Class ⇒ B.Sc. (Hons.) Part II
Subject ⇒ Chemistry
Paper ⇒ IIIA (Physical Chemistry)
Chapter ⇒ Catalysis
Topic ⇒ Characteristics of Catalyst, Autocatalysis.

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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 generally needed to produce almost unlimited reaction.

(3) A catalyst is more effective when finely divided ⇒

In heterogeneous catalysis, the solid catalyst is more effective when in a state of fine sub-division than it is used in bulk.

Thus a lump of Platinum will have much less catalytic activity than colloidal or Platinised asbestos.

Finely divided Nickel is a better catalyst than lump of solid Nickel.

(4) A catalyst is specific in its action ⇒

Different catalyst, moreover, can bring about completely different reactions for

the same substance.

e.g.

$C_2H_5OH \xrightarrow{\text{hot } Al_2O_3} CH_2=CH_2 + H_2O$

Ethanol → Ethene

(Dehydration)

$C_2H_5OH \xrightarrow{\text{hot Cu}} CH_3CHO + H_2$

Ethanol

(Dehydrogenation)

(5) A Catalyst does not initiate a reaction, it simply increases or decreases the speed of the reaction.

(6) A Catalyst does not affect the final position of equilibrium, although it shortens the time required to establish the equilibrium.

(7) A Catalyst has an optimum temperature ⇒ The rate of reaction is maximum at a particular temperature is called **optimum** temperature.

(8) A Catalyst is poisoned by the presence of certain substances even in small amounts are called **catalystic poisons**.

(9) Activity of a Catalyst is increased by the presence of substances is called **promoter**.

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Autocatalysis

When one of the products of reaction itself acts as a catalyst for that reaction the phenomenon is called **Autocatalysis**.

In autocatalysis the initial rate of the reaction rises as the catalytic product is formed, instead of decreasing steadily.

The curve plotted between reaction rate and time shows a maximum when the reaction is complete.

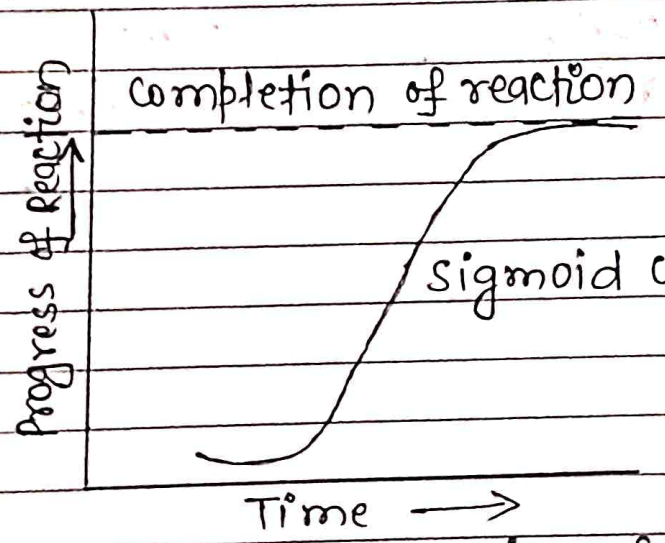

fig :- Curve showing the rise of rate of reaction with time.

Examples of Autocatalysis

(1) Hydrolysis of an Ester ⇒ The hydrolysis of Ethyl acetate forms acetic acid and ethanol.

$$\underset{\text{Ethyl acetate}}{CH_3COOC_2H_5} + H_2O \longrightarrow \underset{\text{Acetic acid (Catalyst)}}{CH_3COOH} + \underset{\text{Ethanol}}{C_2H_5OH}$$

Acetic acid acts as a catalyst for the reaction

(2) oxidation of oxalic acid ⇒ When oxalic acid is oxidised by acidified Potassium permanganate

Manganous sulphate produced during the reaction acts as a catalyst for the reaction.

$$2\,KMnO_4 + 5\,H_2C_2O_4 + 3\,H_2SO_4 \longrightarrow 2\,MnSO_4 + K_2SO_4 + 8\,H_2O + 10\,CO_2$$

Potassium permanganate — Oxalic acid — Sulphuric acid — Catalyst

(3) Decomposition of Arsine ⇒ The free Arsenic produced by the decomposition of Arsine (AsH_3) autocatalyses the reaction.

$$2\,AsH_3 \longrightarrow 2\,As + 3\,H_2$$

Arsine — Catalyst

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