

Control of corrosion

As corrosion occurs in various forms and affected by numerous factors, the science behind control or prevention corrosion is highly complex. According to the requirements, different corrosion control methods are adopted by various industries to tackle unsafe effects and negative result of corrosion. Corrosion leads to water pollution. For example corroded pipelines, containers, etc. contaminates the drinking water and poses problem not only to the environment but also to the mankind. So, efficient preventive measures should be employed to check the detrimental effect of corrosion.

As corrosion is occurs due to interaction between metal and environment, one can check the rate of corrosion either by modifying the properties of metal or by modifying the environment. Accordingly, control methods are classified into two parts:

A. Corrosion control by modification of the environment: In this type, metals are protected by two ways: (1) by the removal of corrosion causing substances / corrosion stimulants; and (2) by the use of substances (known as *inhibitors*) which can reduce the rate of cathodic/anodic reaction.

B. Corrosion control by modification of the properties of metal: The various methods applied to modify the properties of metal are:

1. Use of Protective coatings
2. Electrochemical or cathodic protection
3. By selection of suitable metal and proper designing of structures
4. By alloying
5. By Annealing

A. Corrosion control by modification of the environment

1. Removal of corrosion causing substances / corrosion stimulants

- Corrosion due to DO can be prevented by its removal by addition of reducing substance like hydrazine
- To prevent corrosion due to acids, they are neutralized with lime
- To prevent corrosion due to alkalis, they are neutralized with acids
- To prevent corrosion due to salts, they are removed by ion-exchange methods.

- To prevent corrosion due to moisture, they are removed by dehumidification using silica gel.

2. Using Corrosion Inhibitors

Corrosion inhibitors are chemical substances which are added in small amount (0.1 %) to the corrosion medium to prevent or slow down the oxidation or reduction reactions on the surface of the metal. Inhibitors do their job by providing a protective layer on the metal surfaces.

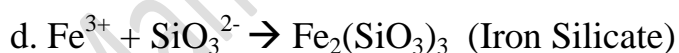
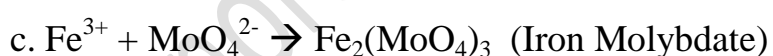
Inhibitors are of two types; (1) **Inorganic**, and (2) **Organic**

Inorganic Inhibitors: It includes chromates, phosphates, molybdates, silicates, sulphites, sulphides, etc. They are mainly used in boilers, fractional distillation plant, cooling towers, etc.

Inorganic inhibitors are classified as (a) Anodic, and (b) Cathodic

Anodic Inhibitors: Chemical substances which inhibit the anodic (oxidation) reaction are called ***Anodic Inhibitors***. Example includes molybdates (MoO_4^{2-}), phosphates (PO_4^{3-}), chromates (CrO_4^{2-}), silicates (SiO_3^{2-}), etc. These anions react with metallic ions to produce insoluble precipitates. Insoluble substances so obtained are then get adsorbed on the surface of metal and hence slow down the rate of anodic reaction.

Examples: Fe^{3+} ion form insoluble precipitates as follows:



Cathodic Inhibitors: Chemical substances which inhibit the cathodic (reduction) reaction are called ***Cathodic Inhibitors***. For example Na_2SO_3 reduces the rate of reaction by removing dissolved oxygen from the environment ($\text{Na}_2\text{SO}_3 + 1/2\text{O}_2 \rightarrow \text{Na}_2\text{SO}_4$).

Organic Inhibitors: It includes amines (RNH_2), mercaptans (R-SH), substituted urea, and thioureas, amides (R-CONH_2), etc. These substances adsorbed on the surface of metal and acts as protective coating. They attach to the surface by *chemical and physical adsorption*.

Q. How to control rate of corrosion by removing corrosion stimulants from the environment? (5 marks)

Ans. Some of the methods of removal of corrosion stimulants are as follows:

- Corrosion due to DO can be prevented by its removal by addition of reducing substance like hydrazine
- To prevent corrosion due to acids, they are neutralized with lime
- To prevent corrosion due to alkalis, they are neutralized with acids
- To prevent corrosion due to salts, they are removed by ion-exchange methods.
- To prevent corrosion due to moisture, they are removed by dehumidification using silica gel.

Q. What is an inhibitor?

Ans. It is a chemical substance which when added to the environment slows down the corrosion reaction. Example- molybdates (MoO_4^{2-}), phosphates (PO_4^{3-}).

Q. Define anodic inhibitor with an example.

Ans. Those Chemical substances which inhibit the anodic (oxidation) reaction are called as anodic inhibitor. For example molybdates (MoO_4^{2-})

Q. Define cathodic inhibitor with an example.

Ans. Those Chemical substances which inhibit the cathodic (reduction) reaction are called as cathodic inhibitor. Example: Na_2SO_3

Q. What is an organic inhibitor?

Ans. It is an organic substance which decreases the rate of corrosion. For example: Thiourea