Chapter-6 Corrosion

⇒ Definition of Corrosion:

The process of conversion of a metal into an undesireable compound on exposure to atmospheric conditions i.e. moisture (water) and air is called corrosion. It is also called as weeping of metals.

⇒ Types of Corrosion: Corrosion is of the following types:

i. Atmospheric corrosion
ii. Water line corrosion
iii. Pitting corrosion
iv. Stress corrosion.

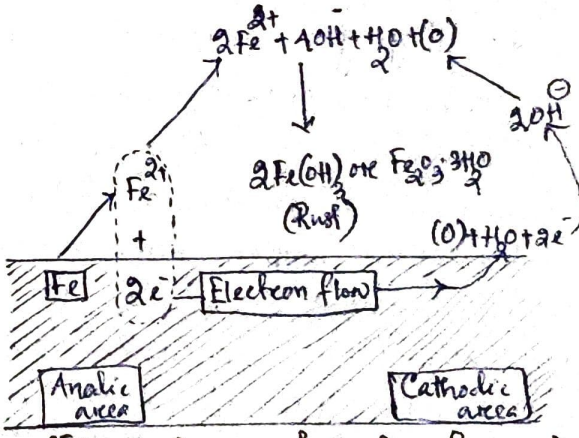
i. Atmospheric corrosion:

The process of development of undesireable substances usually oxide over the surface of a metal when exposed to atmosphere is called atmospheric corrosion.

Example: (a) rusting of iron
(b) tarnishing of silver
(c) developing of green coating over copper and bronze.

* Mechanism of rusting of iron:

Pure iron doesn't rust. However commercial form of iron behaves like a tiny electric cell in presence of water containing dissolved oxygen and acidic substances like CO_2, SO_2 etc. The following changes take place on the surface of iron during the process of corrosion.



(Fig. Mechanism of Rusting of Iron)

At Anode:

At anode, iron gets oxidized into ferrous ion.

$$2Fe \longrightarrow 2Fe^{2+} + 4e^-$$

The electrons thus formed migrate towards the cathodic part of the piece of iron.

At Cathode:

At the cathodic part, the electrons combine with moisture and dissolved oxygen to form hydroxyl ions.

$$H_2O + O + 2e^- \longrightarrow 2OH^-$$

The Fe^{2+} ions and OH^- ions then diffuse under the influence of dissolved oxygen and Fe^{2+} ions are oxidized into Fe^{3+} ions. These Fe^{3+} ions then combine with OH^- ions to form hydrated ferric oxide which is nothing but rust.

$$2Fe^{2+} + H_2O + O \longrightarrow 2Fe^{3+} + 2OH^{\ominus}$$

$$2Fe^{3+} + 6OH^{\ominus} \longrightarrow Fe_2O_3 \cdot 3H_2O \text{ (Rust)}$$

Note: * Rust is nothing but hydrated ferric oxide ($Fe_2O_3 \cdot nH_2O$)

* Presence of CO_2 in water or trace of Cu or Zn in iron accelerates the process of corrosion. Also, corrosion process is accelerated in saline water.

* Presence of alkalis in water or Cr, Ni in iron slows down the process of corrosion.

ii. Waterline Corrosion:

This type of corrosion occurs due to differential oxygen concentration above and below the level of water. When water is stored in a steel tank, it is noticed that corrosion occurs along the line just below the level of water.

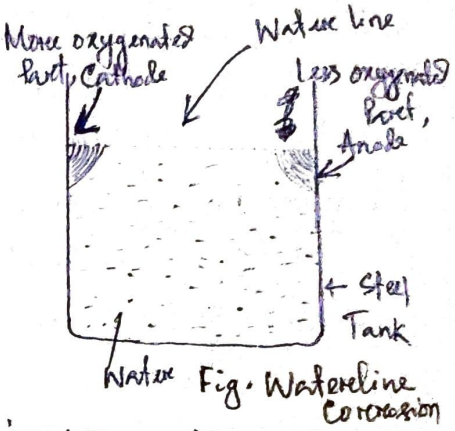


Fig. Waterline Corrosion

The concentration of oxygen in the area above the waterline is high and hence the area is called Cathodic part. The area just below the waterline is called anodic part as this part is deficient in oxygen. This type of corrosion is mostly seen in ships, water tanks, etc.

⇒ Protection of Corrosion:

1. Alloying: Corrosion can be prevented by alloying a metal. Alloying prevent corrosion in two ways.

(i) Homogeneity: Alloying increases the homogeneity of the metal for which the rate of corrosion is reduced. Rusting of iron can be prevented by alloying it with chromium. It is important to note that only uniform alloy can prevent corrosion to a maximum extent.

(ii) Oxide film: In some cases, the oxide film formed at the surface of the metal prevents corrosion. Duricon is a silica-iron alloy. It is resistant to acids as a layer of silicon oxide is formed at the surface of iron.

2. Galvanization: Normally iron gets rusted when exposed to moist air. Rusting of iron can be prevented by applying a coating of Zn or Cr over it. The process of applying a coating of Zn over Fe with a view to protect it from rusting is called Galvanization.

During the process of Galvanization of iron, Zn is used as anode and iron bar is used as cathode. Both the electrodes are connected to the terminals of a battery. The electrodes are dipped in an aqueous solution of $ZnSO_4$. When electricity is passed, the anode, i.e., Zn bar dissolves in its aqueous salt solution to liberate Zn^{2+} ion which get discharged and deposited over the cathode. In this way a coating of Zn is applied over the surface of iron.