

# MIT - WORLD PEACE UNIVERSITY, PUNE

## Assignment - 01

DIV - 09

Trimester - II

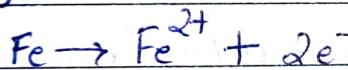
Subject - Chemistry.

Q1 What is wet corrosion? Explain H<sub>2</sub> evolution mechanism with proper diagram.

→ Wet corrosion of metals occurs through electron transfer, involving two processes, oxidation and reduction. The metal, where electrons are lost is called the anode the reaction that occurs at the cathode is not necessarily related to the material that it is made from wet corrosion therefore involves an oxidation reaction at the anode & a reduction reaction at the cathode.

Evolution of H<sub>2</sub> Electrochemical corrosion: With evolution of H<sub>2</sub> occurs in acidic environment

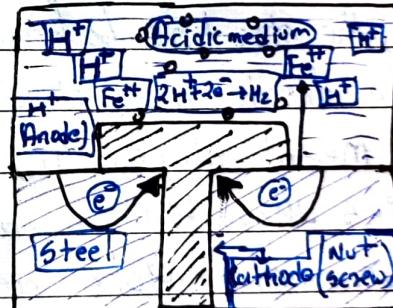
At Anode:



At Cathode



∴ Overall reaction



→ H<sub>2</sub> gas liberates in the form of ~~corrosion~~ bubbles near the cathode. Thus, hydrogen evolution type of corrosion is nothing but displacement of H<sup>+</sup> from acidic solution by metal ions.

→ All the metals ~~are~~ above H<sub>2</sub> in the electrochemical series get dissolved in acidic solution with simultaneous evolution of hydrogen.

Q2 What is the principle of cathodic protection? Explain sacrificial anode in detail.

→ Cathodic protection is a technique used to control the corrosion of a metal surface by making it the cathodic side of an electrochemical cell.

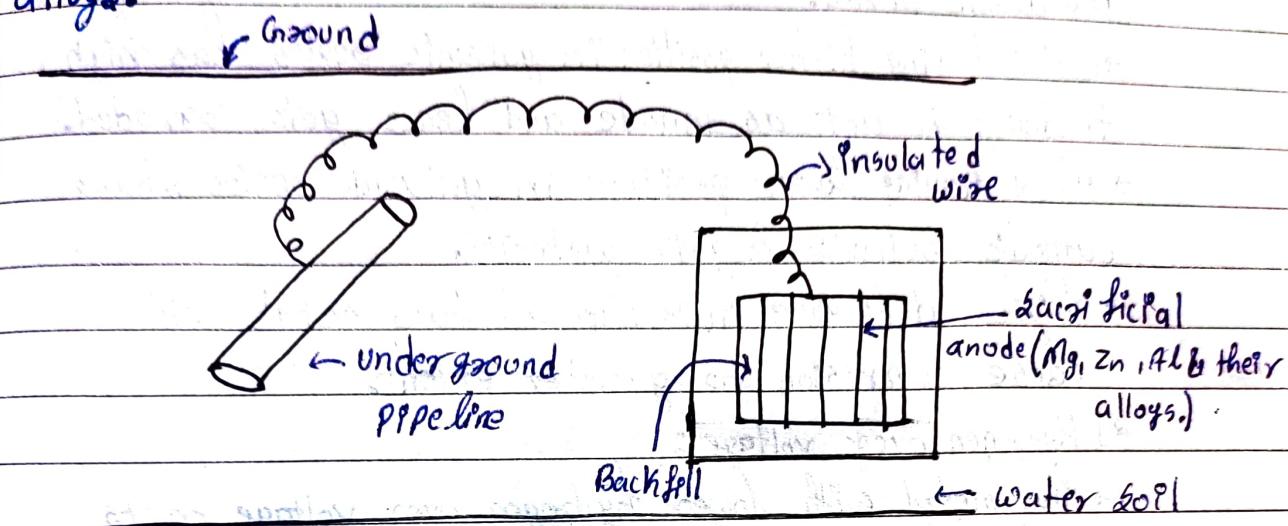
Principle: In electrochemical corrosion; anode is the one which undergoes corrosion & cathode remains protected from corrosion. In cathodic protection, the metal to be protected is forced to behave like a cathode.

Types: (a) sacrificial anodic/galvanic protection  
(b) impressed current method.

Sacrificial Anodic Method:

- Here, the structure to be protected is connected to a small block or piece of more active/anodic metal. The metal placed in higher in the electrochemical series than that metal to be protected. The more active metal acts as an anode. The corrosion attack is concentrated at this more active metal and it slowly undergoes corrosion.
- The main structure is to be protected as a cathode and remains protected from corrosion. The more active metal so employed is replaced by fresh one, when consumed completely. To increase electrical contact, sacrificial anode block is replaced by fresh ones.

To increase electrical contact, sacrificial anode metal is placed in back fill  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ . Metals commonly used as sacrificial anode are: Mg, Zn, Al & their alloys.



### SACRIFICIAL ANODE / GALVANIC PROTECTION.

#### Advantages:

- No external power is required.
- Installation cost is less, if installed during construction.
- It is easy to instal.

#### Application:

The method can be applied for the protection of underground pipelines, cables, marine structures, ship hull, water tanks, etc.

Q3 Discuss factors affecting on corrosion based on nature of metal.

→ Factors affecting Corrosion based on nature of metals are:

1] Galvanic Series:

- Metal having higher position in galvanic series has high tendency to act as anode and hence gets corroded.
- Metal having lower position in galvanic series shows cathodic behavior & gets protected.
- Higher difference in position of two metal will cause corrosion to greater extent.

2] Hydrogen over voltage:

- the metal with lower hydrogen over voltage on its surface is more susceptible for corrosion, when cathodic reaction is hydrogen evolution type.
- Lower hydrogen over voltage, higher the corrosion.
- Higher the over voltage, lower/lesser is the corrosion.

3] Nature of the corrosion product:

- The corrosion product formed like metal oxide may act as protective film, if it is stable, insoluble, and non-porous.
- If it acts as protective film it prevents further corrosion by acting as barrier between metal surface & corrosion medium.
- On other hand if corrosion product is unstable, porous & soluble, it further enhances corrosion.

## 4] Purity of metal:

- ↪ Pure metals are resistive to the corrosion.
- ↪ If there are impurities in a metal, a local galvanic cell is created with the metal as an anode & the impurity as a cathode.
- ↪ The result is corrosion of the metal.
- ↪ In the case of alloys, if the solution is homogeneous it resists corrosion & local galvanic cell.

## 5] Physical state of metal:

- ↪ Rate of corrosion in small granular metal is higher than the large granular metal.
- ↪ Also, a stressed metal has a much higher corrosion rate.

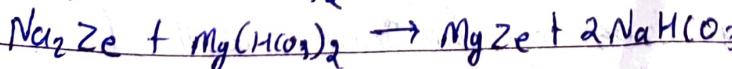
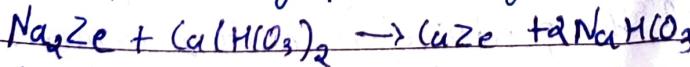
## Q4 Explain zeolite process of softening of water.

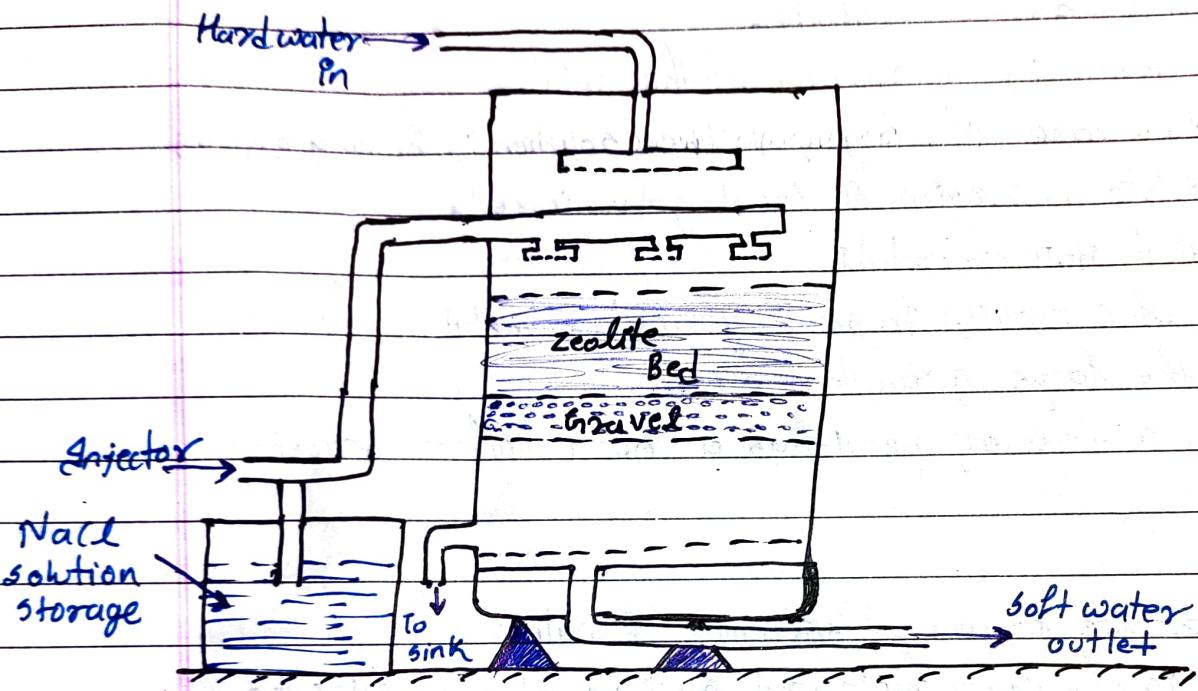
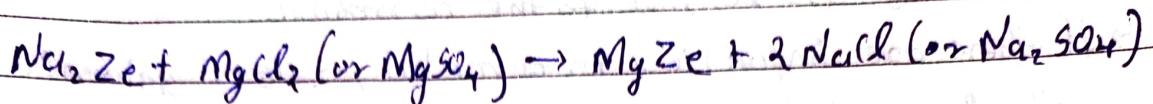
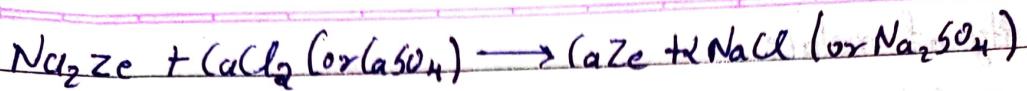
⇒ Zeolite is chemically hydrated sodium aluminosilicate



Process:-

- ↪ Zeolite softener is made up of a cylinder in which there is a bed of zeolite. Hard water is percolated through the bed of zeolite at a specific rate.
- ↪ The hardness producing ions like  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ , etc are retained by the zeolite forming  $\text{CaZe}$  and  $\text{MgZe}$ . The outgoing water contains sodium salts.
- ↪ Reactions taking place during the softening process are:-





Q5 Define scales and sludges. Give the causes, disadvantages & removal methods of pt.

→ In boilers, water evaporates continuously and the concentration of the dissolved salts increases progressively. When their concentrations reach saturation point, they are thrown out of water in the form of precipitates on the inner walls of the boilers.

→ If the precipitation takes place in form of loose & slimy precipitate; it is called sludge.

→ On other hand, if the precipitated matter forms a hard, adhering crust on the inner wall of boiler, it is called scale.

→ Sludge is a soft, loose and slimy precipitate formed within the comparatively colder portions of the boiler and collects in areas of the system, where the flow rate is slow or at bends.

⇒ DISADVANTAGES OF SLUDGE FORMATION:

- 1) Sludges are poor conductors of heat, so they tends to waste a portion of heat generated.
- 2) If sludges are formed along with scale, then former gets entrapped in the latter and both get deposited as scales.
- 3) Excessive sludge formation disturbs the working of the boilers.

⇒ Prevention of SLUDGE formation:

- 1) By using well softened water.
- 2) By frequently 'blow down operation'.

→ Scales are hard deposits, which stick very firmly to inner surface of the boiler. They are difficult to remove; even with the help of hammer and chisel. Scales are the main source of troubles.

⇒ DISADVANTAGES OF SCALE FORMATION:

- 1) Wastage of fuel
- 2) Lowering of boiler safety
- 3) Decrease in efficiency
- 4) Danger of explosion.

### ⇒ Removal of scales:

- 1) With the help of scrapers or piece of wood or wire brush, if they are loosely adhering.
- 2) By giving thermal shocks, if they are brittle.
- 3) By dissolving them by adding them chemicals; if they are adherent & hard.
- 4) By frequent blow-down operation; if the scales are loosely adhering.