



THE ULTIMATE GUIDE TO INDUSTRIAL CORROSION PROTECTION



INTRODUCTION

In the world of industrial operations, corrosion is an ever-present and formidable threat. It silently eats away at your infrastructure, compromising the integrity of equipment, reducing operational efficiency, and driving up maintenance costs. Left unchecked, corrosion can lead to catastrophic failures, resulting in costly downtime, safety hazards, and significant financial losses.

This guide is designed to provide you with a comprehensive understanding of corrosion, its impact on industrial environments, and the best practices for protecting your assets against it.

By implementing effective corrosion protection strategies, you can extend the lifespan of your equipment, improve safety, and ensure the long-term success of your operations.



UNDERSTANDING CORROSION: THE BASICS

WHAT IS CORROSION?

Corrosion is the natural process through which metals deteriorate due to chemical reactions with their environment. While most commonly associated with metals, corrosion can also affect other materials, including concrete and polymers. The most familiar form of corrosion is rusting, which occurs when iron or steel reacts with oxygen and moisture, forming iron oxide. However, corrosion can take many forms, depending on the material involved and the environmental conditions.

Types of Corrosion

- **Uniform Corrosion:** This is the most common form of corrosion, where the material deteriorates uniformly across its surface. It is often predictable and can be managed with regular maintenance and protective coatings.
- **Galvanic Corrosion:** Occurs when two different metals come into contact in the presence of an electrolyte, leading to the accelerated corrosion of the more anodic metal.
- **Pitting Corrosion:** Characterised by small, localized holes or pits in the material, pitting corrosion is particularly dangerous as it can lead to the rapid failure of critical components.
- **Crevice Corrosion:** Occurs in confined spaces where stagnant fluid can collect, such as under gaskets or in joints. This type of corrosion is often difficult to detect until significant damage has occurred.
- **Stress Corrosion Cracking (SCC):** A process where corrosion and tensile stress combine to cause the material to crack. SCC can lead to sudden and catastrophic failures, particularly in high-stress environments.
- **Intergranular Corrosion:** This type affects the grain boundaries of a metal, leading to the deterioration of the material's structural integrity.

FACTORS INFLUENCING CORROSION

Several factors can influence the rate and severity of corrosion, including:

- **Material Composition:** Different metals and alloys have varying resistance to corrosion. Understanding the composition of your materials is essential in predicting their susceptibility to corrosion.
- **Environmental Conditions:** The presence of moisture, oxygen, temperature fluctuations, and pollutants can significantly impact corrosion rates.
- **Electrochemical Potential:** The electrochemical potential of a metal relative to its environment can dictate how likely it is to corrode.
- **Design and Engineering:** Poor design choices, such as sharp edges, welds, or crevices, can create conditions conducive to corrosion.
- **Maintenance Practices:** Regular inspection and maintenance are crucial in identifying and mitigating corrosion before it leads to failure.



THE IMPACT OF CORROSION ON INDUSTRIAL OPERATIONS

FINANCIAL COSTS

The financial implications of corrosion are staggering. According to studies, the global cost of corrosion is estimated to be around 3.5% of the world's GDP, amounting to trillions of dollars annually. **These costs arise from a combination of factors, including:**

- **Repair and Replacement Costs:** Corroded equipment often requires extensive repairs or complete replacement, leading to significant capital expenditures.
- **Operational Downtime:** Corrosion-induced failures can halt production, resulting in lost revenue and increased operational costs.
- **Increased Maintenance:** Ongoing corrosion issues necessitate frequent inspections, repairs, and maintenance, driving up operational expenses.
- **Insurance Premiums:** Facilities with a history of corrosion-related incidents may face higher insurance premiums due to the increased risk.

SAFETY HAZARDS

Corrosion poses serious safety risks in industrial environments. The deterioration of structural components, pressure vessels, pipelines, and storage tanks can lead to leaks, explosions, and collapses, endangering workers and the surrounding community. Additionally, corrosion can compromise the safety of products, leading to contamination and product recalls.

ENVIRONMENTAL IMPACT

Corrosion can also have significant environmental consequences. Leaks from corroded pipelines and storage tanks can result in the release of hazardous substances into the environment, causing soil and water contamination. The cleanup and remediation of such incidents are often costly and time-consuming, with long-lasting impacts on the environment.



BEST PRACTICES FOR INDUSTRIAL CORROSION PROTECTION

MATERIAL SELECTION

Choosing the right materials is the first line of defence against corrosion. Materials with inherent corrosion resistance, such as stainless steel, aluminium, and certain plastics, should be considered for use in environments prone to corrosion.

When selecting materials, consider:

- **Corrosion Resistance:** Evaluate the material's ability to withstand the specific corrosive environment it will be exposed to.
- **Mechanical Properties:** Ensure the material meets the mechanical requirements of the application, such as strength, ductility, and toughness.
- **Cost-Effectiveness:** Balance the material's cost with its expected lifespan and maintenance requirements.

PROTECTIVE COATINGS

Protective coatings are one of the most effective methods for preventing corrosion. Coatings act as a barrier between the material and the corrosive environment, preventing direct contact with corrosive elements.

Common types of protective coatings include:

- **Paints and Varnishes:** Provide a physical barrier against moisture and oxygen. Specialised coatings, such as epoxy or polyurethane, offer enhanced resistance to chemicals and abrasion.
- **Galvanisation:** Involves coating the material with a layer of zinc, which acts as a sacrificial anode, corroding in place of the underlying metal.
- **Plating:** Applies a thin layer of corrosion-resistant metal, such as chromium or nickel, to the surface of the material.
- **Powder Coating:** A dry finishing process that provides a durable, corrosion-resistant layer on metal surfaces.

CATHODIC PROTECTION

Cathodic protection is a technique used to control the corrosion of a metal surface by making it the cathode of an electrochemical cell.

This is achieved through:

- **Sacrificial Anodes:** Attaching a more anodic material, such as zinc or magnesium, to the metal structure. The anode corrodes instead of the protected metal.
- **Impressed Current Systems:** Applying an external current to counteract the electrochemical potential that drives corrosion.



ENVIRONMENTAL CONTROL

Controlling the environment around your assets can significantly reduce the rate of corrosion. **Consider the following strategies:**

- **Humidity Control:** Reducing humidity levels can minimise the presence of moisture, which is a key driver of corrosion.
- **Temperature Regulation:** Maintaining stable temperatures can prevent the formation of condensation and reduce thermal stress on materials.
- **Pollutant Filtration:** Installing filters or scrubbers can remove corrosive gases and particles from the air, protecting your equipment from atmospheric corrosion.

REGULAR INSPECTION & MAINTENANCE

Regular inspection and maintenance are critical to identifying and mitigating corrosion before it leads to failure. **Implement a comprehensive inspection programme that includes:**

- **Visual Inspections:** Regularly check for signs of corrosion, such as rust, pitting, or discolouration.
- **Non-Destructive Testing (NDT):** Use techniques such as ultrasonic testing, radiography, or magnetic particle inspection to detect internal corrosion without damaging the equipment.
- **Corrosion Monitoring:** Install sensors or probes to monitor corrosion rates in real-time, allowing for proactive maintenance and repairs.

DESIGN & ENGINEERING CONSIDERATIONS

Good design and engineering practices can significantly reduce the risk of corrosion. **When designing your infrastructure, consider the following:**

- **Avoid Crevices:** Design joints and connections to minimise crevices where moisture can accumulate.
- **Ensure Proper Drainage:** Prevent water from pooling on surfaces by incorporating adequate drainage systems.
- **Use Protective Barriers:** Install barriers or coatings in areas prone to corrosion, such as under insulation or in contact with dissimilar metals.
- **Minimise Stress:** Reduce mechanical stress on components to lower the risk of stress corrosion cracking.

CONCLUSION

Corrosion is an inevitable challenge in industrial operations, but with the right strategies and practices, its impact can be significantly mitigated.

By understanding the causes of corrosion, selecting appropriate materials, implementing protective measures, and maintaining a proactive approach to inspection and maintenance, you can safeguard your assets against corrosion and ensure the long-term success of your operations. Investing in corrosion protection is not just about preserving your equipment; it is about securing the future of your business. With the knowledge and tools provided in this guide, you are well-equipped to tackle corrosion head-on and protect your industrial operations from its damaging effects.



**DGC AFRICA: YOUR PARTNER IN
INDUSTRIAL CORROSION PROTECTION**

www.dgc-africa.com