SE · Sem · III (Bio. Tech)

Process Calculations

25

QP Code : NP-18788

(3 Hours) [Total Marks : 80

N.B. : (1) Question No. 1 is compulsory.
(2) Answer any three of remaining five questions.
(3) Assume suitable data where ever necessary.

1. (a) Define Units and Dimensions. Explain Dimensional homogeneity with one example. 8
(b) State or define the following :— 12
(i) Amagat's Law
(ii) Daltons Law
(iii) Henry's Law
(iv) Hess' Law of Constant Heat summation.

2. (a) Explain the role of stoichiometry in Biochemical reactions. 10
(b) State the first and second law thermodynamics. What are the draw backs of first law of thermodynamics ? 10

3. (a) Ammonia if produced by the following reaction :— 10

$$N_2 + 3H_2 \longrightarrow 2NH_3$$

Calculate :
(i) The molal flow rate of hydrogen corresponding to nitrogen feed rate of 25 kmol/h if they are fed in the stoichiometric proportion.
(ii) The *kg* of ammonia produced per hour if % conversion 25 and nitrogen feed rate is 25 kmol/h.

(b) A feed to a continuous fractionating column analyses by weight 28 percent benzene and 72% toluene. The analysis of the distillate shows 52 wt% benzene and 5 wt% benzene was found in the bottom product. Calculate the amount of distillate and bottom product per 1000 kg of feed per hour. Also calculate the percentage recovery of benzene. 10

4. (a) The waste acid from a nitrating process contains 30% H_2SO_4, 35% HNO_3 and 35% H_2O by wt. The acid is to be concentrated to contain 39% H_2SO_4 and 42% HNO_3 by addition of concentrated sulphuric acid containing 98% H_2SO_4 and concentrated nitric acid containing 72% HNO_3 by wt. Calculate the quantities of three acids to be mixed to get 1000 kg of desired mixed acid. 10
(b) In the production of sulphur trioxide, 100 kmol of SO_2 and 100 kmol O_2 are fed to a reactor. If the percent conversion of SO_2 is 80, calculate the composition of the product stream on mole basis. 10

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5. (a) The temperature of oxygen is raised from 350 K to 1500 K. Calculate the amount of heat that must be supplied for raising the temperature of 1 kmol oxygen using the standard specific heat data : 10

$$C_p^{\circ} = a + bT + cT^2 + dT^3$$

Gas	a	$bX10^3$	$cX10^6$	$dX10^9$
Oxygen	26.0257	11.7551	– 2.3426	– 0.5623

(b) What is dimensional analysis ? Explain the step by step procedure of Rayleigh's method of dimensional analysis. 10

6. (a) Define the following :— 5
   (i) Stoichiometry
   (ii) Normality
   (iii) Molarity
   (iv) %Excess
   (v) Yield
   (b) Prove mol% = Vol% = Pressure% 8
   (c) A mixture of CH_4 and C_2H_6 has the average molecular weight of 22.4. Find the mol% of CH_4 and C_2H_6 in the mixture. 7

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