

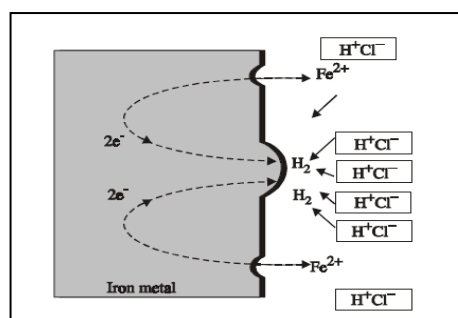


WET ELECTROCHEMICAL CORROSION

Wet corrosion occurs under the following conditions.

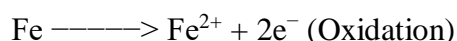
- When two dissimilar metals or alloys are in contact with each other in the presence of an aqueous solution or moisture.
- When a metal is exposed to varying concentration of oxygen or any electrolyte.

When iron metal contacts with non-oxidising acid like HCl, H₂ evolution occurs



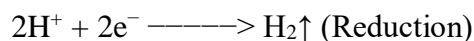
At Anode

Iron undergoes dissolution to give Fe²⁺ ions with the liberation of electrons.



At Cathode

The liberated electrons flow from anodic to cathodic part, where H⁺ ions get reduced to H₂.

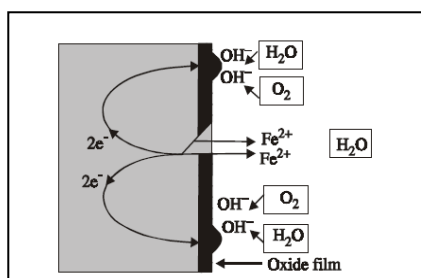


All metals above hydrogen in the electrochemical series have a tendency to get dissolved in acidic solution with simultaneously evolution of hydrogen gas

b) Absorption of oxygen (or) Formation of hydroxide ion type corrosion

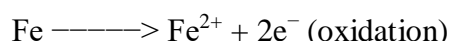
The surface of iron is usually, coated with a thin film of iron oxide. However, if the oxide film develops, some crack will come and anodic areas are created on the surface while the remaining part acts as cathode

Ex: When iron metal contacts with a neutral solution of an electrolyte in presence of oxygen, OH⁻ ions are formed



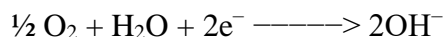
At Anode

Iron dissolves as Fe²⁺ with the liberation of electrons.



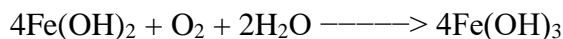


The liberated electrons flow from anodic to cathodic part through metal, where the electrons are taken up by the dissolved oxygen to form OH^- ions.



Thus, the net corrosion reaction is $\text{Fe}^{2+} + 2\text{OH}^- \longrightarrow \text{Fe}(\text{OH})_2 \downarrow$

If enough O_2 is present $\text{Fe}(\text{OH})_2$ is easily oxidised to $\text{Fe}(\text{OH})_3$, a rust ($\text{Fe}_2\text{O}_3 \cdot \text{H}_2\text{O}$)

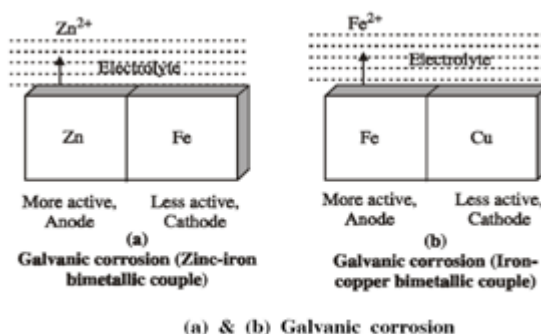


Types of Electrochemical Corrosion

1. Galvanic Corrosion
2. Differential Aeration (or) Concentration Cell Corrosion

1. Galvanic Corrosion

When two different metals are in contact with each other in presence of an aqueous solution or moisture, galvanic corrosion occurs. Here, the more active metal (with more negative electrode potential) acts as anode and the less active metal (with less negative electrode potential) acts as cathode.



Ex: [Zn – Fe Couple] Fig. (a) represents Zn-Fe couple, in which zinc (more active or higher in emf series) dissolves in preference to iron (less active metal) i.e., Zn acts as anode and undergoes corrosion and Fe acts as cathode

Ex: [Cu – Fe Couple] Fig.(b) represents Fe – Cu couple, in which iron (more active, when compared to Cu) dissolves in preference to copper (less active) i.e., Fe acts as anode and undergoes corrosion and Cu acts as cathode.

Examples for Galvanic Corrosion (i) Steel screw in a brass marine hardware corrodes

This is due to galvanic corrosion. Iron (higher position in electrochemical series) becomes anodic and is attacked and corroded,

while brass (lower in electrochemical series) acts as cathodic and is not attacked

ii) Bolt and Nut made of the same metal is preferred



It is preferred in practice, because galvanic corrosion is avoided due to homogeneous metals (no anodic and cathodic part)

Prevention

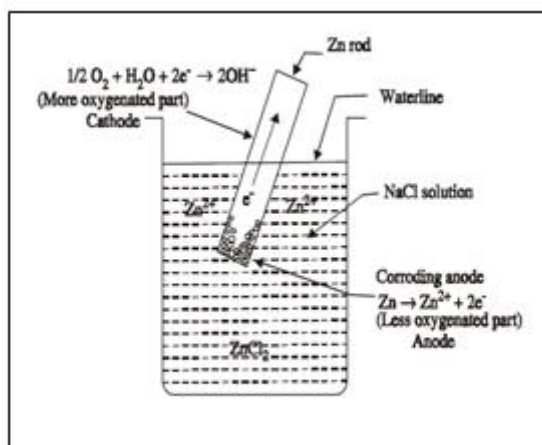
Galvanic corrosion can be minimized by providing an insulating material between the two metals

2. Differential aeration (or) concentration cell corrosion

This type of corrosion occurs when a metal is exposed to varying concentration of oxygen or any electrolyte on the surface of the base metal.

EX: Metals partially immersed in water (or) conducting solution

If a metal is partially immersed in a conducting solution the metal part above the solution is more aerated and hence become cathodic. On the other hand, the metal part inside the solution is less aerated and thus, become anodic and suffers corrosion.



At anode (less aerated), Corrosion occurs $M \longrightarrow M^{2+} + 2e^{-}$

At cathode (more aerated part) OH^{-} ions are produced

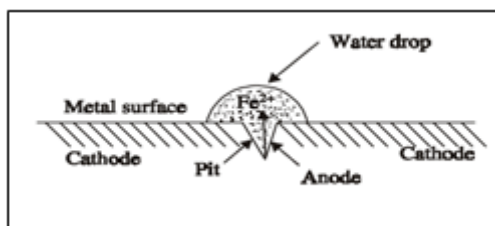


Examples for Differential Aeration Corrosion

a) Pitting or localised corrosion, b) Crevice corrosion, c) Pipeline corrosion, d) Corrosion on wire fence.

1) Pitting or Localized Corrosion. Pitting is a localised attack, resulting in the formation of a hole around which the metal is relatively unattached.

For e.g. Metal area are covered by a drop of water, sand, dust, scale etc



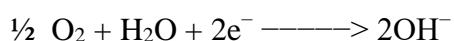
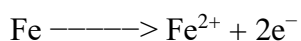
The area covered by the drop of water acts as an anode due to less oxygen concentration and suffers corrosion. The uncovered area (freely Exposed to air) acts as a cathode due to high oxygen concentration.

The rate of corrosion will be more, when the area of cathode is larger and the area of anode is smaller.

Therefore, more and more material is removed from the same spot. Thus a small hole or pit is formed on the surface of the metal.

At Anode: Iron is oxidised to Fe^{2+} ions

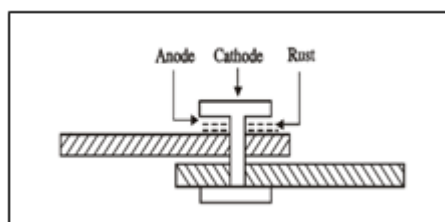
At Cathode: Oxygen is converted to OH^- ions



This type of intense corrosion is called pitting

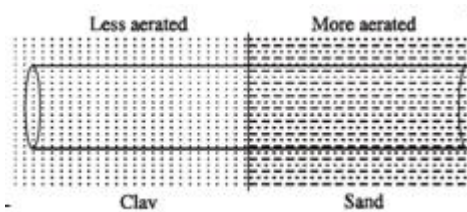
2) Crevice corrosion

If a crevice between different metallic objects or between metal and non-metallic material is in contact with liquids, the crevice becomes the anodic region and suffers corrosion. This is due to less oxygen in crevice area. The Exposed areas act as the cathode



3) Pipeline corrosion:

Differential aeration corrosion may also occur in different parts of pipeline. Buried pipelines or cables passing from one type of soil to another say, from clay (less aerated) to sand (more aerated) may get corroded due to differential aeration.



4) Corrosion on wire-fence: The areas where the wires cross are less aerated than the rest of the fence & hence corrosion occurs at the wire crossings, which are anodic.

