8/5/18

TE / CHEM. / VI / CBGS / CRE-II

(1)

QP Code : 5154

Sub.: Chemical Reaction Engg. II. (31)

Duration: 3 hours

Total Marks: 80

Question no 1 is compulsory
Attempt any three questions from remaining five questions
Assume suitable data if needed & justify

Q1 a. Explain the terms: porous catalyst and supported catalyst, catalyst promotor , catalyst inhibitor . 04

Q1 b. Explain the steps involved in hetrogeneous reaction with any example. 06

Q1 c. A batch of solids of uniform size is treated by gas in a uniform environment. Solids is converted to give a non-flaking product according to the Shrinking core model. Conversion is 7/8 for a reaction time 1 hour, conversion is complete in 2 hours. What mechanism is rate controlling? 05

Q1 d. What is the significance of Hatta number in fluid –fluid reactions? 05

Q2 a. Derive an expression to calculate the time required for complete combustion of a particle when resistance through the gas film is controlling. 08

Q2 b. A solid feed consisting of 30 wt% of 1 mm particle,30 wt% of 3mm particle, 40 wt % of 4 mm particles is to be passed through a fluidised bed reactor where it reacts with a gas of uniform composition to give hard nonfriable solid product. The progress of conversion can be represented by reaction control for the unreacted core model and the time for complete conversion of 4 mm particles is 8 hours. Find the conversion of solids if the residence time in the reactor is 4 hrs. 12

CHEM/VI/CBGS/CRE

Q3 a At high pressure CO, is absorbed into a solution of NaOH in a packed column. The reaction is as follows: $CO_2 + 2NaOH \rightarrow Na_2CO_3 + H_2O$ with 14

(A) (B)

$-r_A = kC_AC_B$

Find the rate of absorption, the controlling resistance, and what is happening in the liquid film, at a point in the column where $p_A = 10^5$ Pa and $C_B = 500$ mol/m^3.

Data: $k_{Ag}a$ = mol/m^2.s.p_A , $H_A = 25000$ Pa. m^3/mol , k_{Al}=1x10^{-4} m/s,
D_A =1.8 x 10^{-2} m^2/s , D_B =3.06 x 10^{-9} m^2/s , a=100 m^{-1} , k=10 m^3/mol.s , f_i=0.1

Q3 b Discuss the factors considered for selecting reactor for gas liquid reactions? what type of reactor should be used for kinetically controlled reactions. 06

Q4 a. Develop Langmuir-Hinshelwood type of rate equation for 10

$$A + B \rightleftarrows R + S$$

When the reaction between adsorbed A and adsorbed B is rate controlling step.

Q4 b. A catalytic reaction $A \rightarrow 3R$ is carried out in apacked bed reactor at 3.5 atm pressure and 115degC . It is desired to treat 1450 mol/hr of pure reactant A and fractional conversion to be achieve is 32%. The reaction rate concentration data is available. calculate the weight of catalyst needed the reaction. 10

C_A mol/lt	0.04	0.06	0.075	0.09
$(-r_A)$ molA/Kg Cat.hr	3.5	5.7	7.2	8.8

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3.

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Q5 The following data have been reported as a result of our effort to determine the distribution of residence time in packed bed reactor. Determine the average residence time and variance in the reactor. 20

Time, t min	0	4	8	12	16	20	24	28
Effulent tracer conc	0	3	5	5	4	2	1	0

a)If one desires to utilize this reactor to carry out a first order isomerization reaction of type A → Band if the rate constant for the reaction is 0.045 min-1. Determine the average conversion that one expects in the reactor using seggregated flow model.

b) What integar value of n gives the most accurate fit of the data in part a when we have a equal volume CSTR in series? what conversion is expected on the basis of this model

Q6 Write short note on (any two): 20

a) Fixed Bed vs Fluidized Bed reactor
b) Reactors for Gas Liquid reaction.
c) Two Parameter Models for Non ideal reactor
d) Shrinking Core Model for Noncatalytic reaction.