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MAEER's MIT

Engineering Chemistry

Corrosion - Tutorial 2

1) Distinguish between chemical corrosion and electro-chemical corrosion.

Ans

Chemical corrosion	Electro-chemical corrosion
1) Chemical corrosion occurs in dry condition.	1) Electro-chemical corrosion occurs in presence of aqueous solution or electrolytes.
2) The direct chemical attack of the metal by environment.	2) It occurs through a large number of galvanic cells.
3) It can be explained by absorption mechanism.	3) It can be explained by electrochemical reaction.
4) Corrosion products accumulate at the same spot where corrosion starts. Hence, further corrosion is prevented and it is a slow process.	4) Corrosion products generally accumulate at the cathodic area. Hence, further corrosion occured and it is a rapid process.
5) It occurs on both homogeneous and heterogeneous surface.	5) It occurs in heterogeneous surfaces.
6) Corrosion is uniform.	6) It is not uniform.

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2) Write a note on concentration cell corrosion with the help of a neat labelled diagram.

Ans. i) Concentration cell corrosion is due to the electrochemical attack on the metal surface, which is exposed to an electrolyte of varying concentrations or of varying aerations.

2) It is the most common type of corrosion, and it occurs when one part of the metal is exposed to a different air concentrations from the other part.

3) This causes a difference in potential between differently aerated areas. It has been found that poor oxygenated parts are anodic and rest are cathodic.

4) Metal (Iron) tank storing water or a strip of zinc metal partially dipped in dilute solution of salt like NaCl and if solution is not agitated properly then the parts of the strip above and closely adjacent to the water line are more strongly aerated, because they have more supply of oxygen while remaining parts of the same strip which are immersed to greater depth have less supply of oxygen and these are poorly aerated and show lower oxygen concentration or lesser access of oxygen, and thus they become anodic.

5) Thus, difference of potential is created which cause a flow of current between the two differently aerated areas of the same metal. Zinc will dissolve at anodic areas as,

$$Zn \longrightarrow Zn^{+2} + 2e^{-} \quad \text{(Oxidation)}$$

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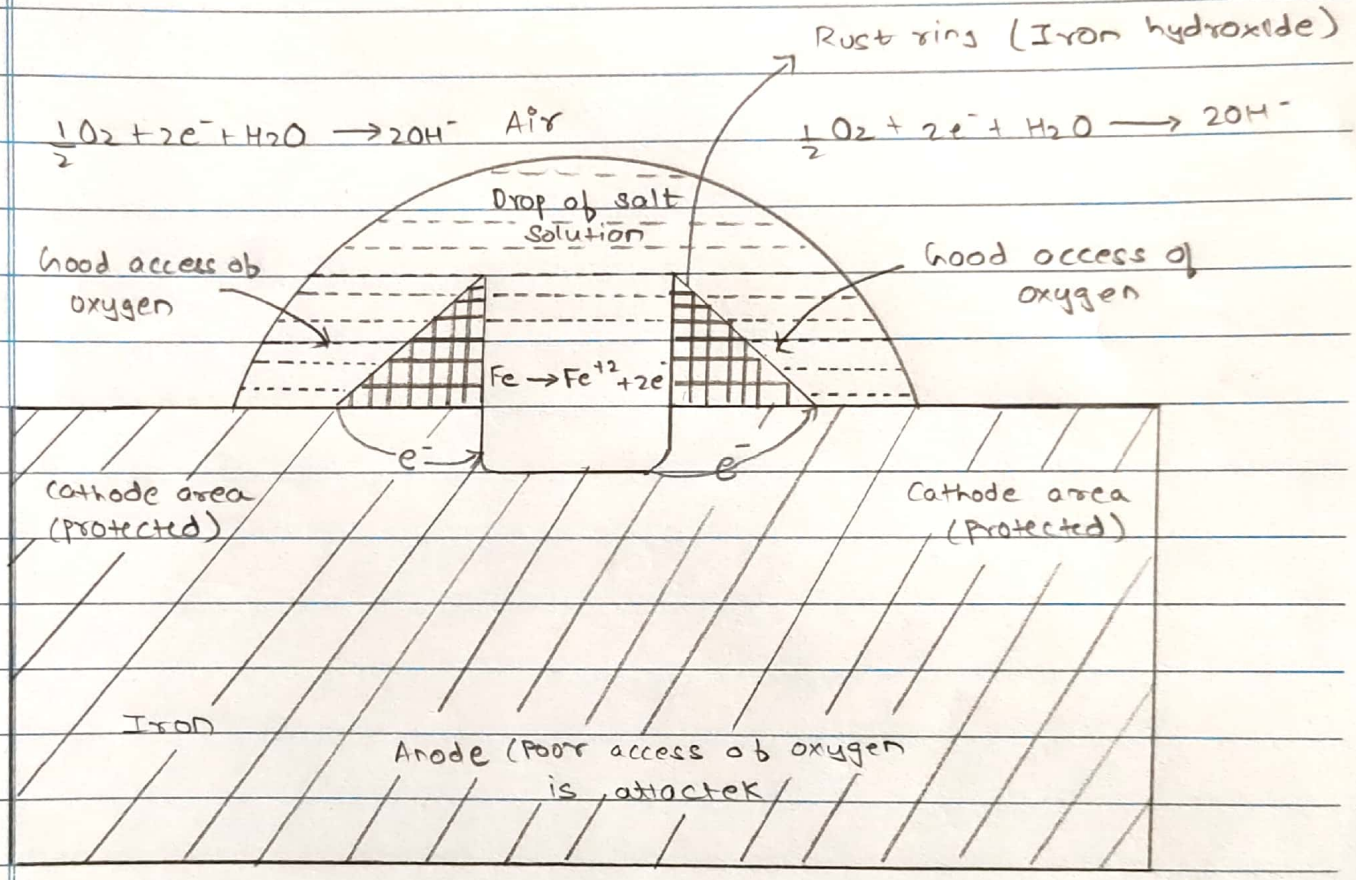
O_2 will take up electrons at the cathodic areas to form OH^- ions.

$$\frac{1}{2}O_2 + H_2O + 2e^- \longrightarrow 2OH^- \text{ (Reduction)}$$



Concentration cell corrosion

6) Pitting corrosion:

Pitting is a localised attack, which results in the formation of a hole around which the metal is relatively unattacked.

7) Waterline corrosion: The metal parts immersed in water or in a conducting liquid is called water line corrosion.

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3) How the following factors affect rate of corrosion?

Ans. i) Position in Galvanic Series.

a) According to the nerst, all metals have a tendency to pass into solution in the form of ions. But all metals will not corrode to same extent under similar conditions of environment.

b) More the negative value of the standard electrode potential, more the metal corrodes. For example, if zinc, copper and sodium electrodes are dipped in the solution of electrolyte, having some concentration, for same period, it is found that sodium corrodes more than zinc, copper is noble compared to them.

c) When two dissimilar metals are in electrical content in presence of an electrolyte, the metal higher up in the galvanic series becomes anodic and suffers corrosion.

d) Further, the more the two metals are apart in the galvanic series, the greater will be the difference in their oxidation potential and hence the faster will be the corrosion of the anodic metal.

ii) Relative area of anode and cathode.

a) The important factor in galvanic corrosion is the area effect i.e. the ratio of cathodic area to anodic area.

b) When cathode and anode are equal, cathodic and anodic current densities are equal and corrosion

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phenomenon will not get accelerated.

c) If cathode area is much larger than anode area, anodic current density will be greater, as a result corrosion of anode metal will be more.

d) In more easeir way we can say that if the areas of cathode and anode are different, the intensity of corrosion of anode is directly proportional to the area of cathode.

It can be expressed as:

$$\text{Rate of corrosion} \propto \frac{\text{cathodic area}}{\text{anodic area}}.$$

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