56

Chemical Engineering Department

Major Test in CHL 604

Answer all Questions:

(1)

(a) A long cylindrical shaped solid pellet is reacting with a gas. Assuming shrinking core model derive t vs X relationship when the reaction is controlled both by gas film and ash layer diffusion.

(6)

(b) Determine the time required for 50% Conversion of Fe_2O_3 with H_2 from the following data:

ρ_s = 4.0 gm/cc R= 5mm Mol.wt of Fe=56

P = 1atm T= 600° C Frequency factor= 2.0×10^5 (cm/sec)

Activation energy = 24 K.Cal/gmol

(4)

(2)

(a) A solid feed consists of

Wt% →	20	– 30	– 50
Dp (mm)	1	2	4

is being reacted in a vertical tubular reactor. If the time for 4mm particles Complete Conversion is 4 hrs. and the raction Chemical Reaction controlled according to Shrinking core model. Find the residence time needed in the reactor for 50%, 75% and 100% conversion of the solid feed respectively.

(6)

(b) Derive the equation for temperature variation with respect to concentration for an exothermic Catalytic gas- solid reaction in a spherical catalyst pellet .

(4)

(3) For the reaction A $\rightleftharpoons$ B occurring on a Catalyst, derive the overall reaction rate expression for adsorption of A as the rate controlling step. Neglect gas film resistance Internal diffusinal resistance steps.

(7)

(4) A solid- catalyzed decomposition of gaseous A proceeds as follows:

$A \rightarrow R \qquad -r_A = KC_A^2$

A tubular Pilot plant reactor packed with 2 liters of catalyst is fed $2m^3$/hr of pure A at 300°C, 20 atm. Conversion of A is 65% In a larger plant, to treat $100m^3$/hr of feed gases at 40 atm, 300°c containing 60% A and 40% inverts to achieve 85% conversion, determine the volume of the reactor required.

(6)

(5) The following data is obtained for an irreversible reaction with decaying catalyst in a batch reactor (Batch, solids, batch fluid). Derive and determine the kinectics:

CA →	1.0	0.8	0.68	0.53	0.42	0.37
T (hr) →	0	0.25	0.5	1	2	∞

(7)