


WET CORROSION

- It is also known as electrochemical corrosion .
- Such type of corrosion is due to the flow of electron from metal surface anodic area towards cathodic area through a conducting solution.





Electrochemical corrosion involves:

- i) The formation of anodic and cathodic areas or parts in contact with each other**
- ii) Presence of a conducting medium**
- iii) Corrosion of anodic areas only**
- iv) Formation of corrosion product somewhere between anodic and cathodic areas.**

This involves flow of electron-current between the anodic and cathodic areas

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Mechanism:

In acidic solution, the corrosion occurs by the hydrogen evolution process;
while in neutral or slightly alkaline solution, oxygen absorption occurs.

The electron-current flows from the anode metal, zinc to the cathode metal, copper.



Thus it is evident that the corrosion occurs at the anode metal;
while the cathodic part is protected from the attack.

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Mechanism Of Wet Corrosion

- The reaction at anode is always oxidation reaction & is associated with the dissolution of metal i.e.

Metal \longrightarrow Metal ions + electron

- The reaction at cathode is always a reduction reaction with no corrosion of cathode & varies depending on the nature of electrolyte in contact

1. Hydrogen evolution :
2. Oxygen absorption :

(A) Evolution of hydrogen:

- This type of corrosion occurs in acidic medium e.g., considering the metal Fe, anodic reaction is dissolution of iron as ferrous ions with liberation of electrons.



Anode $\xrightarrow{\text{electrons flow}}$ Cathode

- The overall reaction is

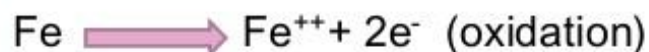


- This type of corrosion causes displacement of hydrogen ions from the solution by metal ions.
- All metals above hydrogen in electrochemical series have a tendency to get dissolved in acidic solution
- The anodes are large areas, whereas cathodes are small areas.



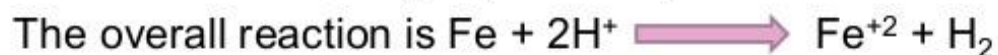
Case I: Evolution of H₂

At anode:

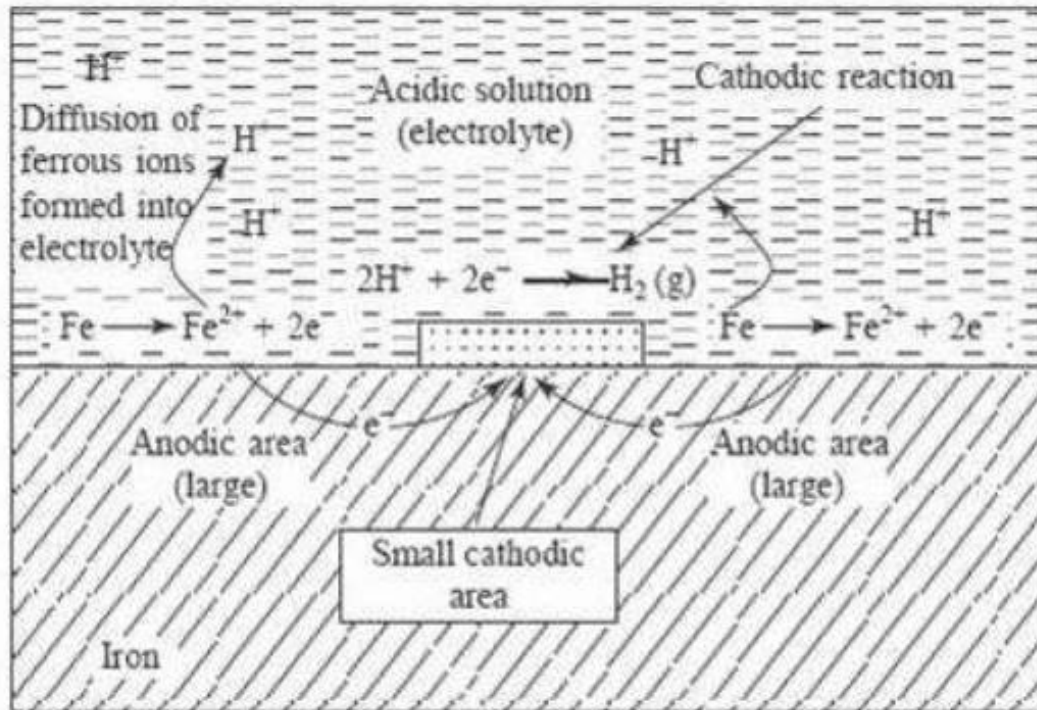


At cathode:

The hydrogen ions (H⁺) are formed due to the acidic environment and the following reaction occurs in the absence of oxygen



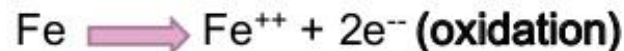
Mechanism of wet corrosion by hydrogen evolution



Case II: Absorption of O₂

This type of corrosion takes place in neutral or basic medium in the presence of oxygen. The oxide of iron covers the surface of the iron. The small scratch on the surface creates small anodic area and rest of the surface acts as cathodic area

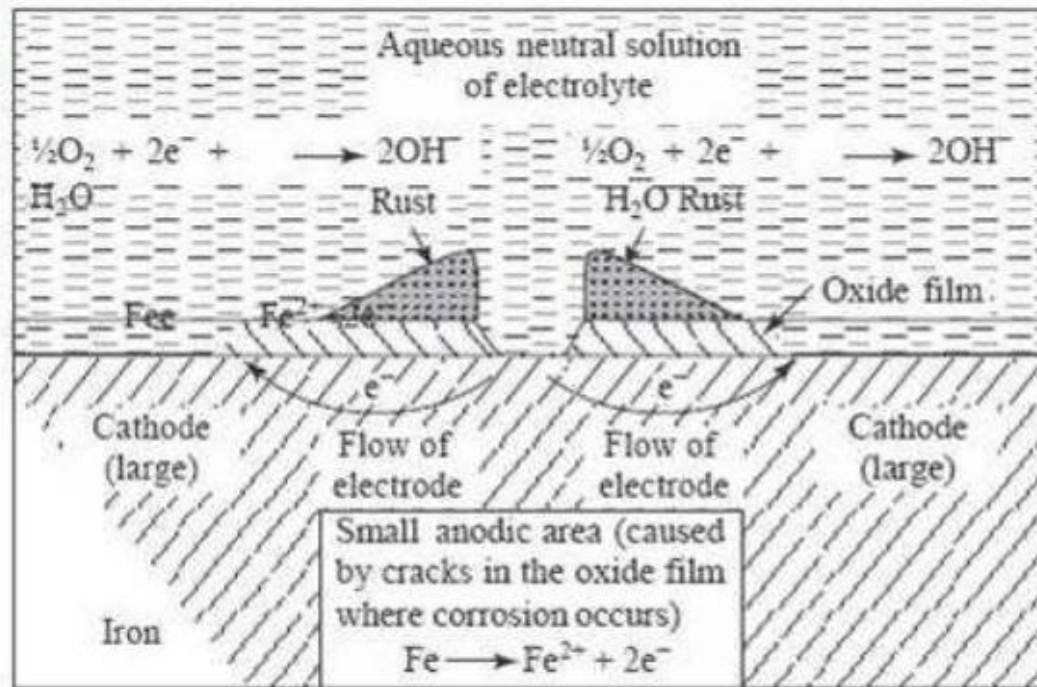
At anode:



At cathode:



Mechanism of wet corrosion by oxygen absorption





Differences between dry and wet corrosion

Dry corrosion

- Corrosion occurs in the absence of moisture.
- It involves direct attack of chemicals on the metal surface.
- The process is slow.
- Corrosion products are produced at the site of corrosion.
- The process of corrosion is uniform.

Wet corrosion

- Corrosion occurs in presence of conducting medium.
- It involves formation of electrochemical cells.
- It is a rapid process.
- Corrosion occurs at anode but rust is deposited at cathode.
- It depends on the size of the anodic part of metal.

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GALVANIC CORROSION

- Galvanic corrosion (also called bimetallic corrosion) is an electrochemical process in which one metal corrodes preferentially to another when both metals are in electrical contact, in the presence of an electrolyte.
- This same galvanic reaction is exploited in primary batteries to generate an electrical voltage.
- A galvanic couple forms between the two metals, where one metal becomes the anode and the other the cathode.

Three conditions must exist for galvanic corrosion to occur:

1. **Electrochemically dissimilar metals must be present**
2. **The metals must be in electrical contact**
3. **The metals must be exposed to an electrolyte**

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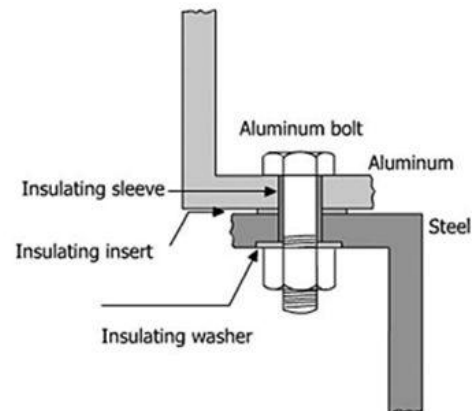
Corrosion types

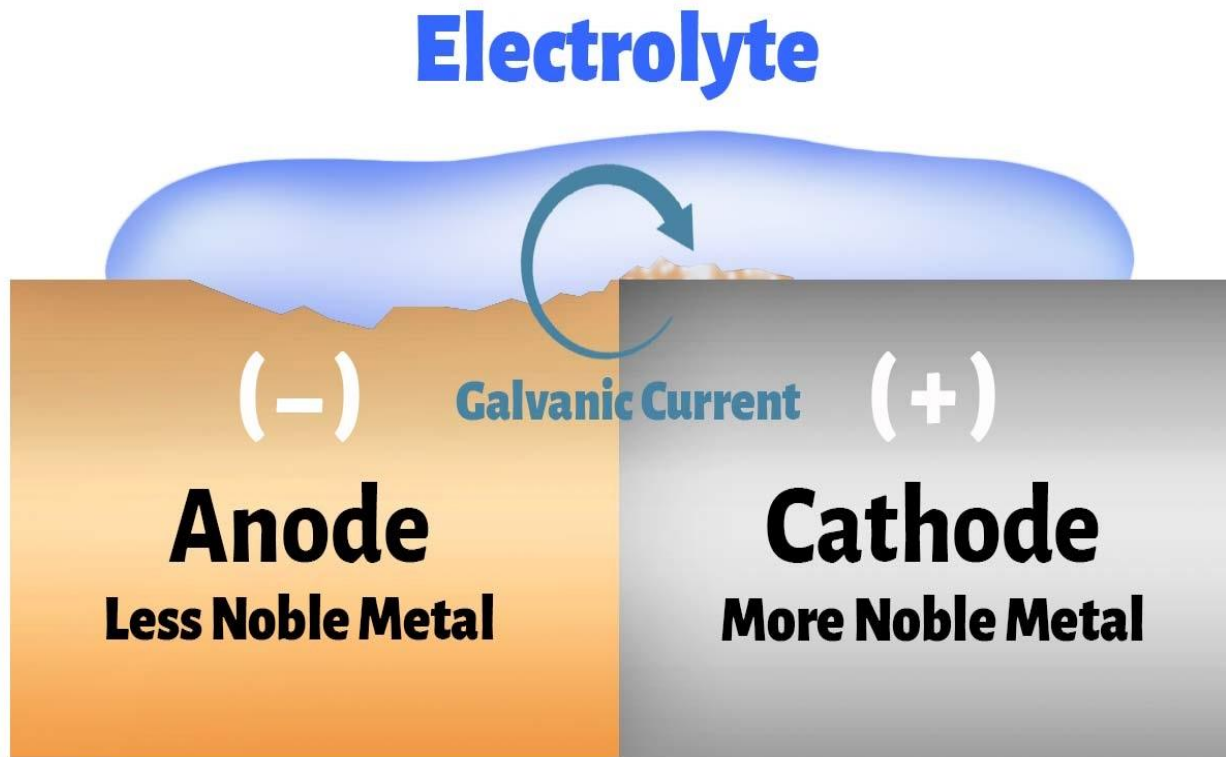
Galvanic corrosion

Factors affecting galvanic corrosion

- Area, Distance and Geometric Effects.

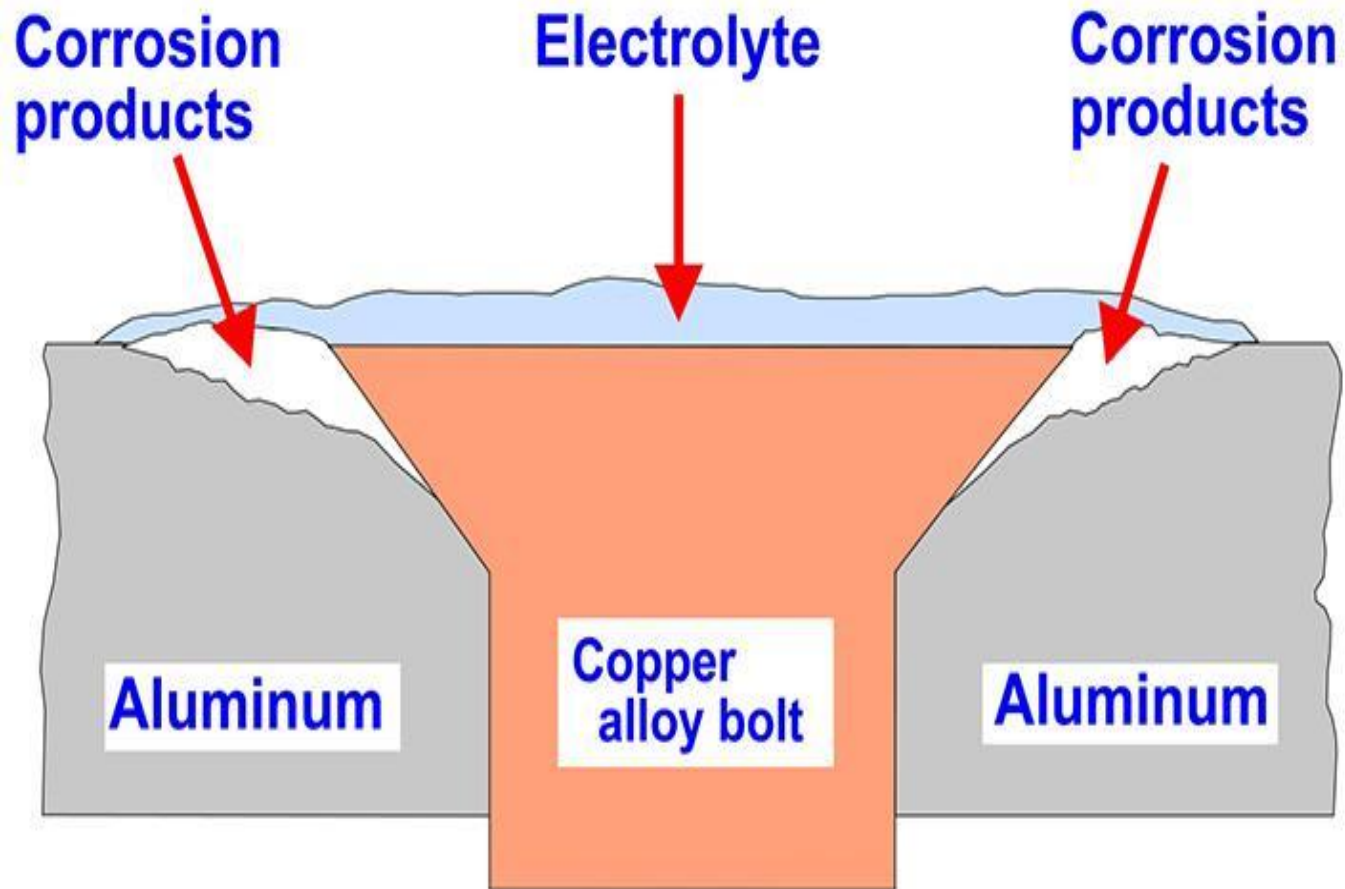
The anode to cathode area ratio is extremely important as the magnitude of galvanic corrosion is seriously affected by it

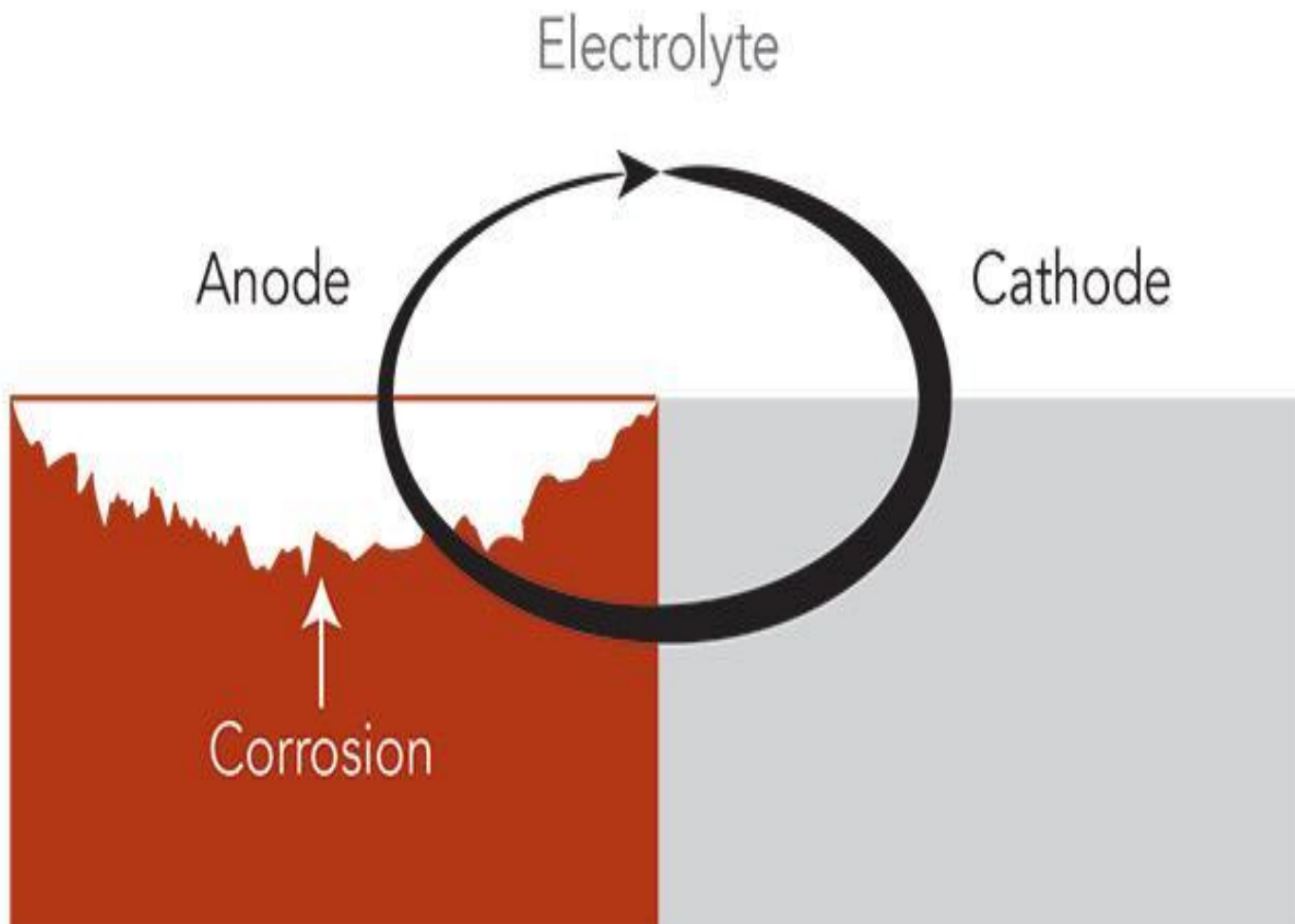




Galvanic/Bimetallic Corrosion of dissimilar metals.







Prevention of Galvanic Corrosion

- **Select metals/alloys as close together as possible in the galvanic series.**
- **Avoid unfavorable area effect of a small anode and large cathode.**
- **Insulate dissimilar metals wherever practical.**
- **Apply coatings with caution. Paint the cathode (or both) and keep the coatings in good repair on the anode.**
- **Avoid threaded joints for materials far apart in the galvanic series.**

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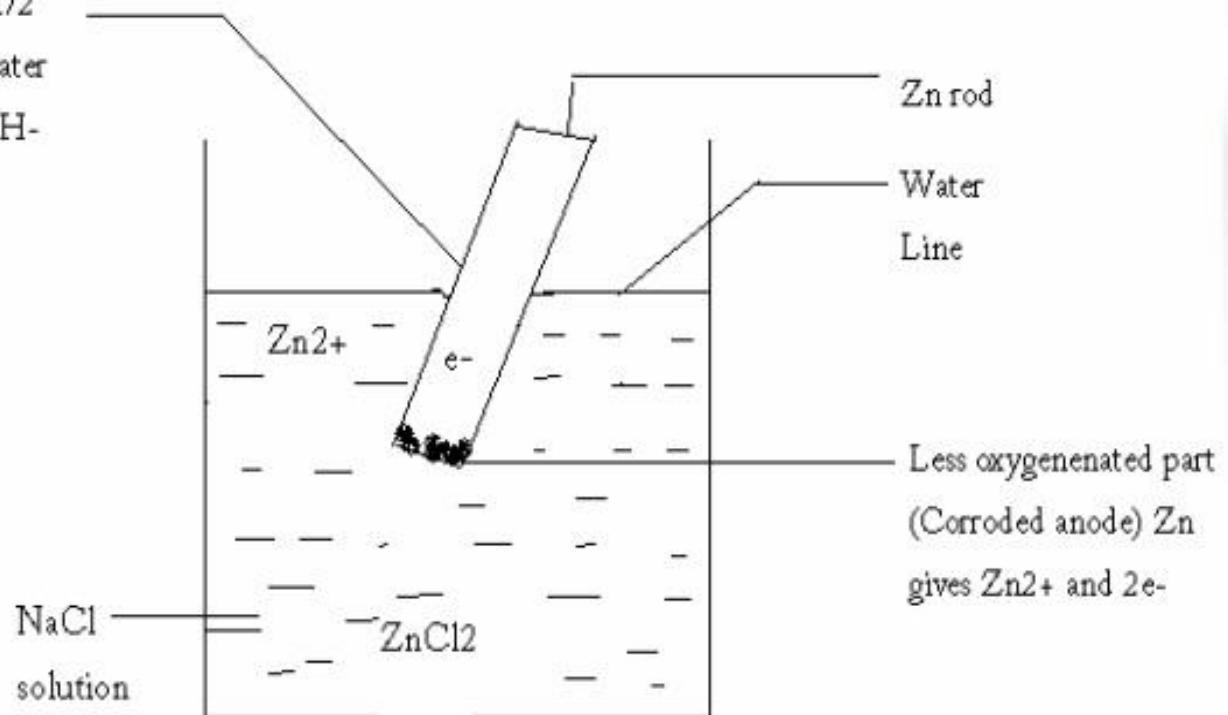
Concentration Cell Corrosion

This type of corrosion is due to electrochemical attack on the metal surface exposed to an electrolyte of varying concentrations. Metal in contact with lower concentration will act as anode and undergoes corrosion. It is observed in chemical plants and storage tanks and also in marine structures like ships. Differential aeration corrosion is the most important.

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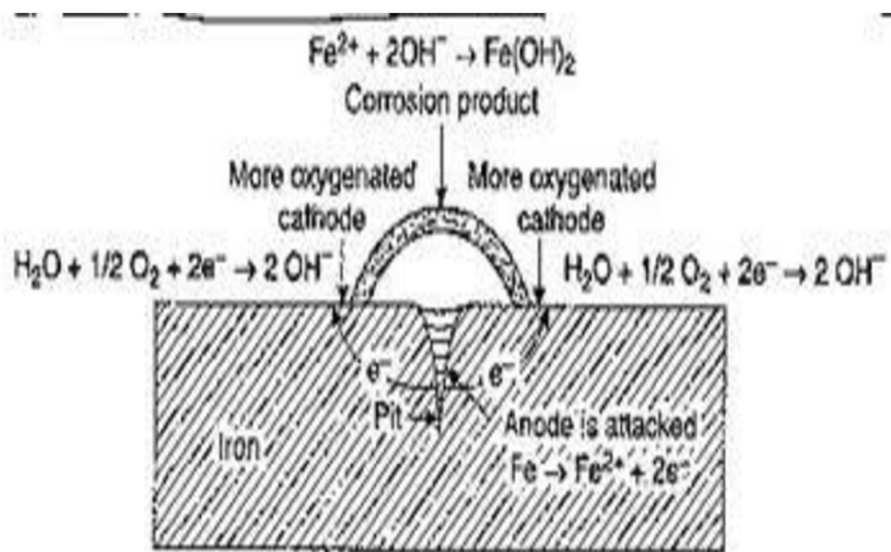
More oxygenated part
(Cathode), here $\frac{1}{2}$
 O_2 reacts with water
and $2e^-$ gives $2OH^-$

CONCENTRATION CELL CORROSION



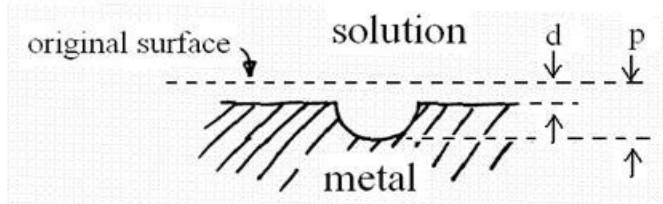
Pitting Corrosion

- Formed as a result of pit and cavities
- Localized attack and formed by cracking protective coating



Pitting Corrosion

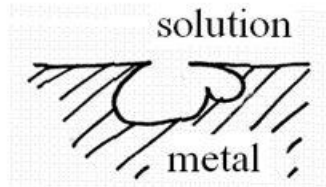
PITTING: Extreme localized attack, may perforate metal sheet/plate . . . etc.



$$\text{"Pitting factor"} = \frac{p}{d}$$

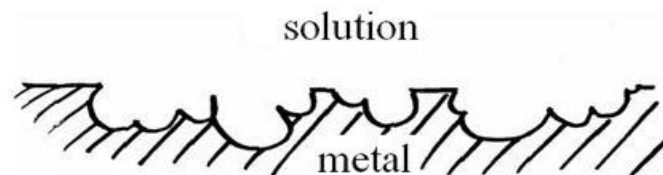
d = average penetration from weight loss;

p = deepest penetration



"Undercutting"

pit opening usually < 1 mm.



Pits may overlap to give the appearance of rough, general **wastage**.

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PITTING CORROSION

- Causes of Pitting Corrosion
 - Localized chemical or mechanical damage to the protective oxide film.
 - Low dissolved oxygen concentrations and high concentrations of chloride (as in seawater)
 - Localized damage to, or poor application of, a protective coating
 - The presence of non-uniformities in the metal structure of the component, e.g. inclusions.

SUDEEP PARALKAR

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2.

signature

REFERENCES

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