**Assignment-1 , Reaction Engineering, 2019**

1. The rate equation for the homogeneous decomposition of nitrous oxide

N2O→ N2+ 1/2O2 is given by

 mol/lit.min

Derive a rate mechanism to explain this observed rate.

1. The following kinetic data are obtained in a constant volume batch reactor at 273 K using pure gas A.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Time, min | 0 | 2 | 4 | 6 | 8 | 10 | 12 | 14 | ∞ |
| pA, mmHg | 760 | 600 | 475 | 390 | 320 | 275 | 240 | 215 | 150 |

The stoichiometry of the decomposition of A is A→2.5S. Find a rate equation which will satisfactorily fit the data.

1. The gas phase reaction A + 2B  2D is to be carried out in an isothermal plug-flow reactor at 5.0 atm. The feed contains 20 mole% of A, 50 mole% of B and rest inerts.
2. Construct the stoichiometric table for the above reaction.
3. What are the expressions for the concentrations of A,B and D as a function of conversion at any point along the reactor ?
4. How large must the plug-flow reactor be to achieve a 70% conversion of A, if the feed temperature in the reactor is uniform(55oC), the volumetric feed rate is 50 dm3/min and the rate equation at 55oC is -rA = 2.5  kmol/m3. min
5. How large would a CSTR have to be to take the effluent from the PFR in part (c) and achieve a conversion of 0.85 ( based on the feed of A to the PFR) if the temperature of the CSTR is 55oC?
6. Find the first order reaction rate constant, k of the gaseous reaction 2A →P, on holding the pressure constant, the volume of the reaction mixture, starting with 80mole% A and 20mole%inerts,decreases by 20% in 3 mins.
7. A first-order homogeneous gas-phase reaction, A → 3R is first studied in a constant pressure batch reactor. At a pressure of 2 atm and starting with pure A, the volume increases by 75% in 15 min. If the same reaction is carried out in a constant-volume reactor, and the initial pressure is 2 atm, how long is required for the pressure to reach 3 atm?
8. The gas-phase reaction A ⭢ R + S is carried out isothermally in a mixed reactor using CAo = 0.002 gmol/liter varying the space-time(τ) with pure A. The results are obtained as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Run Number | 1 | 2 | 3 | 4 | 5 |
| τ , sec | 0.423 | 5.10 | 13.5 | 44.0 | 192 |
| XA | 0.22 | 0.63 | 0.75 | 0.88 | 0.96 |

Find a satisfactory rate equation.

1. The gas-phase reaction A3R is carried out at 8 atm and 700oC in a basket type mixed reactor of 960 cc. volume using 1 gm of solid catalystm ( 3 mm. catalyst). The following reactor data was obtained using pure A at various feed rates . Find a rate equation to represent the rate equation.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| FA, lit/hr. | 100 | 22 | 4 | 1 | 0.6 |
| pA,out/pA,in | 0.8 | 0.5 | 0.2 | 0.1 | 0.05 |

1. The solid-catalyzed decomposition of gaseous A proceeds as follows:

A R -rA = kA CA2

A tubular pilot plant reactor packed with 2 liters of catalyst is fed m3/hr of pure A at 400oC and 20 atm. Conversion of reactant is 65%.

In a larger plant it is desired to treat 100 m3/hr of feed gases at 40 atm and 400oC containing 60% A and 40% diluents to obtain 80% conversion of A. Find the reactor volume required.

1. The irreversible reaction 2H2 + 2NO  N2 +H2O is carried out in a constant volume reactor using equimolar amounts of hydrogen and nitric oxide. The reactor data is as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Pt, mm Hg | 200 | 240 | 280 | 320 | 326 |
| t1/2 , sec | 265 | 186 | 115 | 104 | 67 |

Find the overall order of the reaction.

1. the aquous reaction A → R + S is carried out in a batch reactor with CAo=0.183mol/l, CRo=0 and CSo=55 mol/l. The reactor data is as follows:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| t, min | 0 | 36 | 65 | 100 | 160 | ∞ |
| CA,mol/l | 0.183 | 0.145 | 0.122 | 0.103 | 0.0795 | 0.0494 |

Find a rate equation for this reaction.