

# TYPES OF CORROSION

## 1. GALVANIC CORROSION :

### 5.4.1 Differential metal corrosion

This type of corrosion of metals is also referred to as "galvanic corrosion".

When dissimilar metals are electrically connected exposed to an environment, the metal of lower reduction potential (or higher up) in the electrochemical series undergoes corrosion.

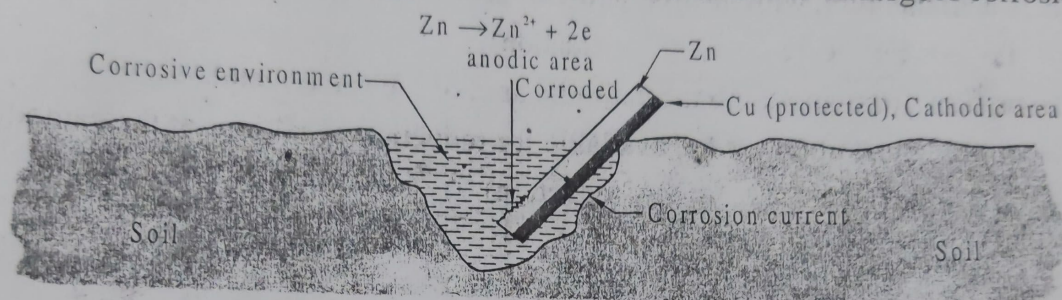
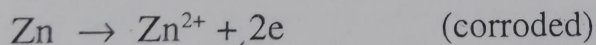


Fig 5.1 Differential metal corrosion

In the above figure 5.1. Zinc is in contact with copper and is immersed to a corrosive environment (soil). Zinc metal being higher up in the electrochemical services acts as anodic area; gets corroded as shown in the figure 5.1; whereas copper metal which is lower down in the series behaves as cathodic area of the dissimilar metals.

The corrosion of Zinc can be summed up as:

At the anodic,



The corrosion current is due to the flow of electrons from anodic area (Zn) to the cathodic area (Cu).

In an acid medium, corrosion of Zinc occurs with the evolution of hydrogen, while in the neutral medium, oxygen absorption occurs and produces  $\text{OH}^-$  ions. In short, Zn gets corroded while Cu is protected.

This type of corrosion can be observed in the following examples.

- (1) Steel pipe connected to copper
- (2) Zinc coating on mild steel
- (3) Tin coating on copper vessel
- (4) Lead - antimony solder around copper wires.

### 5.4.2 Differential aeration corrosion

Occasionally, we find a situation wherein, a metal is exposed to different oxygen environment. The mechanism of corrosion of such metals can be explained by differential aeration environment.

'Differential aeration corrosion' occurs when one part of the metal is exposed to a different air /  $O_2$  concentration from the rest of the part. It can be noted that a portion of the metal surface exposed to less oxygenated acts 'anodic area' and gets corroded; while the more oxygenated part of the metal is protected (cathodic area).

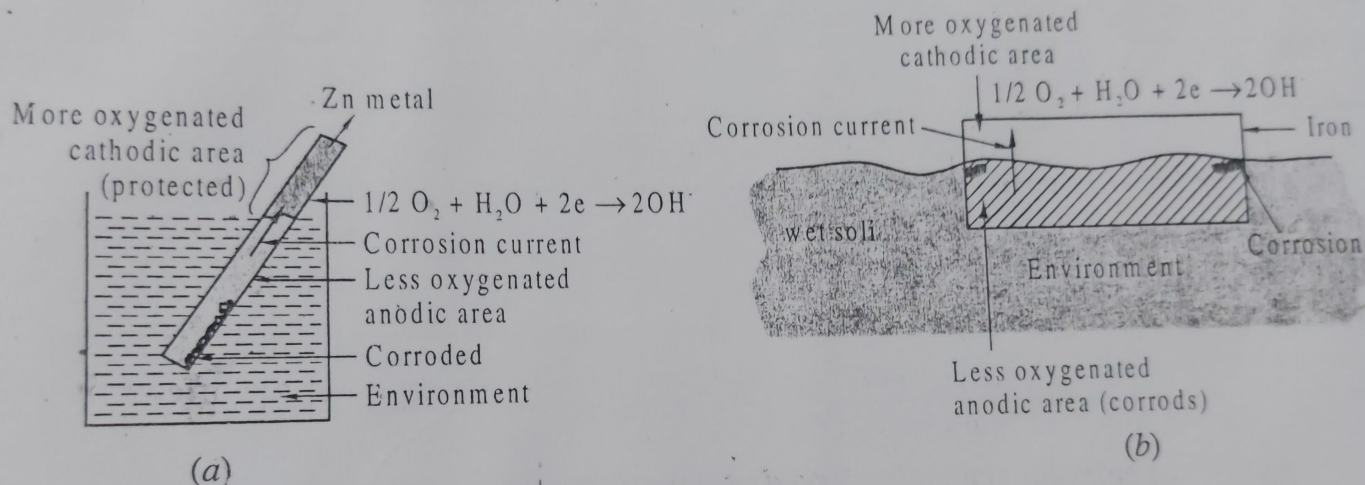


Fig 5.2 Typical examples of differential aeration corrosion

According to the electrochemical theory of corrosion, the anodic part of the metal ( $M = Zn$  or  $Fe$ ) gets corroded in a corrosive environment due to oxidation process, liberating electrons



## PITTING CORROSION

### 5.4.2.1 Pitting Corrosion

This type of corrosion metals generally localized to very small area and accelerated corrosion takes place at the anodic region causing minute pits or pin holes on the surface of the metal. It is one of the most destructive types of corrosion that reduces the life of chemical equipments and other metal parts, which results when small extraneous or dust particles get adhered to a metal surface.

Pitting type of corrosion can also be explained in the light of differential aeration corrosion.

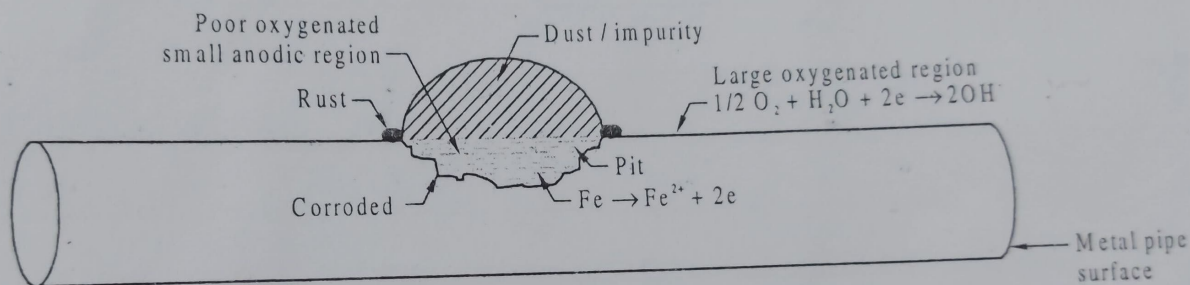


Fig. 5.3 A pitting type of corrosion

It can be noted that the impurity / dust adhered region of the metal surface acts as the anodic region. This tiny portion of covered surface of the metal is poorly oxygenated compared to the large exposed area. Initially, pits or pin holes are formed on the surface of the metal beneath the dust. The corrosion rates of such minute pits or pin holes are much faster by releasing large number of electrons to the cathodic area of the metal for reduction reaction. This results in the enlargement of pits or pin holes.

# WATERLINE CORROSION

## 5.4.2.2 Water-line Corrosion

Water-line type of corrosion of metals can be illustrated in terms of the affects of different concentration of oxygen on metal surface.

This type of corrosion can be observed in water tanks, ocean going ships and so on, which are shown figure 5.4(a) and 5.4(b).

Water used for domestic purpose is stored in storage metal tanks for long time. Corrosion occurs gradually in water storage iron tanks due to the affect of different oxygen concentrations inside and outside the water level as shown in figure 5.4(a). In case of a water taken partially filled,

the iron above the water line is exposed to more oxygen and acts as cathodic region and is unaffected by corrosion, while iron beneath the water line is poorly oxygenated. This region of the metal behaves as anodic and slowly corrodes due to oxidation. The  $Fe^{2+}$  ions formed in the process dissolves in water.

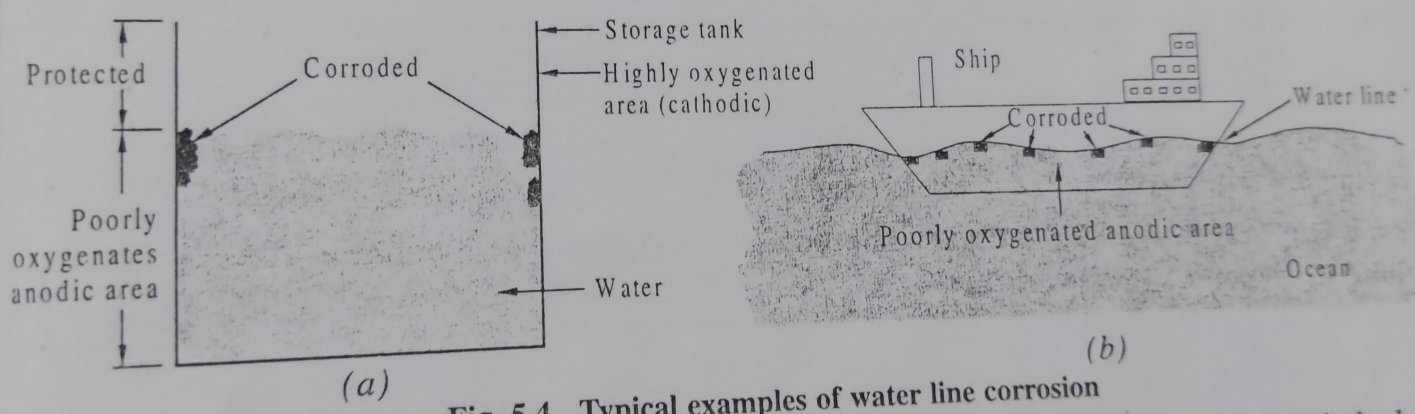
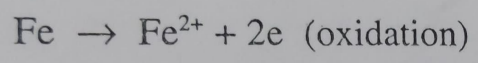


Fig. 5.4 Typical examples of water line corrosion

It is noticed that the effect of corrosion (or rusting) is maximum along a line beneath the level of water miniscus.

Similar, corrosion effects can be observed in ocean going ships or water lifting pipes in water.