Prevention of corrosion

Objectives : At the end of this lesson you shall be able to
- **state the importance of keeping the work free from rust and corrosion**
- **state the need for prevention of corrosion**
- **name the different methods of metallic coatings used for preventing crrosion**
- **state the different cementation processes**
- **state the application of different metallic protective coatings**
- **state the treatments to provide pleasing finish.**

The importance of keeping the work free from rust and corrosion

Rusting is in the simplest form, the slow eating away of iron and its allows. Rusting is the same as corrosion, but it is used to describe the corrosion of iron and its alloys only. Rusting is a chemical process in which ferrous reacts with oxygen in the presence of moisture or water, to produce ferric oxides and hydroxides (which are called rust). Rusting causes slow degradation of iron and its alloys. This results in the weakening of the material and ultimate failure. Since iron and its alloys are very widely used (Some examples are pipe lines for water and waste water flowl structures like bridges, railway tracks, ships etc.) any degradation in the metal's quality will directly affect these structures our economy, our health and well-being. And thus the prevention of rusting is necessary. There are a number of ways of doing it, such as galvanization, paints, coating etc.

Most common non-ferrous metals and alloys form their own protective coating when exposed to the atmosphere. Corrosion prevention is largely applied to iron and steel. For maximum life, accuracy and utility of a component, it is very essential that corrosion is controlled or prevented. One method of crrosion proofing is to protect the metallic material from the corroding influence by means of protective coats or deposits which prevent or reduce corosion to acceptable levels.

Protective treatment of metal surface

The type of protective treatment used depends upon:

- the material from which the component is made
- the purpose for which it is used
- the environment in which it is to operate.

There are more or less permanent methods for preventing corrosion. These methods can be grouped as metallic corrosion-resistant coating and non-metallic corrosion-resistant coating.

Commonly used metallic corrosion-resisting coatings

- Hot dipping (galvanising)
- Electroplating
- Cladding
- Metal spraying
- Cementation

Galvanizing

In this process mild steel is coated with zinc. For hot dip galvanizing, the workpieces are initially pickled in hot sulphuric or cold hydrochloric acid to clean the surface, and then fluxed with zinc chloride and ammonium chloride. After this they are dipped in molten zinc. Sometimes a small quantity of aluminium is added which gives a bright appearance and uniform thickness.

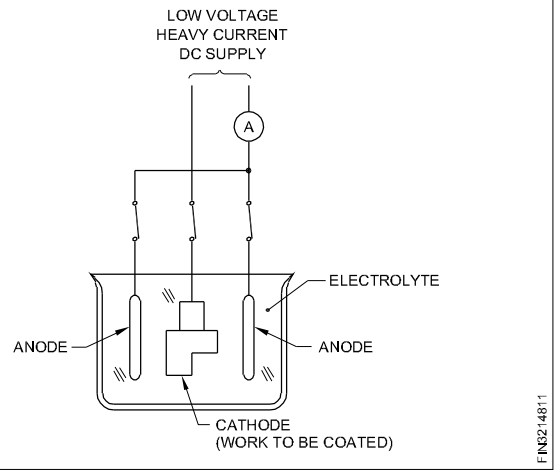
The temperature of the zinc bath is usually maintained between 450^{o} and 465^{o}C. The hot-dipped workpieces are then quenched in a water bath. Galvanizing is done for structural work, bolts and nuts, pipes and wires, which are exposed to different atmospheric conditions. This method is highly reliable. It can withstand severe working conditions and the cost is low.

Electroplating

Many metals can be plated on to workpieces electrically, and this process is called electroplating. In electroplating the surfaces of components are coated with another metallic coating for the purpose of obtaining decorative or protective surfaces.

In the electrolytic process the components to be plated are immersed in a solution called the electrolyte. The component to be plated is made as the cathode by connecting the negative pole of a low voltage, high current DC supply. (Fig 1) To complete the circuit, anodes connected to the positive pole of the supply are also immersed in the electrolyte.

Fig 1



The electrolyte supplies the metal ions which are to be deposited on to the components (cathode). The anodes may be soluble and made of the same metal to be plated on the component surface i.e. nickel, copper or zinc.

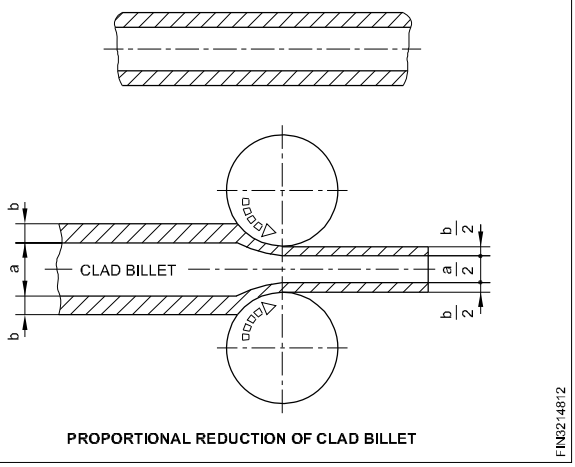
Certain anodes are insoluble, for example - chromium. In such cases anodes are useful only to complete the circuit in the electrolytic process.

Metals like copper, chromium, cadmium, nickel, silver etc. are used for electroplating.

Cladding

This is a process in which composite billets consisting of a base metal and a coating of corrosion-resistant metal are rolled or drawn. The thickness of the base metal and the coating reduce proportionally. (Fig 2) An application of this is cladding of steel with aluminium.

Fig 2



PROPORTIONAL REDUCTION OF CLAD BILLET

Metal spraying

Ferrous metals are sprayed with metal coatings for preventing corrosion, building up worn out shafts, providing wear-resistant surfaces etc. In this process molten particles of metal are sprayed on surfaces which are properly degreased and grit-blasted. Common metals used for metal spraying are - copper, zinc, brass, carbon steel, stainless steel etc.

Cementation

There are three types of cementation process for protecting metal surfaces.

- Sherardising (Zinc coating)
- Calorising (Aluminium coating)
- Chromising (Chromium coating)

Sherardising

In this process the workpieces are initially prepared by acid pickling or grit-blasting. They are then placed in a rotating steel barrel containing zinc powder, and heated to a temperature around 370°C. The time taken for the coating depends on the thickness of the coat. The heated powder bonds to the ferrous workpiece by diffusion and forms a hard even layer of iron/zinc intermetallic compound. The surface of the sherardised components will be slightly rough which provides a good grip for subsequent painting.

Calorising

This process is very similar to sherardising but the powder used is aluminium, and the heating temperature is between 850° C and 1000°C. This is used to protect steel components from corrosion. This process requires a higher temperature and higher humidity than sherardising.

Chromising

This provides a chromium-rich surface. The work to be chromised is baked with aluminium oxide and chromium powder in a temperature of 1300° to 1400°C in an atmosphere of hydrogen to prevent oxidation of chromium. The process is expensive, and due to this reason, it is used only in places where extreme protection is required.

This coating caused by the action of the acids in the atmosphere protects the surface of the copper.

Zinc

A carbonate coating forms on the surface after a period of exposure, and this acts as a protective film that gradually strengthens with time. This coating is grey in colour like the colour of the parent metal itself.

This coating does not crack or peel off due to variation in tem-perature. For this reason zinc is an excellent exterior building material. It gives excellent protection when coated on steel.

Aluminium

Aluminium and its alloys have a great affinity for oxygen. Aluminium surfaces quickly develop a thin, transparent film of aluminium oxide or 'Alumina' which prevents

further oxidation and retains bright appearance. However exterior use of aluminium results in the thickening of the oxide film. This film becomes grey in colour and protects the parent metal from further attack. The oxide film on aluminium and its alloys can be artificially thickened by a process called anodising.

Lead

Lead is one of the most corrosion-resistant of all metals. A large quantity of lead is used as sheathing material for underground telephones and power cables. The WHITE OXIDE film resulting from exposure to the atmosphere prevents further attack.

Stainless steel

It has high structural strength as well as resistance to corrosion. Stainless steels are not confined to applications requiring resistance to atmosphere corrosion. They are used extensively for chemical plant and food processing equipment where they combine corrosion resistance at elevated temperatures.

Nickel

Nickel is used extensively for 'NICKEL PLATING' as it has high resistance to chemical attack. When alloyed with copper in the proportion of 2:1 (Nickel two third) 'MONEY METAL' is produced which is extremely resistant to corrosion, particularly to sea water and acid.

Chromium

One of its most important uses is for electroplating metallic surfaces. It is highly resistant to the influence of corrosion and it retains its high polish and colour for a long period.