7.9 PROTECTION AGAINST CORROSION (CORROSION CONTROL)

The process of corrosion is slow but the losses incurred are enormous. In fact our economy would be drastically changed if there were no corrosion. But while the corrosion is inevitable, its cost can be considerably reduced. The main responsibility of a corrosion engineer is to control corrosion. Corrosion engineering mainly deals in applying scientific principles to prevent or control corrosion damage.

Methods for Controlling Corrosion

The various methods by which corrosion can be controlled and prevented are:

1. Protection by proper designing.
2. Material selection.
3. Modifying the environment.
4. Modification of the properties of the metal.
5. Use of inhibitors.
6. Use of protective coatings.
7. Cathodic protection or Electrochemical protection.

These methods are discussed below in detail.

2. Material Selection

Selection of the right type of material is one of the main factors for corrosion control.

(i) *Using Pure Metal:* As is discussed in section 7.8, impurities in a metal cause heterogeneity, which lead to corrosion. Thus, the corrosion resistance of a given metal may be improved by increasing its purity.

However it is not always fruitful to use a metal of high purity because:

(a) Pure metals are expensive

(b) They are usually weak and do not posses the required strength. For example, one would not build a bridge of pure iron.

(ii) *Using metal alloys:* Corrosion resistance of most commercial metals can be increased by alloying them with suitable alloying elements. (Alloys are mixtures of two or more metals or elements.) There are two kinds of allovs:

3. Use of Inhibitors

Corrosion inhibitors are the substances which when added in small quantities to the corrosive environments decrease the corrosion rate. Inhibitors are organic as well as inorganic substances that dissolve in the corroding medium.

Inhibitors are generally classified on the basis of electrode at which their action is predominant. Thus we have two types of inhibitors, Cathodic inhibitors and Anodic inhibitors.

6. Protective Coatings

The metal structure to be protected can be coated with metallic or non-metallic coatings. These coatings insolate the insulate from the surrounding corrosive environment. The various types of coatings used for controlling corrosion are:

(i) Metallic Coatings (ii) Non-metallic Coatings

(i) *Metallic Coatings:* The metals used for coatings are Zn, Ni, Sn, Cd and Cr because these are capable of forming their respective oxide films which adhere to the surface of the metal and prevents corrosion. For example, to prevent the rusting of iron it can be coated with Zn or Cr.

Metallic coatings can be applied by using following techniques

(a) *Electroplating:* This is the most widely used method of coating metals to protect them from corrosion. The metal to be plated is made the cathode in a plating bath

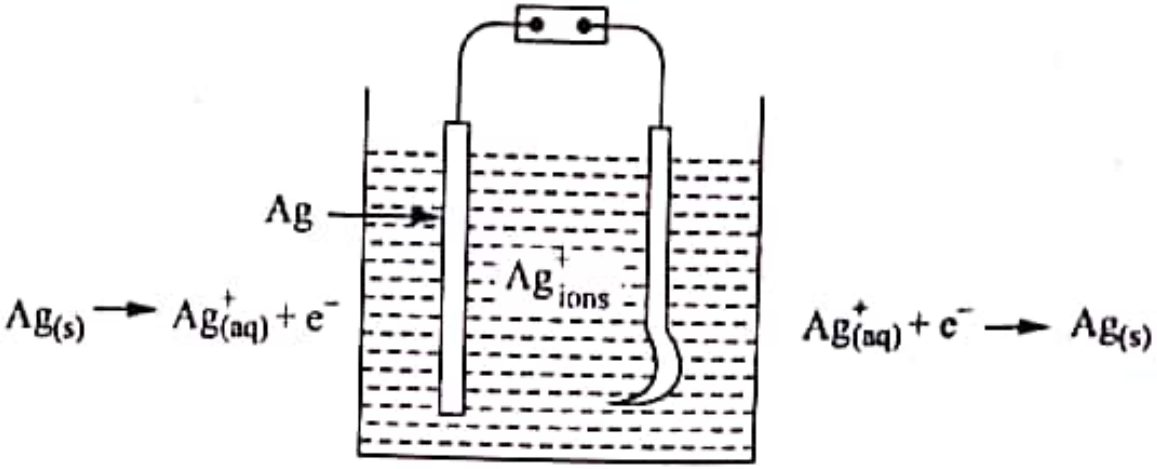

Fig. 7.21 Electroplating

containing the ions of the metal to be deposited. The anode is either an inert material or coating metal to be deposited. When current is passed, the coating metal ions migrate to the cathode and get deposited in the form of thin layer. Fig. 7.16 shows the silver plating of a spoon

(ii) *Non-Metallic Coatings:* The non-metallic coatings may be inorganic or organic coatings and fall under the following categories.

(a) *Organic Coatings:* Organic coatings are inert organic barriers which provide corrosion resistance as well as decorative value to the structure which is coated. The organic coatings include; paints, varnishes, enamels, and lacquers.

(b) *Chemical Conversion Coatings:* These are inorganic surface-barriers produced by chemical or electrochemical reactions at the surface of the metal. These coatings provide the protection to the base metal from corrosion and also provide a surface ideal for painting or other decorative measures. Examples of chemical coatings include, phosphate coating, chromate coating etc. The phosphate coating is produced by the chemical reaction of base metal with aqueous solution of phosphoric acid and zinc or manganese phosphate. Such coatings are applied to iron, steel and zinc. The chemical reaction between the phosphating solution and the base metal results in the formation of a surface film consisting of crystalline zinc-iron or manganese-iron phosphates.