❑ Difference between chemical (dry) corrosion and electrochemical (wet) corrosion

Chemical (dry) corrosion	Electrochemical (wet) corrosion
Chemical corrosion occurs in the dry state.	It occurs the presence of moisture or electrolyte.
Corrosion products accumulate at the same spot where corrosion occurs.	It involves the setting up of a huge number of tiny galvanic cells.
Involves the direct chemical attack to the metal.	Occurs only on heterogeneous metal surface.
It follows absorption mechanism.	It follows mechanism electrochemical reactions.
Occurs on homogeneous & heterogeneous surfaces.	Corrosion occurs at the anode surface
Uniform corrosion takes place.	Pitting is more frequent if anode area is small.
It is slow process	It is fast process

❑ Factors Influencing Rate of Corrosion

- Primary Factors
  - Nature of the metal
  - Surface state of the metal
  - Electrode potential difference
  - Formation of protective films by metals
- Secondary Factors
  - pH
  - Temperature
  - Humidity
  - Conductance of the medium
  - Anodic & Cathodic area effect

Factors Influencing Rate of Corrosion

⇒ **Nature of metal:** having low reduction potential are high in reactivity – leads to more corrosion(Li, Na, Mg, Zn). High reduction potential metal associates with less reactivity – leads to less/no corrosion(Ag, Au, Pt,)

⇒ **Ele. Potential difference:** Iron and silver = 1.04V (more corrosion) Vs. Iron and Tin = -0.3V

⇒ **Surface state of metal-** oil, dust, water leads corrosion

⇒ **Formation of protective film-** The passive layer(Oxides) formation around the metal. Unstable, soluble, non-uniform, porous oxides not able to control the corrosion

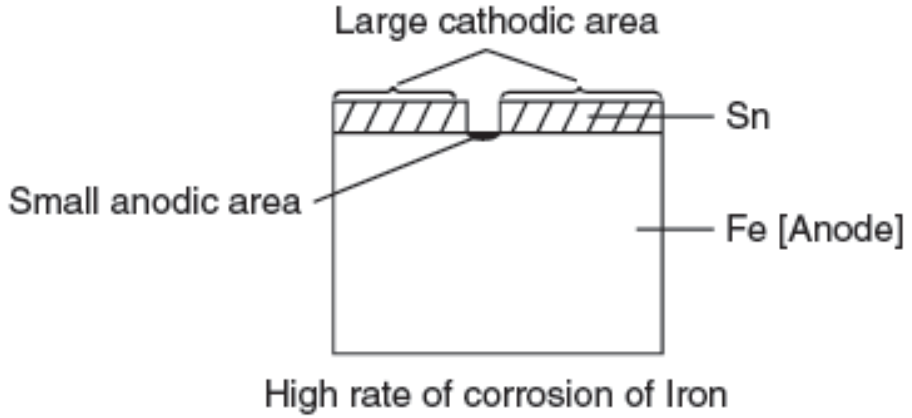
⇒ **pH:** Lower pH medium→higher corrosion

⇒ **Temperature:** Rate of reaction increases with increasing temp.

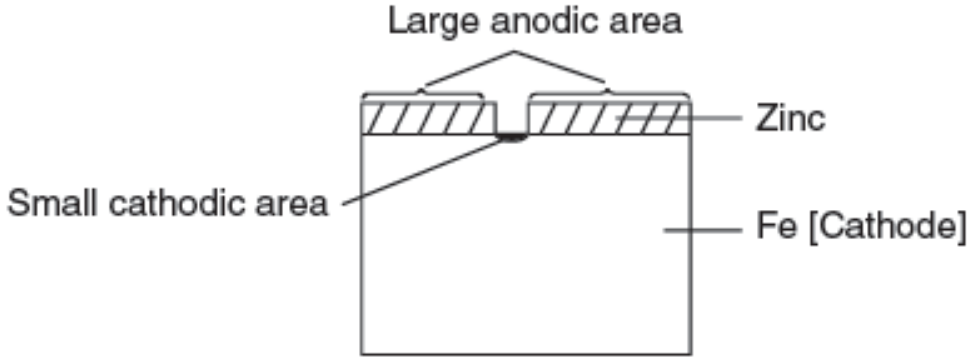
⇒ **Conductance of the medium:** more conductance medium increases corrosion

⇒ **Humidity:** Low humidity →low rate of corrosion and vice versa

⇒ **Anodic and cathodic area:** Sizes of Anodic and cathodic area



High rate of corrosion of Iron



Low rate of corrosion of Iron

Differential aeration corrosion

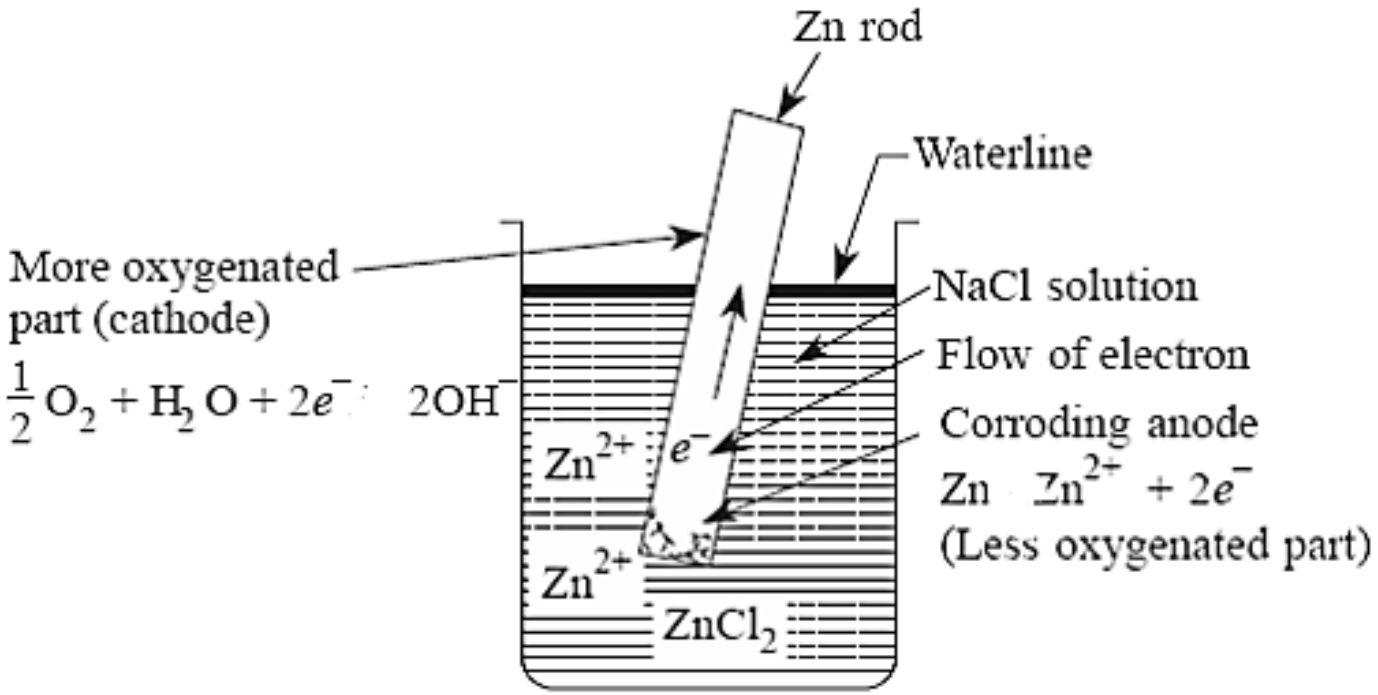
- If a metal rod is dipped in an electrolyte, the portion dipped in water is poor in oxygen concentration and works as anode which gets corroded and the portion above water acts as cathode which is protected.

- The system will act as a concentration cell and the chemical reactions for zinc dipped in water are given as:

$$Zn \longrightarrow Zn^{++} + 2e^-$$

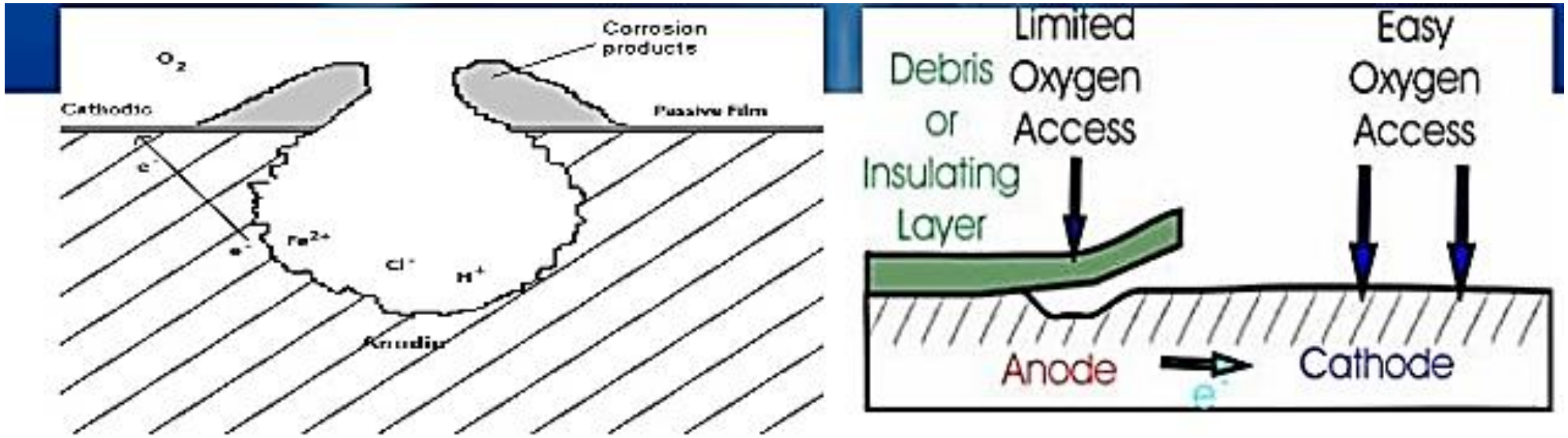
$$H_2O + \frac{1}{2}O_2 + 2e^- \longrightarrow 2OH^-$$

$$Zn + H_2O + \frac{1}{2}O_2 \longrightarrow Zn(OH)_2$$



$Zn(OH)_2$ is the corrosion product here.

Crevice Corrosion



This is a concentration cell in action. Notice how the damage occurs in out of sight places.

Form of Electrochemical Corrosion

Uniform corrosion

Generally occurs due to direct attack

Galvanic corrosion

An electrochemical action that occurs between two dissimilar metals

Concentration cell corrosion

Metal surfaces are in contact with diff. concentration of same solution

Pitting corrosion

Local corrosion occurs with pits at underneath surface formed due to corrosion product accumulation

Crevice corrosion

Generally occurs when metals are in contact with non-metal

Intergranular corrosion

Generally occurs at the grain boundary of a metal/alloy

Filiform corrosion – occurs on painted surface due to penetration of coated surface by moisture in the form of filaments

Corrosion Resistance

- ☑ Selecting materials with similar electrode potentials [e.g., Joining Cu metal and Bronze]
- ☑ Breaking the electrical connection by insulating [Plastic washer, Paint] the two metals from each other. Insulation is typically achieved by using polymer/elastomer-based bushings, washers, gaskets and coatings
- ☑ Applying coatings to both materials. The coating on the cathode is the most important and must be in good condition, otherwise the galvanic corrosion could be worsened.
- ☑ Separating the two materials by inserting a suitably sized spacer.
- ☑ Installing a sacrificial anode that is anodic to both metals.
- ☑ Adding corrosion inhibitor to the environment. The inhibitor will adsorb on the metal surface there by preventing the contacts of anode and cathode surface with electrolyte or aqueous medium.
- ☑ Minimizing the Area Ratio: During the preliminary design stages, it is worthwhile to ensure that the area of the anodic metal is made as large as possible in relation to the cathode.