hr)	221000 (100243)	208000 (94347)
Inlet gas rate, MMscfd (MMSm ³ /d)	115.6 (3.27)	115.2 (3.26)
Molar mass	17.46	16.5
Inlet pressure, psia (bar)	1080 (74.5)	470 (32.4)
Inlet temperature °F (°C)	-50 (-46)	60 (16)
Outlet pressure, psia (bar)	30 (2.1)	576 (39.7)
Outlet temperature °F (°C)	-113.6 (-80.9)	93.5 (34.2)
Liquid formation, wt%	19.3	-
Efficiency, %	83	74
Speed, rpm	22000	22000
Power, bhp (kW)	1380 (1029)	1350 (1007)

4. Two adsorbents are used in the dehydration of natural. The feed gas containing 0.5% water went to complete dryness. The bed is packed with granules of particle diameter of 0.13 in and the bulk density is 42.5 lbm/ft^3 . For rate of $10^5 \text{ ft}^3/\text{min}$ of the feed gas at $100^\circ F$ and atmospheric pressure, calculate: (10 marks)

- a. Amount of silica gel used.
- b. If you use molecular sieve, what will be the amount used.
- c. Bed dimensions.
- d. Pressure drop across the bed

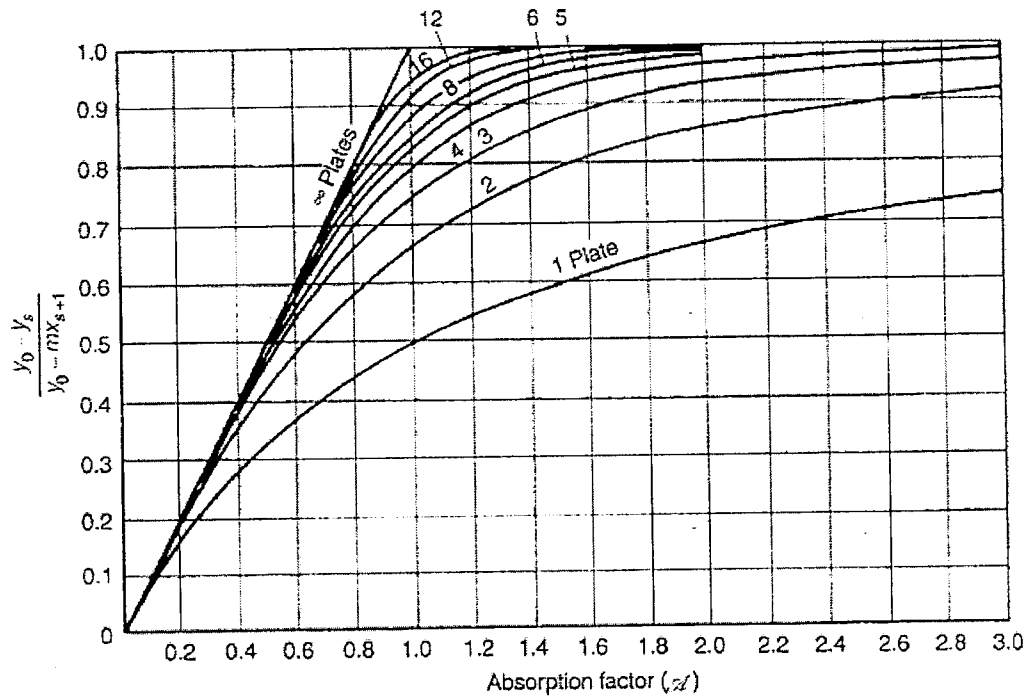
Data

Gas molecular weight = 27 g/gmol

Gas viscosity = 0.02782 lb/hr

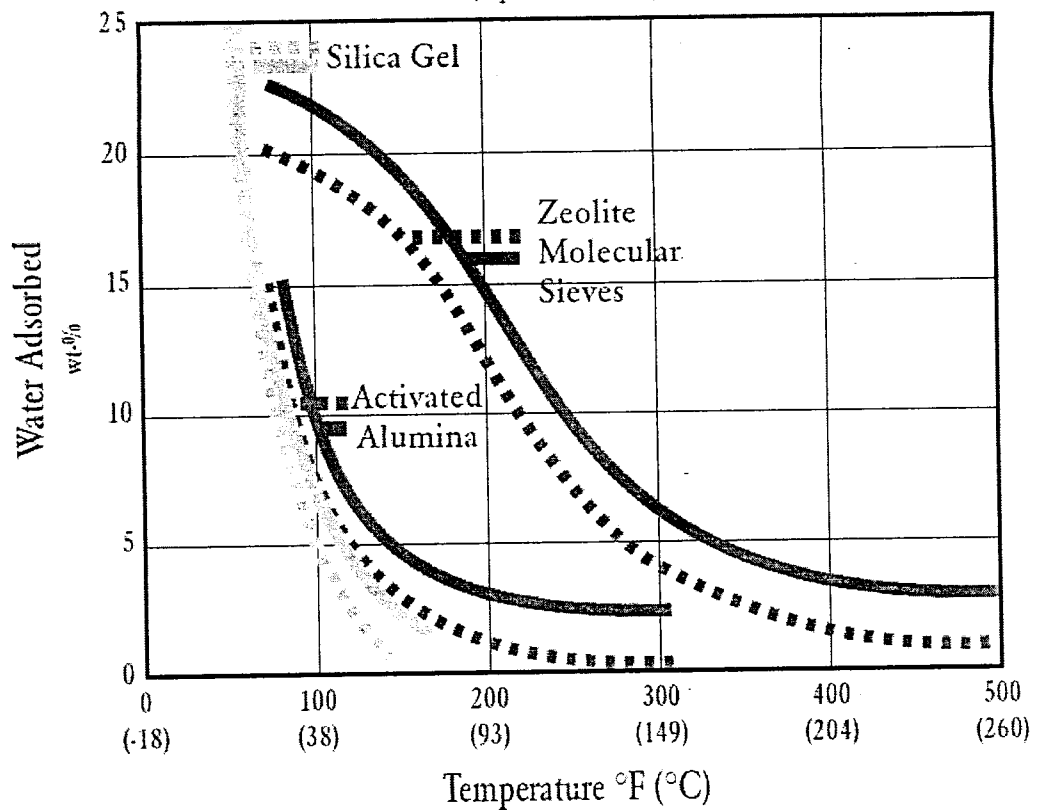
Permeability coefficient of the bed = 10^{-7} ft^2

$$U=B(\Delta P/\mu L)$$



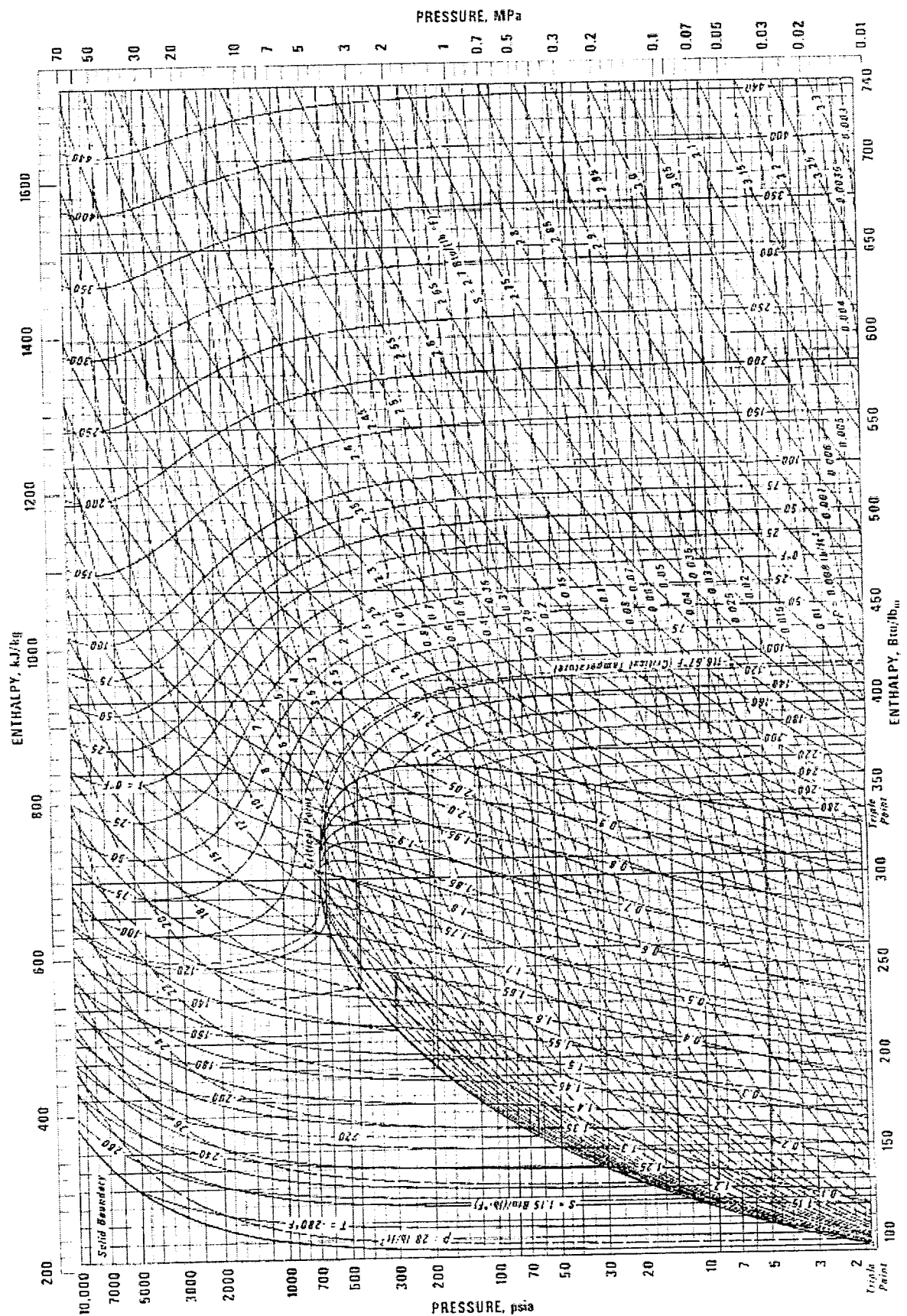
Graphical representation of the effect of the absorption factor and the number of plates on the degree of absorption

Water Vapor Adsorption Isobars at 10mm Hg Partial Pressure (Equilibrium Data)



Drying power of silica gel, zeolite molecular sieves and activated alumina under various operating temperatures

Units equivalences		Pressure
Length		
1 m = 3.28084 ft = 39.37 in	1 angstrom (Å) = 10 ⁻¹⁰ m	1 atm = 2116.224 lb _f /ft ² = 1.013×10 ⁵ Pa = 14.696 psi = 1 kg _f /cm ² = 1.0132 bar
1 cm = 0.01 m	1 micron (μ) = 10 ⁻⁶ m	= 760 mmHg = 10.33 m H ₂ O = 29.9213 inHg
1 ft = 12 in = 0.3048 m	1 mi = 5280 ft = 1.609344 km = 1760 yd	1 lb _f /ft ² = 47.88 Pa = 6.94444×10 ⁻³ psi
1 in = 2.54 cm = 0.083333 ft	1 mm = 10 ⁻³ m	1 psi (lb _f /in ²) = 6894.8 Pa = 144 lb _f /ft ² = 0.07031 kg _f /cm ²
1 km = 1000 m = 0.621371 mi	1 yd = 3 ft = 36 in	1 N/cm ² = 10 ⁴ Pa
		1 pascal (Pa) = 1 N/m ² = 2.08856×10 ⁻² lb _f /ft ²
		1 mmHg = 2.7845 lb _f /ft ²
		1 inHg = 3.38639 kPa = 0.491 lb _f /in ²
		1 ft H ₂ O = 2.98907 kPa = 0.030 kg _f /cm ² = 22.3997 mmHg
Mass		Energy
1 g = 10 ⁻³ kg	1 slug = 14.5939 kg = 32.174 lb _m	1 Btu = 777.649 ft.lbf = 1054.35 J = 0.251996 kcal = 1.05506 kJ
1 kg = 1000 g = 2.20462 lb _m	1 ton = 907.185 kg = 2000 lb _m	1 erg = 1 dyn.cm = 1.0×10 ⁻⁷ J
1 lb _m = 0.453592 kg	1 oz = 28.349 g	1 ft.lbf = 1.28593×10 ⁻³ Btu = 1.35582 J
	1 h = 60 min = 3600 s	1 hp.h = 2546.14 Btu = 1.98×10 ⁶ ft.lbf = 2.68452×10 ⁶ J
	1 ms = 10 ⁻³ s	1 J = 0.737562 ft.lbf = 2.3006×10 ⁻⁴ kcal = 0.277778×10 ⁻⁶ kW.h
	1 ps = 10 ⁻¹² s	1 kcal = 3.96832 Btu = 3085.96 ft.lbf = 4184 J = 4.184×10 ¹⁰ erg
		1 kW.h = 3409.52 Btu = 2.65522×10 ⁶ ft.lbf = 3.6×10 ⁶ J = 3.6 MJ
Temperature	Temperature conversion formulas:	Power
	K = °C + 273.15	1 Btu/h = 3.92752×10 ⁻⁴ hp = 0.292875 W
	°F = 1.8 °C + 32	1 hp = 550 ft.lbf/sec = 745.7 W
	°R = 1.8 K	1 kW = 1.34102 hp = 1000 W
	1 °C = 1 K = 1.8 °F = 1.8 °R	1 W = 1 J/s = 0.737562 ft.lbf/sec = 1.34402×10 ⁻³ hp
	1 °F = 1 °R = 0.555556 °C = 0.555556 K	
Area	This is temperature difference	Heat Capacity
1 acre = 43560 ft ² = 4.046856 × 10 ⁻³ km ² = 1.5625 × 10 ⁻³ mi		1 Btu/lb _m °F = 1 cal/g °C = 1 kcal/kg.K = 777.649 ft.lbf/lb _m °R = 4184 J/kg.K
1 yd ² = 0.092903 m ²		1 ft.lbf/lb _m °R = 1.28593×10 ⁻³ Btu/lb _m °F = 1.28593 kcal/kg.°C
		1 J/kg.K = 2.39006×10 ⁻⁴ Btu/lb _m °F = 2.39006×10 ⁻⁴ kcal/kg.°C
Volume		Thermal conductivity
1 gallon (gal) = 0.133681 ft ³ = 3.78531 liter (l or L) = 4 qt		1 Btu/h.ft.°F = 4.1364×10 ⁻⁴ kcal/s.m.°C = 1.7307 W/m.K
1 liter = 1000.028 cm ³ = 1.05672 qt		1 kcal/s.m.°C = 2417.56 Btu/h.ft.°F = 4184 W/m.K
1 pint (pt) = 0.125 gal = 0.473163 liter = 0.5 qt		1 W/m.K = 2.39006×10 ⁻⁴ kcal/s.m.°C
Density		Viscosity
1 g/cm ³ = 1000 kg/m ³ = 62.428 lb _m /ft ³		1 Pa.s = 1 kg/m.s = 2419.1 lb _m /ft.h = 10 poises
1 kg/m ³ = 10 ⁻³ g/cm ³ = 0.062428 lb _m /ft ³		1 poise = 1 g/cm.s = 0.1 Pa.s = 241.91 lb _m /ft.h = 0.067197 lb _m /ft.sec
1 lb _m /ft ³ = 0.0160185 g/cm ³ = 16.0185 kg/m ³		1 centipoise (cp) = 0.01 poise = 0.001 Pa.s = 2.4191 lb _m /ft.h
		1 kg/m.s = 10 g/cm.s = 1 Pa.s = 2419.1 lb _m /ft.h = 0.67197 lb _m /ft.sec
		1 lb _m /ft.h = 0.413377 cp = 4.13377×10 ⁻⁴ kg/m.s = 2.7778×10 ⁻⁴ lb _m /ft.sec
		= 4.13377×10 ⁻⁴ Pa.s = 4.13377×10 ⁻³ poise
		1 lb _m /ft.sec = 1488.16 cp = 3600 lb _m /ft.h = 1.48816 Pa.s = 14.8816 poises
Force		Viscosity (kinematic)
1 dyne (dyn) = 10 ⁻⁵ N = 7.233 × 10 ⁻⁵ poundal		1 centistokes = 10 ⁻⁶ m ² /s = 0.01 stokes
1 lbf = 4.44822 N = 32.174 poundal = 0.45359 kg _f		1 stokes = 1 cm ² /s = 10 ⁻⁴ m ² /s
1 N = 0.224809 lbf = 7.233 poundal		1 ft ² /h = 2.7778×10 ⁻⁴ ft ² /sec = 0.258064 stokes
1 poundal = 0.031081 lbf = 0.138255 N		1 ft ² /sec = 3600 ft ² /h = 929.03 stokes
1 kg _f = 9.80665 N		1 m ² /s = 3.875×10 ⁴ ft ² /h = 10.7639 ft ² /sec = 10 ⁴ stokes
1 ton _f = 9.96402 kN = 1016.05 kg _f		



Pure methane P-H Diagram
 ترفق مع كراسة الإجابة



January, 2015

Fourth Year

Course title Number: Petroleum Refining Engineering

Time allowed: Three hours

يناير 2015

الفرقة الرابعة

هندسة تكرير البترول

الزمن: ثلاث ساعات

Answer all questions:

(1) Compare between each of the following: (20 marks)

- a) Spark ignition engine and compression ignition engine
- b) Fixed bed catalytic cracking and moving bed catalytic cracking
- c) Gas oil and diesel oil.
- d) Air blown asphalt and cut back asphalt.
- e) The thermal cracking and the catalytic cracking.

(2) Mention the following: (10 marks)

- a) The requirements of a jet fuel.
- b) The uses of kerosene.
- c) The uses of fuel oils.
- d) The types of thickeners used to prepare lubricating greases.
- e) The function of lubricating oils.

(3) Put (✓) or (X) and correct the wrong sentences if any: (9 marks)

- a) The best jet fuels are obtained from asphaltic base crudes.
- b) Gas oils are not refined they are sold as produced.
- c) Gasoline and diesel require easy self-ignition for good performance.
- d) Diesel with low aniline point is a good fuel.
- e) There are two types of thickeners used to prepare the lubricating greases.
- f) In thermal cracking, by increasing timing gasoline yield increases to a maximum value then decreases again.
- g) The reaction mechanism in catalytic cracking is free radical mechanism.
- h) Unsaturated and polycyclic aromatics are a good stock for catalytic cracking.
- i) Thermal cracking gasoline has a higher octane number than catalytic cracking gasoline.
- j) Catalytic cracking is an overall exothermic process.
- k) Increasing the catalyst-to-feed ratio increases the activity of the catalyst in catalytic cracking.
- l) The main reaction in catalytic reforming is the cracking of long paraffin chains.
- m) The hydrocracking reactions occurring during catalytic reforming are desirable.
- n) In catalytic reforming the catalyst must be distributed evenly between the reactors.
- o) Plat forming catalysts are subjected to frequent deactivation.
- p) Reactions of catalytic reforming are carried out in one single reactor.
- q) Gases produced from catalytic cracking are mostly methane and ethane.
- r) A temperature higher than 1100°F is required to activate the catalyst in the catalytic cracking process.

(4) Sketch the Thermofore catalytic cracking process (5 marks)

(5) Give reasons for each of the following: (18 marks)

- i) The presence of aromatics in kerosene can be both useful and objectionable.
- ii) A diesel fuel with high cetane number is required.
- iii) Low viscosity of diesel fuel is not required.
- iv) Cracking residue from T.C has better properties than straight run fuel oil.
- v) Most petroleum transformations are catalytic.
- vi) Hydrofinning of stock gives good catalytic cracking results.

(6) For a petroleum fraction having $K=11.5$ and $API=35$, find the following: (15 marks)

- i) The average molal boiling point.
- ii) The average molecular weight.
- iii) The pseudo critical temperature and pressure.
- iv) The atmospheric latent heat of vaporization.
- v) Latent heat of vaporization at 450°C .

Note: $T(^{\circ}\text{F}) = 1.8 T(^{\circ}\text{C}) + 32$

$T(^{\circ}\text{R}) = T(^{\circ}\text{F}) + 460$

Best of Luck

Dr. Yasmine Ossama