Catalysis

Content

1. Definition of catalyst and its characteristics
2. Definition of Catalysis and its types
3. Types of Catalyst
4. Promoters and Inhibitors
5. Application of Catalyst
6. Questions

Definition of catalyst

Catalyst is defined as a substance which alters the rate of a chemical reaction,without itself undergoing any change in mass and composition at the end of the reaction.

Characteristics of catalyst

1)A catalyst remains unchanged in mass and chemical composition at the end of the reaction.

2)A small quantity of catalyst is sufficient.

3)A Catalyst is more effective when finely divided

4)A catalyst is specific in its action

5)A catalyst cannot initiate reaction

6) A Catalyst shortens the time required to complete the reaction

Definition of Catalysis

Catalysis: The process of altering the rate of a chemical reaction by adding a substance known as a *catalyst*, which is not consumed in the catalyzed reaction.

Mechanism of Catalysis

Adsorption theory: The reactants are adsorbed on the surface of the catalyst and form a film. Due to high concentrations of the reactants on the film, reaction proceeds at a faster rate.

Energy activation theory: The catalyst lowers the activation energy, reactants thus easily reacts to form products.

Types of Catalysis

a)Homogeneous catalysis

b)Heterogeneous catalysis.

Homogeneous catalysis

In such catalytic reactions, **catalyst** and the **reactants** are in the **same phase.**

$$2SO_2(g) + O_2(g) \overset{NO(g)}{\rightarrow} 2SO_3(g)$$

$$CH_3COOH_3(l) + H_2O(l) \underset{H^+(l)}{\overset{OH^-(l) or}{\rightarrow}} CH_3COOH(l) + CH_3OH(l)$$

Heterogeneous catalysis.

In such catalytic reactions, **catalyst** and the reactants are in **different phases**

$$2SO_2(g) + O_2(g) \xrightarrow{V_2O_5(s)} 2SO_3(g)$$

$$CO(g) + H_2O(g) \xrightarrow{Fe_2O_3(s} CO_2(g) + H_2(g)$$

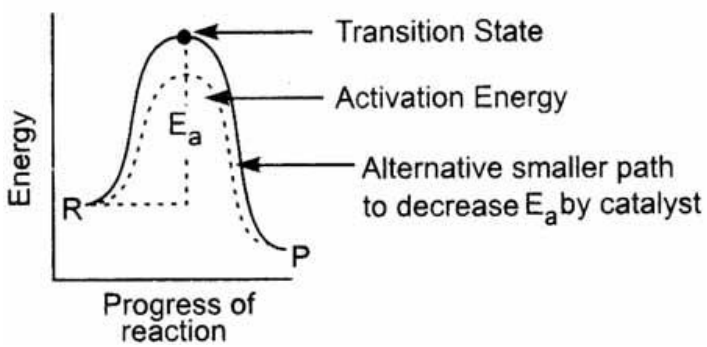
Types of Catalyst:

1) Positive catalyst

2) Negative catalyst

Positive catalyst

A catalyst which increases the rate of reaction is called positive catalyst. Such catalyst decreases activation energy by accepting a smaller path, so the rate of reaction is increased.



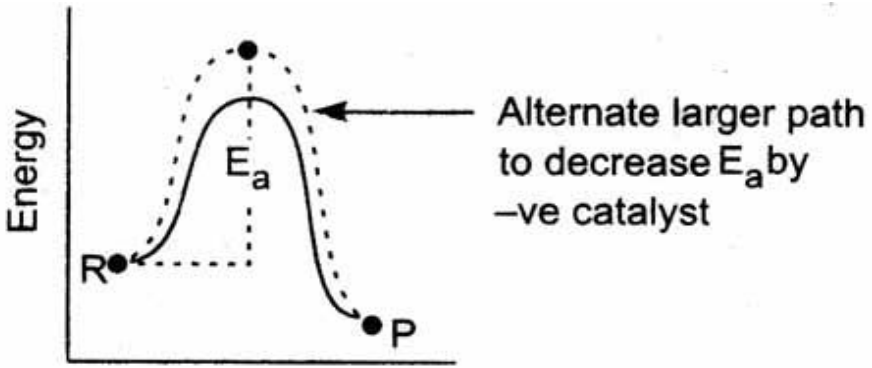
$$2SO_2(g) + O_2(g) \xrightarrow{Pt(s)} 2SO_3(g)$$

$$2KClO_3(s) \xrightarrow{MnO_2(s)} 2KCl(s) + 3O_2(g)$$

Negative catalyst

A catalyst which decreases or retards the rate of reaction is called negative catalysts

eg:Chloroform is used as an anaesthetic .on oxidation by air is forms carbonyl chloride which is poisonous,2% of ethanol added to suppress the formation of carbonyl chloride



Promoters and Inhibitors

Promoters are substances that **increase the catalytic activity**, even though they are not **catalysts** by themselves.

Eg:In Haber's process Fe is used as catalyst to produce Ammonia and **Molybdenum** (Mo) is used as promoter.

Catalytic Inhibitor are substances that decrease the catalytic activity.

Eg:In Haber's process Fe is used as catalyst to produce Ammonia and **H_2S** is used as inhibitor

Auto-catalysis and Auto catalyst

Catalysis reaction in which one of the products formed in the reaction acts as a catalyst is called as Auto catalysis.

$$CH_3COOC_2H_5 + H_2O \rightarrow CH_3COOH(auto-catalyst) + C_2H_2OH$$

The product which act as catalyst is called as Auto catalyst.

Industrial Application of Catalyst

Name of reaction	Product manufactured	Catalyst used
Deacon's process	Chlorine gas	CuCl2
Haber's process	Ammonia	Fe2O3
Lead Chamber Process	Sulphuric acid	NO
Contact Process	Sulphuric acid	Pt/V2O5
Manufacturing of Glucose	Glucose	Maltase
Manufacturing of Alcohol	Ethanol	Zymase
Manufacturing of Rubber	Acrylonitrile	CuCl
Manufacturing of Polymer	Polyethylene	Zigler Natta

Questions

1. Name the metal which increases the activity of iron metal catalyst when added in small quantity in Haber process
2. What is the role of Mo in manufacturing of ammonia by haber's process where Fe is used as catalyst
3. Name the catalyst which is used for the manufacture of glucose from cane sugar
4. _____process is used for the preparation of chlorine gas
5. _____process is used for the preparation of Sulphuric acid using Pt/V2O5 as catalyst
6. Name the catalyst in Haber Process
7. Name the catalyst used in manufacturing of sulphuric acid by contact process
8. _____catalyst used for manufacture of ethanol from glucose
9. 2% Ethanol added to chloroform to prevent its oxidation into phosphine gas , which act as_____