**Reaction Engineering, Problem Sheet-3, 2017**

Q1. The homogeneous gas phase reaction A⭢ 3R satisfactorily follows second-order kinetics. For a feed rate of 4 m3/h of pure A at 3500C and 5 atm, an experimental reactor(size: 25 mm IDpipe × 2 meter length) gives 60% conversion of A. A commercial plant is to be designed to process 320 m3/h of feed containing 50 mole % A and 50 mole% inerts at 350 0C and 25 atm for obtaining 80% conversion of A.

1. How many 2-m lengths of 25 mm ID pipes are needed for 80% conversion?
2. Should they (pipes) be arranged in parallel or in series?

(Assume ideal gas behavior and plug flow in the pipe)

**Q2.The following kinetic data on the reaction, A⭢ R are obtained in an experimental packed bed reactor using various amounts of catalyst and a fixed rate, FA0= 10 kg-mol/hr.**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **W, kg Cat** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| **XA** | **0.12** | **0.20** | **0.27** | **0.33** | **0.37** | **0.41** | **0.44** |

1. **Find the reaction rate at 40% conversion.**
2. **For alarge packed bed reactor with afeed rate FA0= 400 kg-mol/hr, how much catalyst would be needed for 40% conversion?**
3. **How much catalyst would be needed in part(b) if the reactor employed a very large recycle reactor?**

Q3. Kinetic experiments on the solid catalyzed gas-phase reaction A⭢ 3R with pure A are conducted at 8 atm and 7000C in a basket reactor of 960 cm3 in volume and containing 1 gm of catalyst of diameter dP= 3 mm. Feed consisting of pure A is introduced at various rates in the reactor and partial pressure of A in the exit stream measured for each feed rate. The results are

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Feed rate, liters/hr | 100 | 22 | 4 | 1 | 0.6 |
|  | 0.8 | 0.5 | 0.2 | 0.1 | 0.05 |

Find a rate equation to represent the rate of reaction for the above catalyst.

**Q4. The second order reaction A⭢ R is studied in a recycle reactor with very large recycle ratio, and the following data are recorded.**

**Void volume of reactor: 1 liter; weight of catalyst: 3 gm; Feed to the reactor: CA0=2 mol/liter, v0=1 liter/hr, CA,out =0.5 mol/liter.**

1. **Find the rate constant for this reaction.**
2. **How much catalyst is needed in a packed bed reactor for 80% conversion of 1000 liter/hr of feed of concentration CA0=1 mol/liter?**