Corrosion control

5. Modifying the environment

- Certain changes in the environment can be made to reduce acidic, oxygen or humidity which will reduce corrosion.

- Oxygen can be removed by mechanical agitation or by addition of hydrazine or sodium sulphite.

$$2\,Na_2SO_3 + O_2 \longrightarrow 2\,Na_2SO_4$$

$$N_2H_4 + O_2 \longrightarrow N_2 + 2\,H_2O$$

- Dehumidification is carried out by introducing certain substances like dehydrated alumina, anhydrous silica gel etc. (suitable for closed areas).

- Neutralization of acidic environment containing H_2S, SO_2, HCl, CO_2 etc., can be done by introducing alkaline neutralizers like ammonia gas, lime, naphthionic soaps, caustic etc., (Used in refinery to protect the equipment).

Corrosion Protection/Control

6. Corrosion inhibitors (Reduce the rate of corrosion)

- Two types – anodic and Cathodic inhibitors
  - ✓ **Anodic inhibitors** – form sparingly soluble products which are adsorbed on the surface of metal, protect from corrosion
    - e.g. Phosphate, chromate and tungstate
  - ✓ **Cathodic inhibitors** – Delay reduction reaction occurs at cathode
    - e.g. organic amines, mercaptans, thiourea and substituted urea

7. Protective coatings

Protective coating provide a physical barrier between the metal and the environment.

- They not only give corrosion protection but also add to the decorative value of the system.
- Coatings are broadly divided as:
    a) Inorganic coatings : metallic and chemical conversion coatings
    b) Organic coatings : paints, varnishes, enamels, lacquers
- Protective coatings are classified as:
    I. metallic coatings
    II. chemical conversion coatings
    III. organic coatings and linings
    IV. ceramic protective coatings

Protective coatings (Surface preparation)

The most important step before protective coatings are applied to metals is *surface preparation*.

- Surface preparation is a process to remove rust, oxide scales, oil, grease, dust etc.
- If these materials are not removed, the protective coating will not be smooth, uniform, cohesive and will not adhere to the metallic surface.
- Hence, mechanical and electrical methods are used to prepare the surface of the metallic article to be coated clean and free of these impurities.
- Mechanical cleaning, sandblasting, solvent cleaning, alkali cleaning, acid pickling and etching are normal processes followed for surface preparation of the article to be coated.

a) Mechanical cleaning:

- Useful for removing loose scales and rust.
- Hammering, wire brushing, grinding, pneumatic blasting, polishing are the methods commonly used.

Protective coatings

b) Sand blasting:

- Fine sand or abrasive material along with air stream at a pressure of 25-100 atm. is impinged on the metal surface.
- This will produce enough roughness for good adherence of the protective coating.
- Though the method is expensive, it is quite fast and useful.

Protective coatings

c) Solvent cleaning:

- Solvent cleaning is mainly used to remove oil, grease and rust from the base metal.
- Alcohols, xylene, toluene, chlorinated hydrocarbons are used.
- Hot water cleaning is followed after solvent cleaning is done.

Protective coatings

d) Alkali cleaning:

- Cleaning of the base metal with sodium hydroxide, trisodium phosphate, sodium silicate, soda ash etc., is carried out to remove old paint coatings soluble in alkaline medium.
- After alkali cleaning, washing is done with 1% chromic acid solution.

e) Acid pickling and etching:

- Base metal is dipped inside the acid solution at higher temperature for long periods of time.
- This treatment ensures cleaning of the base metal surface free from all kinds of impurities including oils, greases, rust etc.,
- H_2SO_4, HCl, HF, H_3PO_4, HNO_3 are the acids commonly used for pickling and etching.

Protective coatings

Metallic coatings:

a) **Anodic coatings**
b) **Cathodic coatings**

a) Anodic coatings:

- Anodic coatings are given on cathodic metals using metals which are more anodic.
- Zinc, aluminium, cadmium coatings on iron are anodic coatings.
- If the coating breaks, then a galvanic couple is set up and corrosion rate gets enhanced.
- During this process, the anodic coating gets disintegrated, but it protects the cathodic base metal.
- Hence, the anodic metal sacrifices itself to protect the base metal.
- This type of coating is known as *galvanization.*

Protective coatings

Cathodic inhibitors/coatings:

- Cathodic coatings are given on anodic metals using metals which are more cathodic.
- Coating of tin, chromium, nickel on iron surface are cathodic coatings.
- If there is a discontinuity in the coating, then galvanic couple will form with base metal as anode and the coated metal as cathode.
- Then the process of corrosion will start by the base metal ions going into solution and the metal deteriorating.
- To avoid this, the article is checked and re-plated periodically so that there is no discontinuity in the coating.

Protective coatings

Methods of metallic coatings:

a) Hot dipping
b) Electroplating
c) Electroless plating
d) Metal cladding
e) PVD
f) CVD