



19CH101 – ENGINEERING CHEMISTRY

Unit-2 CORROSION AND ITS CONTROL

Corrosion Inhibitors

A corrosion inhibitor is a substance which reduces the corrosion of a metal, when it is added to the corrosive environment.

Types of Inhibitors

1. Anodic Inhibitors

Examples: Chromates, nitrates, phosphates, tungstates (or) other ions of transition elements with high oxygen content.

Anodic inhibitors are those that prevent the corrosion reaction, occurring at the anode, by forming an insoluble compound with the newly produced metal ions. These precipitates are adsorbed on the metal (anode) surface, forming a protective film and reducing the corrosion rate.

Though this type of control is effective, it may be dangerous, since severe local attack can occur, if some areas are uncovered.

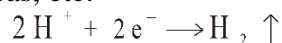
2. Cathodic Inhibitors

In an electrochemical corrosion, the cathodic reactions are of two types depending upon environment.

(a) In an Acidic Solution

Examples:

Organic inhibitors heterocyclic nitrogen compounds, heavy metal soaps. In an acidic solution, the cathodic reaction is evolution of hydrogen i.e., like amines, mercaptans, thioureas, substituted ureas, etc.



The corrosion can be reduced in two ways

(i) By slowing down the diffusion of H⁺ ions to the cathode. This can be done by adding organic inhibitors like amines, pyridines, etc., which are adsorbed at the metal surfaces.

(ii) By Increasing the over voltage of Hydrogen evolution. This can be done by adding antimony and arsenic oxides which deposit adherent film of metallic arsenic and antimony at the cathodic areas.

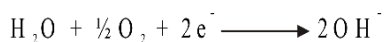


(b) In a Neutral Solution

Examples:

Sodium sulphite (Na_2SO_3), hydrazine (N_2H_4).

In a neutral solution, the cathodic reaction is



The corrosion can be reduced in two ways.

- (i) By eliminating the oxygen from the neutral solution, thereby formation of OH^- ions are inhibited. This can be done by adding reducing agents like Na_2SO_3 , N_2H_4 etc.
- (ii) By eliminating the OH^- ions from the neutral solution. This can be done by adding Mg, Zn or Ni salts. These react with OH^- ions form insoluble hydroxides, which are deposited on the cathode forming less impermeable self - barriers.

3. Vapour Phase Inhibitors (VPI)

Examples: Dicyclohexylammonium nitrate, benzotriazole, etc.

Vapour phase inhibitors (VPI) are organic inhibitors, which readily vapourise and form a protective layer on the metal surface. VPI are used in the protection of storage containers, packing materials, sophisticated equipments, etc.

iv) Control of corrosion by modifying the metal

1. By selection of the metal

Selection of right type of metal is the main factor for corrosion control. Thus, noble metals are used in ornaments and in surgical instruments.

2. By using pure metal

Pure metals have higher corrosion resistance. Even a small amount of impurity may lead to severe corrosion.

3. By alloying

Corrosion resistance of many metals can be improved by alloying. For example, stainless steel containing chromium produces a coherent oxide film, which protects the steel from further attack.



4. By proper design

Some of the important rules for designing, which must be observed, are given below.

i) Avoid galvanic corrosion

If two different metals are joined, galvanic corrosion will occur. In such a case galvanic corrosion is prevented by

- a) Selecting the metals as close as possible in the electrochemical series.
- b) Providing smaller area for cathode and larger area for anode.
- c) Inserting an insulating material between the two metals.

ii) Drainage affects corrosion

Tanks and other containers must be designed in such a way that, the whole of the liquid should be drained off completely.

iii) Avoid sharp corners and bends

Sharp corners and bends should always be avoided, and hence erosion corrosion can be avoided by smooth corners or curved pipe bends

iv) By avoiding crevices

Crevices allow moisture and dirt, which results in increased electrochemical corrosion. This can be prevented by filling the crevices with filler.

Example: Riveted joints produce crevice corrosion, so welded joints are preferred.