

# Chapter 14: Corrosion – Mechanism & Prevention

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## Abstract

The chapter discusses corrosion, its mechanism, types, and prevention methods and the importance of learning about corrosion in industrial and structural facilities. Corrosion refers to the progressive amounts of decay of metals occurring in the chemical or electrochemical interaction of the metals with their surroundings, resulting in the failure of the material, loss of money and unsafe situations. The chapter has explained the different forms of corrosion, including uniform corrosion, pitting corrosion, galvanic corrosion, crevice corrosion and stress corrosion, with the factors that determine the rate of corrosion, including temperature, humidity, pH and presence of electrolytes. It is also composed of mechanistic facts, such as anodic and cathodic reactions, electrochemical potentials and the significance of passivation layers. Corrosion affects pipelines, machinery, bridges, ships and chemical reactors industrially, and thus it is important to ensure that it is effectively prevented. Corrosion control techniques such as protective coating, cathodic protection, material choice, and corrosion inhibitors are elaborated. The chapter incorporates theory and practical industrial solutions that focus on cost-efficient, sustainable, and greener solutions. The knowledge of the corrosion process and prevention strategies will enable students and professionals to improve the lifespan of materials, maintain safety, and minimize the cost of maintenance processes, which will equip them with materials engineering, chemical industries, and structural design careers.

**Keywords:** Corrosion, Mechanism, Galvanic corrosion, Pitting corrosion, Cathodic protection, Protective coatings, Industrial applications.

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## 14.1. Introduction

Corrosion, a phenomenon in materials science and engineering, is one of the most important issues because this directly influences the viability, safety and functional performance of metallic materials. It is characterized as the chemical or electrochemical decomposition of a material which is mainly metals as a result of reaction with its surrounding environment and is irreversible. Rusting of iron is the most common example, though, corrosion is not exclusive to iron. Corrosion is possible almost in all the engineering metals, such as steel, copper, aluminium, nickel and their alloy, when they are subjected to the right environment. In the industrial view or in the industrial perspective, corrosion causes colossal economic losses in the tune of billions of dollar annually. Such losses are attributed to premature equipment failure, high maintenance and replacement expenses, breakdown of industrial processes and high amount of energy used. Corrosion is also dangerous in terms of safety and environmental risks, as well as economically. The structural failures that are usually associated with uncontrolled corrosion include the collapse of the bridges and buildings, the leakage of the oil and gas pipelines, and the accidents that were always caused by the chemical and nuclear plants. Corrosion study is thus of significant concern in analytical chemistry, electrochemistry, metallurgy, materials science and environmental engineering. Good knowledge of corrosion processes also allows scientists and engineers to come up with effective methods of preventive and control measures to improve service life of materials, enhance safety, as well as, mitigating environmental and economic hazards.

## 14.2. Types of Corrosion