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Total No. of Questions : 09

B.Tech. (Petroleum Refinary Engineering) (2013 Batch) (Sem.–5)

CHEMICAL REACTION ENGINEERING-II

Subject Code : BTPC-501/ BTCH-601

M.Code : 72654

Time : 3 Hrs. Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt ANY FOUR questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt ANY TWO questions.**

SECTION-A

1. Write short notes on :

a) What are zeolite based catalysts?

b) List the assumptions of Langmuir adsorption isotherm.

c) Name the different mechanisms of catalyst deactivation.

d) How the specific reaction rate constant affect the Thiele modulus?

e) How the observed activation energy differ from the true activation energy for gas solid catalytic reaction under strong resistance to pore diffusion?

f) How can you improve the overall rate for gas solid non-catalytic reaction if the mass transfer through gas film is rate controlling?

g) If the conversion is directly proportional to reaction time, which step is likely to be rate controlling? Shrinking core model is valid.

h) List the conditions when the gas phase mass transfer will be rate controlling in a gas liquid non-catalytic reaction.

i) What is bubbling fluidized bed?

j) How the minimum fluidization velocity is affected by particle size?

SECTION-B

2. Differentiate between physical adsorption and chemisorption.

3. Due to resistance to mass transfer in catalyst pore, the effectiveness factor is reduced. Then, why we still prefer porous catalyst?

4. From shrinking core model derive an equation for the time of complete reaction for a gas solid non catalytic reaction if the mass transfer through the ash layer is rate controlling and the particles are spherical in shape.

5. For a very fast fluid-fluid non catalytic reaction A(I) + B(II) $\rightarrow$ C(II), how the reaction interface shifts with the change in concentration of B. Sketch the concentration profiles.

6. Discuss the industrial applications of fixed bed catalytic reactors.

SECTION-C

7. Spherical particles of zinc blende of size R = 1 mm are roasted in an 8% oxygen stream at 900°C and 1 atm. The stoichiometry of the reaction is

   $2ZnS + 3O_2 \rightarrow 2ZnO + 2SO_2$

   Assuming that reaction proceeds by the shrinking-core model calculate the time needed for complete conversion of a particle and the relative resistance of ash layer diffusion during this operation. Given :

   Density of solid = 0.0425 mol/cm^3

   Reaction rate constant, k". = 2 cm/sec

   Diffusivity of gases in the ZnO layer = 0.08 cm^2/sec

   Note that external gas film resistance can safely be neglected as long as a growing ash layer is present.

8. Derive an expression for the effectiveness factor for a 1^{st} order gas solid catalytic reaction taking place in a straight cylindrical pore.

9. 1-Butene is selectively oxidised to 1,3-butadiene by passing through an experimental fixed bed of iron molybdate catalyst. The catalyst has specific surface area of 50 m^2/g. The feed is 6.5% butene, 7% oxygen, rest helium, flowing at 120 ml/min, at atmospheric pressure and 400 °C temperature. The mass of catalyst in the fixed bed is 0.2 g. 50% conversion of butene is obtained. The reaction is 1^{st} order in butene. Find out the reaction rate constant for the reaction based on unit area of the catalyst.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.