

CORROSION DEFINITION AND PREVENTION

Corrosion is when a refined metal is naturally converted to a more stable form such as its oxide, hydroxide or sulphide state this leads to deterioration of the material.

This article is one of a series of .

Causes of Corrosion

Metal corrodes when it reacts with another substance such as oxygen, hydrogen, an electrical current or even dirt and bacteria. Corrosion can also happen when metals like steel are placed under too much stress causing the material to crack.

Corrosion of Iron

The most common type of iron corrosion occurs when it is exposed to oxygen and the presence of water, which creates a red iron oxide commonly called rust. Rust can also effect iron alloys such as steel. The rusting of iron can also occur when iron reacts with chloride in an oxygen-deprived environment, while green rust, which is another type of corrosion can be formed directly from metallic iron or iron hydroxide.

Types of Corrosion

Uniform Corrosion

This is the most common form of corrosion which usually takes place evenly over large areas of a material's surface.

Pitting Corrosion

One of the most aggressive forms of corrosion, pitting can be hard to predict, detect or characterise. This localised type of corrosion happens when a local anodic or cathodic point forms a corrosion cell with the surrounding surface. This pitting can create a hole or cavity which typically penetrates the material in a vertical direction down from the surface.

Pitting corrosion can be caused by damage or a break in the oxide film or a protective coating and can also be caused through non-uniformities in the structure of the metal. This dangerous form of corrosion can cause a structure to fail despite a relatively low loss of metal.

Crevice Corrosion

This form of corrosion occurs in areas where oxygen is restricted such as under washers or bolt heads. This localised corrosion usually results from a difference in the ion concentration between two areas of metal. The stagnant microenvironment prevents circulation of oxygen, which stops re-passivation and causes a build-up of stagnant solution moving the pH balance away from neutral.

The imbalance between the crevice and the rest of the material contributes to the high rates of corrosion. Crevice corrosion can take place at lower temperatures than pitting corrosion, but can be minimised by proper joint design.

Intergranular Corrosion

Intergranular corrosion occurs when impurities are present at the grain boundaries form during solidification of an alloy. It can also be caused by the enrichment or depletion

of an alloying element at the grain boundaries. This type of corrosion occurs along or adjacent to the grains, affecting the mechanical properties of the metal despite the bulk of the material being unaffected.

Stress Corrosion Cracking (SCC)

Stress corrosion cracking refers to the growth of cracks due to a corrosive environment which can lead to the failure of ductile metals when subjected to tensile stress, particularly at high temperatures. This type of corrosion is more common among alloys than with pure metals and is dependant on the specific chemical environment whereby only small concentrations of active chemicals are required for catastrophic cracking.

Galvanic Corrosion

This form of corrosion occurs when two different metals with physical or electrical contact are immersed in a common electrolyte (such as salt water) or when a metal is exposed to different concentrations of electrolyte. Where two metals are immersed together, known as a galvanic couple the more active metal (the anode) corrodes fast than the more noble metal (the cathode). The galvanic series determines which metals corrode faster, which is useful when using a sacrificial anode to protect a structure from corrosion.

Effects of Corrosion

The annual worldwide cost of metallic corrosion is estimated to be over \$2 trillion, yet experts believe 25 - 30% could be prevented with proper corrosion protection. Poorly planned construction projects can lead to a corroded structure needing to be replaced, which is a waste of natural resources and contradictory to global concerns over sustainability. In addition corrosion can lead to safety concerns, loss of life, additional indirect costs and damage to reputation.

How to Prevent Corrosion

There are several cost effective ways to prevent corrosion including:

- Use non-corrosive metals, such as stainless steel or aluminium
- Make sure the metal surface stays clean and dry
- Use drying agents
- Use a coating or barrier product such as grease, oil, paint or carbon fibre coating
- Lay a layer of backfill, for example limestone, with underground piping
- Use a sacrificial anode to provide a cathodic protection system

