

**Training Title**

**CORROSION FOR NON-CORROSION ENGINEERS**

**Training Duration**

5 days

**Training Dates & Venue**

REF WC026	Corrosion for Non-Corrosion Engineers	5	25-29 October 2020	\$4,500	Dubai, UAE
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Training will be held at any of the 5 star hotels. Exact venue will be informed later.

**Training Fees**

- 4,500 US\$ per participant for Public Training includes Materials/Handouts, tea/coffee breaks, refreshments & Buffet Lunch

**Training Certificate**

Define Management Consultancy & Training Certificate of course completion will be issued to all attendees.

**TRAINING INTRODUCTION**

An understanding of corrosion and its control is vital for engineers working in energy industry to avoid the high costs that can be directly or indirectly attributed to corrosion. This course presents fundamental principles of corrosion, helping engineers recognize corrosion problems, determine their causes, and understands and then select control methods.

**TRAINING OBJECTIVES**

- To understand metallurgical properties of metals and alloys.
- To understand fundamental principles and mechanisms of corrosion phenomenon.
- To know the characteristics and types of corrosion encountered in the metal materials used the chemical and oil and gas industries.
- To know how to recognize corrosion problems, determine their causes and to select control methods.
- To be aware of the means of protection against such corrosion.
- To know how to take the necessary measures for monitoring the state of corrosion of the equipment. To understand corrosion test methods and interpretation of results. To understand the application of corrosion protection techniques. To understand how to develop and implement corrosion control programs.

**WHO SHOULD ATTEND?**

*DMCT/OL/9/18(Rev3Dt:23/9/18)*

Newly appointed Engineers of Mechanical, Chemical and Electric Power Engineering disciplines.

### TRAINING METHODOLOGY

A highly interactive combination of lecture and discussion sessions will be managed to maximize the amount and quality of information, knowledge and experience transfer. The sessions will start by raising the most relevant questions, and motivate everybody finding the right answers. The attendants will also be encouraged to raise more of their own questions and to share developing the right answers using their own analysis and experience.

All attendees receive a course manual as a reference.

This interactive training workshop includes the following training methodologies

30% Lectures

30% Workshops and work presentation

20% Group Work & Practical Exercises

20% Videos & General Discussions

### COURSE OUTLINE

#### INTRODUCTION

Definition of corrosion, Types of corrosion, The cost of corrosion, Significance of corrosion control.

#### Electrical concepts relevant to corrosion:

Resistivity, conductivity, impedance, Electron conductor, electrolytic (ionic) conductor and semiconductor, Direction of current and flow of electrons.

#### Matters of Substance:

Metals in the melting pot, Defects in metals.

#### Chemical and electrochemical concepts relevant to corrosion:

Ionization of water, Definition of pH, Ionization of metal in water, Electrode process, Anodic and cathodic reactions, Passivation behavior of iron in nitric acid, Standard redox potential, EMF series, Common reference electrodes, The Daniel cell and Galvanic cell, Galvanic series, Essential components in a corrosion cell, Common types of corrosion cells in practical situations, General methods of corrosion control.

#### Thermodynamic aspects of aqueous corrosion:

Stable states of metals in nature, The driving force for corrosion, The energy change and the cell potential, Faraday's Law Effect of concentration, the Nernst Equation, Effect of pH,

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the potential-pH diagram (Pourbaix diagram) Practical applications of E-pH diagram and its limitations.

**Kinetics of corrosion:**

Rate of reaction and rate constant, Factors affect rate of reaction, Anodic and cathodic current densities, Exchange current density, The mixed potential theory, E-log(i) Evans diagram, Tafel Equation and Tafel plot for corrosion rate determination, Linear polarization and Stern-Geary, Equation Type of polarization and rate-controlling step, Concentration polarization and the importance of dissolved oxygen Effect of oxidizer concentration on corrosion rate, Effect of velocity on corrosion rate.

**Oxidation of metals & alloys:**

Mechanisms of ionic movements in metallic oxides, Rate of oxidation and rate laws, Effects of alloying elements on the protective property of oxides, Oxidation resistance of low-alloy steel, Factors governing oxidation behavior, Oxidation of iron, Alloying effects on oxidation of iron Stress effects, Commercial low-alloy steels in air or oxygen.

**Nature of environments:**

Air and oxygen, Steam, Sulphur-containing gases, olten salts, Molten metals.

**Materials for high temperature applications:**

Oxidation, Sulphidation, Hot-salt corrosion, Carburisation and attack by carbon-containing gases, Corrosion by molten metals and salts, Corrosion of advanced ceramics.

**Forms of Corrosion:**

Uniform corrosion, Galvanic corrosion, Dealloying and Graphitisation, Crevice corrosion, Pitting corrosion, Intergranular stress corrosion cracking, weld decay and knife-line attack, Exfoliation, Filiform corrosion, Microbiologically-Influenced Corrosion (MIC), Environment-sensitive cracking, Stress corrosion cracking (SCC), Hydrogen-induced cracking (HIC), Sulfide stress cracking (SSC), Caustic embrittlement Liquid metal embrittlement (LME) Hydrogen, Damage Cold hydrogen attack or hydrogen blistering, Hot hydrogen attack or decarburization (methane gas embrittlement), Hydride (MHx) embrittlement, Hydrogen Induced Cracking (HIC), Stress Oriented Hydrogen, Induced Cracking (SOHIC) Sulfide Stress Corrosion Cracking (SSC), Corrosion fatigue, Fretting, Erosion corrosion, impingement attack and cavitation damage, Stray current corrosion.

**Corrosion in atmospheres:**

Type of atmospheres and classification of corrosiveness, Importance of relative humidity on rate of corrosion, Other major factors affect the rate of corrosion, Common forms of corrosion encountered in atmospheres, Corrosion behavior of common engineering materials under atmospheric, condition, Corrosion in potable water. natural waters and

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seawater systems, Compositions of waters, Effect of pH, Corrosion resistance of common metals and alloys in water systems.

**Corrosion in Soils:**

Characterisation of the soil environment, Soil resistivity and rate of corrosion, Other factors affect the form and rate of corrosion, Corrosion resistance of common metals and alloys in soil, Corrosion control and prevention methods.

**Corrosion in Concrete Structures:**

Characteristics of the concrete environment, Mechanisms of reinforcement corrosion.

**Corrosion control prevention methods:**

Materials selection, Protective coatings, Cathodic protection, Change of environment, Change in design.

**Identification of Corrosion Problems:**

Visual observation, Non-destructive inspection, Destructive evaluations.

**Corrosion Monitoring & Testing:**

Accelerated corrosion testing, Field corrosion testing.

**Corrosion resistance of other common engineering materials:**

Cast iron, Carbon steels and low alloys steels, Stainless steels, Nickel and nickel alloys, Aluminum and aluminum alloys, Copper and copper alloys, Titanium and titanium alloys, Zinc, tin and their alloys.

**Corrosion resistance of non-metallic materials:**

Plastics, rubber, elastomers and vitreous materials, Composite materials, Ceramic materials.

NOTE:

**Pre & Post Tests will be conducted**  
**Case Studies, Group Exercises, Group Discussions, Last Day Review & Assessments will be carried out.**

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