

# Corrosion and Concrete Protection

## INTRODUCTION

- Corrosion is a common and a very expensive problem in most industries. It becomes very obvious in concrete structures where the steel reinforcement becomes exposed to the atmosphere and various other chemical species. Examples include aggressive agents such as carbon dioxide, de-icing agents and sea water, etc., that can diffuse into moist concrete where corrosion of the steel reinforcement will eventually result. Corrosion products may start to crack the concrete, leading to more exposure of the steel reinforcement. Hence, an accumulative destructive cycle of concrete and reinforcement degradation is set up, leading to the eventual failure of the structure.
- This 5-day intensive Corrosion and Concrete Protection training course provides participants with fundamental principles of corrosion and concrete system corrosion, helping participants recognise problems attributed to corrosion, determine their causes and then select relevant inspection, maintenance and control methods. This is vital for any company hoping to avoid the high maintenance and failure costs associated with corrosion.

This training course will feature:

- Corrosion Principles and Mechanisms
- Types of Corrosion that are related to Concrete Systems
- Corrosion Minimisation, Control and Methods of Protection
- Properties of Materials of Construction
- Corrosion Monitoring and Inspection Methods
- Aspects of Corrosion Management

## OBJECTIVES

By the end of this training course, participants will be able to:

- Understand the basic principles of corrosion and its mechanisms
- Identify different types of corrosion with specific attention to concrete systems
- Recognise various aggressive agent and environmental factors affecting concrete systems corrosion
- Understand the application of relevant corrosion protection techniques including cathodic protection and coatings
- Have a knowledge of basic metallurgical considerations and materials of construction
- Understand how to develop and implement corrosion inspection and control programs

## TRAINING METHODOLOGY

- This Corrosion and Concrete Protection training course will utilise a variety of proven adult learning techniques to ensure maximum understanding, comprehension and retention of the information presented. The daily workshops will be highly interactive and participative. This involves regular discussion of applications as well as hands-on exposure to real life examples.
- Participants will be provided with comprehensive hard and electronic training course notes and copies of all presentation material. Relevant computer simulations and videos will be utilised to help with the understanding of the various topics.

## WHO SHOULD ATTEND?

This training course is suitable to a wide range of professionals but will greatly benefit:

- Maintenance and Inspection Engineers
- Construction Engineers
- Risk Assessment Personnel and Health & Safety Officers
- Facilities Engineers and Operators
- Managers and Supervisors
- Project Planners and Procurement Personnel
- Plant Contractors

## Course Outline

### Fundamental Principles of Corrosion

- Introduction to Principles of Corrosion
- Corrosion Cycle
- Kinetics of the Corrosion Reaction
- Electrochemical Reactions
- Anodic and Cathodic Reactions
- Galvanic Series
- Corrosion Rates
- Materials of Construction, Types and Properties of Steel

### Types of Corrosion relevant to Concrete Systems

- Forms of Corrosion
- Uniform Corrosion
- Bimetallic Corrosion
- Pitting Corrosion
- Concentration Cell Corrosion
- Stress Corrosion Cracking
- Erosion Corrosion

## Corrosion in Concrete Structures and Influencing Factors

- Defects in Concrete Structures
- Corrosion Process in Concrete Structures
- Concrete System Corrosion Timeline
- Influence of the Environment
- Macro-cell Corrosion of Steel Reinforcement
- pH Levels and Alkalinity of Concrete
- Influence of Hydroxides
- Influence of Aggressive Agents and Solutions, Carbon Dioxide, Sea Water, etc.
- Carbonation
- Chloride Contamination
- Chloride Limits for Various Types of Concrete Systems, Reinforced, Pre-stressed, etc.
- Penetration of Concrete Structures
- Porosity and Permeability
- Corrosion induced Cracking of Concrete

## Concrete Structures Corrosion Inspection and Monitoring

- Design against Corrosion
- Methods to Control or Prevention
- Cathodic Protection Systems
- Impressed-current Protection
- Sacrificial Concrete Anode Systems and Anode Mesh Systems
- Thermal Spray Anodes
- Reinforced Steel Coatings
- Repair and Rehabilitation of Concrete
- Identify Rehabilitation Alternatives
- Relevant Standards

## Inspection and Monitoring of Concrete Structures Corrosion

- Determining Possible Causes of Failure
- Preliminary and Detailed Inspections
- Delamination Survey
- Core Extraction and Testing
- Nondestructive Testing of to Determine Concrete Cracks
- Crack Survey
- Pachometer (Cover) Survey
- Chloride Content Determination
- Moisture Content Determination
- Half-cell Potential