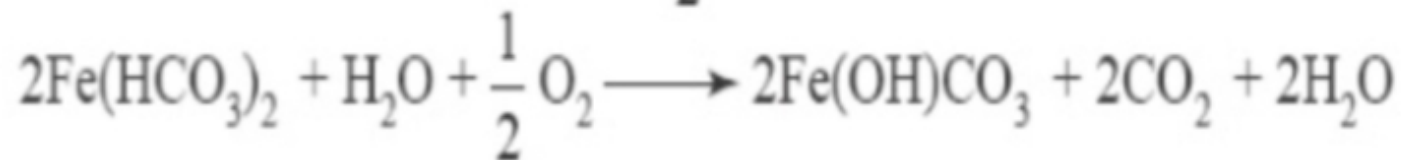
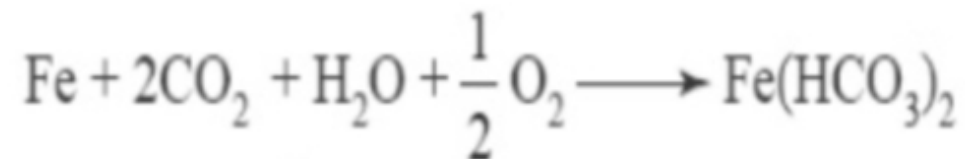


## There are 3 theories of corrosion

- Acid theory of corrosion.
- Dry or chemical theory of corrosion.
- Galvanic or Electrochemical or Wet theory of corrosion.

# Acid theory of corrosion

Acid theory suggests that corrosion of a metal (iron) is due to the presence of acids around it. According to this theory, iron is corroded by atmospheric carbon di-oxide, moisture and oxygen. The corrosion products are the mixture of  $\text{Fe}(\text{HCO}_3)_2$ ,  $\text{Fe}(\text{OH})\text{CO}_3$  and  $\text{Fe}(\text{OH})_3$ . The chemical reactions suggested are given below



This theory is supported by the analysis of rust that gives the test for  $\text{CO}_2$  ion.

# Dry or Chemical theory of corrosion

Corrosion on the surface of a metal is due to direct reaction of atmospheric gases like oxygen, halogens, oxides of sulphur, oxides of nitrogen, hydrogen sulphide and fumes of chemicals, with metal. Oxygen is mainly responsible for the corrosion of most metals when compared to other gases and chemicals.

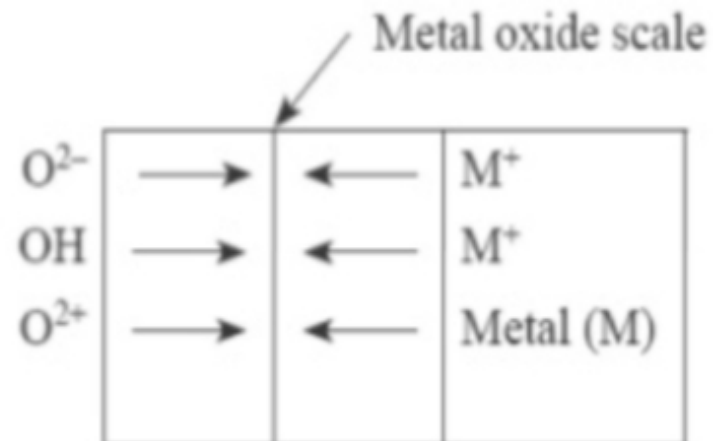
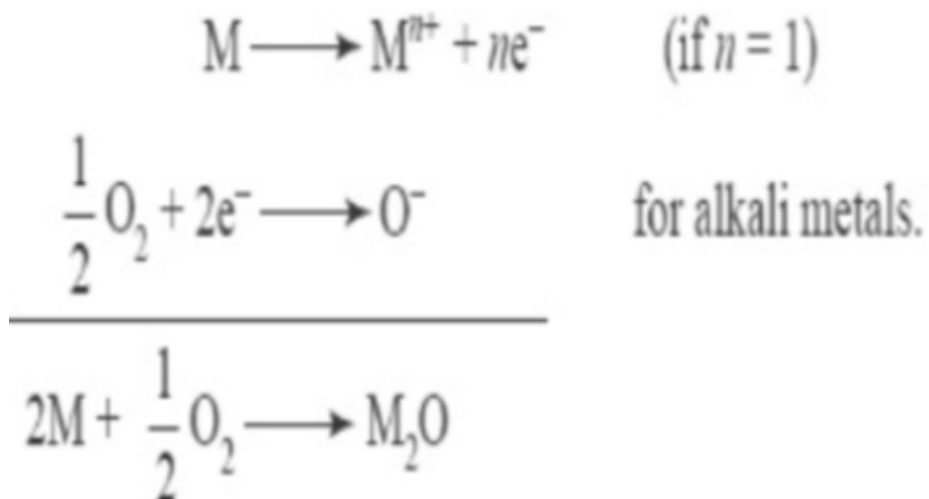
There are three main types of dry corrosion.

1. Oxidation corrosion (Reaction with oxygen)
2. Corrosion by other gases such as  $\text{Cl}_2$ ,  $\text{SO}_2$ ,  $\text{H}_2\text{S}$ ,  $\text{NO}_x$
3. Liquid metal corrosion

# 1: Oxidation corrosion (Reaction with oxygen):

Some of the metals directly react with oxygen in the absence of moisture. Alkali and alkaline earth metals react with oxygen at room temperature and form corresponding oxides.

During oxidation of a metal, metal oxide is formed as a thin film on the metallic surface which protects the metal from further corrosion. If diffusion of either oxygen or metal is across this layer, further corrosion is possible. Thus, the layer of metal oxide plays an important role in the process of corrosion.



**fig. 2.1**  $O_2$  from atmosphere

## **2: Corrosion by other gases such as $\text{Cl}_2$ , $\text{SO}_2$ , $\text{H}_2\text{S}$ , $\text{NO}_x$**

In dry atmosphere, these gases react with metal and form corrosion products which may be protective or non-protective. Dry  $\text{Cl}_2$  reacts with Ag and forms AgCl which is a protective layer, while  $\text{SnCl}_4$  is volatile.

**3: Liquid metal corrosion:** In several industries, molten metal passes through metallic pipes and causes corrosion due to dissolution or due to internal penetration. For example, liquid metal mercury dissolves most metals by forming amalgams, thereby corroding them.



## Wet or electrochemical theory of corrosion

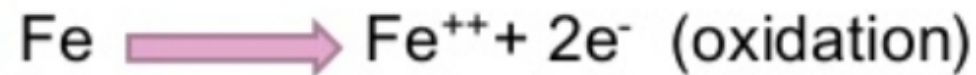
- ° This type of corrosion occurs when the metal comes in contact with a conducting liquid or when two dissimilar metals are immersed or dipped partly in a solution.

There is the formation of a galvanic cell on the surface of metals. Parts of the metal surface act as anode and rest act as cathode. The chemical in the environment and humidity acts as an electrolyte.

Oxidation of anodic part takes place and it results in corrosion at anode, while reduction takes place at cathode. The corrosion product is formed on the surface of the metal between anode and cathode.

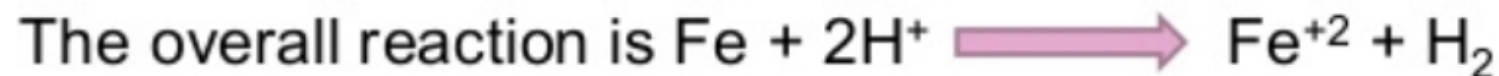
# Case I: Evolution of H<sub>2</sub>

**At anode:**

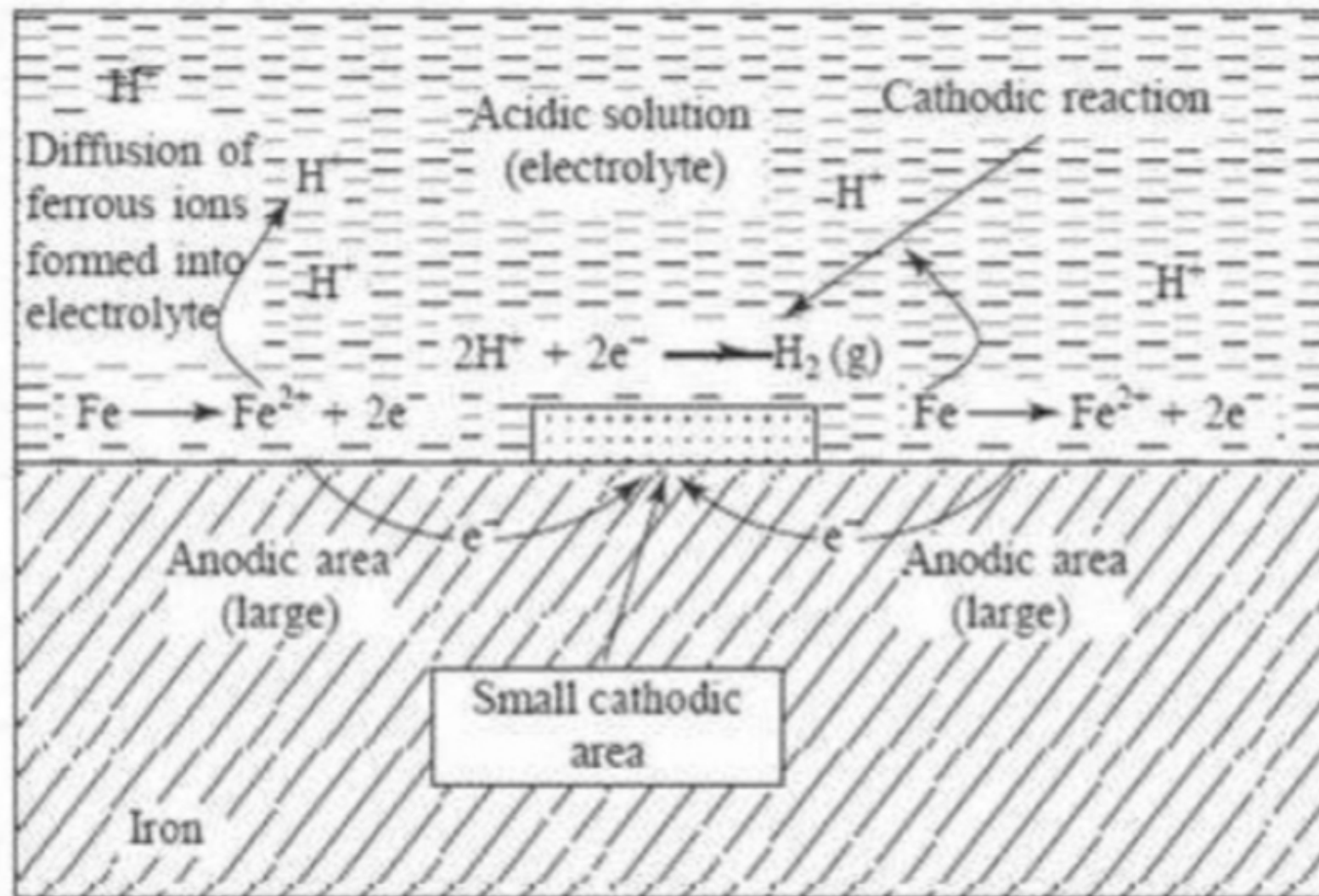


**At cathode:**

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



# Mechanism of wet corrosion by hydrogen evolution

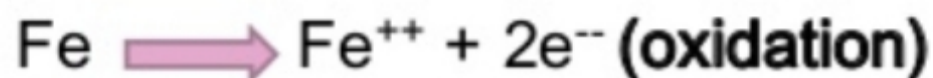




## Case II: Absorption of O<sub>2</sub>

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

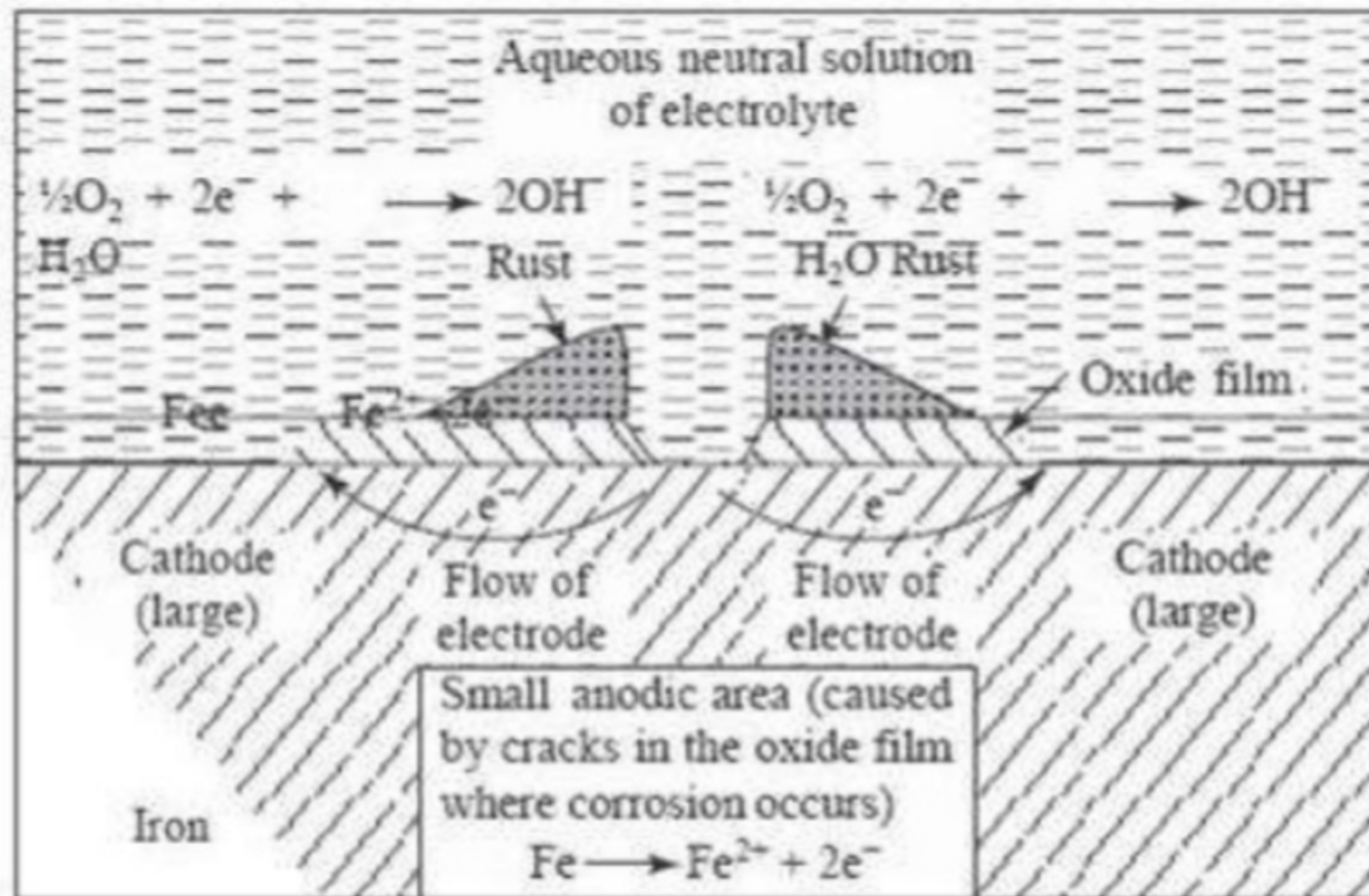
**At anode:**



**At cathode:**



# Mechanism of wet corrosion by oxygen absorption



## 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.

## ° References

- Engineering chemistry R V Gadag, A. Nityananda Shetty.
- Chemistry for Engineering Students- B.S. Jai Prakash, R.Venugopal, K.N. Murthy, Pushpa Iyengar.
- Khanacademy.org