



# THE CHEMICAL ENGINEERING MAJOR

## Basic Corrosion Techniques & Monitoring

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## Introduction:

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Corrosion problems have always presented a severe challenge to oil and gas producing operations. Operators plan for long periods of continuous production with maintenance schedules for the prescribed shutdown periods. Unfortunately, corrosion does not always respect these schedules, resulting in severe economic penalties due to loss of production. In addition, the risk of pollution and hazards to safety are other important reasons for adequate corrosion engineering. The course considers external protection using corrosion resistant materials, coatings, and cathodic protection. The importance of internal corrosion and its prevention will be examined with emphasis on material selection, coatings and use of corrosion inhibitors. The contribution of inspection (non-destructive testing), and corrosion monitoring to the overall operation will be considered in detail. Corrosion problems concerning risers and subsea-lines will be considered together with methods for protection

## Who Should Attend?

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Corrosion Control Engineers & Personnel, Process Engineers, Metallurgists, Inspection Personnel, Mechanical Engineers, Material Selection Personnel, Plant Contractors, Operations Engineers, Team Leaders & Supervisors, Maintenance Engineers, Maintenance

Supervisors, Senior Plant Supervisors, Mechanical Engineers, Corrosion Control & Monitoring Systems Personnel, Equipment Engineers, Maintenance Engineers and Planners, Team Leaders, Managers & Coordinators, Construction Coordinators, Technologists, Safety Officers, Maintenance Team Leaders & Engineers, Design Engineers, Service Company Representatives, Oil and Gas Production Facilities Personnel, Chemists, Chemical Engineers, Inspectors and Inspection Engineers & Supervisors, Technicians and Supervisors, Environmental Specialists, New Petroleum Engineers, Asset Management Personnel, Construction Engineers, Refinery Chemists, Chemical Engineers, Personnel who are / will be responsible for detecting, inspecting, monitoring, controlling corrosion in oil and gas piping, pipelines used in production operations and Personnel responsible for metallurgy, corrosion or the prevention of failures in plant and equipment

## **Course Objectives:**

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

- Gain an understanding of corrosion engineering in oil and gas production involving the various methods available for corrosion control
- Recognize regulatory and safety matters
- Understand the contribution of an integrated monitoring and inspection program for operations and diagnosis of problems

## Course Outline:

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### Corrosion in Oil and Gas Production & Economics of Corrosion Damage

- Loss of production
- Repair costs
- Material choice
- Corrosion control methods
- Management of corrosion control
- Political considerations
- Safety
- Environment

### Introduction to Corrosion and Corrosion Control

- Definitions
- Materials involved
- Environments
- Corrosion damage
- Metallurgy
- Methods for protection

### Basic Corrosion Principles

- Corrosion rate
- Electrochemical reactions
- Electrode potentials
- Kinetics
- Passivity
- Temperature
- Pressure
- Velocity
- Conductivity
- pH
- Dissolved gases

### Forms of Corrosion

- Uniform
- Pitting
- Crevice
- Galvanic

- Erosion
- Intergranular
- Weld corrosion
- Selective leaching
- High temperature
- Turbulence
- Fretting
- Stress corrosion
- Hydrogen embrittlement
- Fatigue

#### Corrosion Aspects: Oxygen

- Role of Oxygen in oilfield corrosion
- Downhole

#### Corrosion Aspects: Sweet

- Role of Carbon Dioxide
- Effect of temperature and pressure
- Corrosion of well tubing and other equipment

#### Corrosion Aspects: Bacterial

- Effect on corrosion situation
- Micro-organisms
- Techniques for control
- Monitoring

#### Corrosion Prevention: Inhibitors

- Types of corrosion inhibitors
- Choice and selection
- Quality assurance
- Logistics
- Criteria for effectiveness

#### Corrosion Prevention: Design

- Environmental effects
- Consideration of geometry
- Elimination of stress
- Different metals
- Velocity of corrodent
- Temperature
- Design codes

- Codes of practice
- Standards

#### Corrosion Prevention: Cathodic Protection

- Principles of operation
- Applications
- Surveys
- Engineering in the field
- Galvanic systems
- Impressed current systems
- Criteria for effectiveness

#### Corrosion Prevention: Materials and Selection

- Carbon, low alloy, stainless and duplex steels
- Non-ferrous metals
- Non-metallic materials

#### Corrosion Prevention: Coatings and Linings

- Inorganic and organic
- Metallic
- Surface preparation
- Quality assurance
- Inspection during application

#### Corrosion Monitoring

- Philosophy
- Objectives
- Methods
- Application
- Design considerations
- Liaison with inspection
- Integrated systems
- Management
- Data handling and presentation

#### Water Chemistry

- Scaling properties
- Disposal
- Microbiology
- Corrosion aspects

#### Manufacturers' Demonstration

- Corrosion control equipment

#### Inspection and Non-Destructive Testing (NDT)

- Inspection function
- Calipers for downhole tubing
- Ultrasonic systems
- Radiography
- Intelligent vehicles
- Other methods
- Management of contracts

#### Failure Analysis

- System approach
- Investigation of corrosion failures

#### Pipelines and Risers

- Corrosion hazards
- Methods for control of corrosion
- Inspection and monitoring
- Coatings and cathodic protection
- Pressure testing

#### Oil Treatment Corrosion

- Crude oil properties
- Desalting
- Distillation and other processing

#### Sweetening Processes: Corrosion

- Quality assurance
- Philosophy
- Planning
- Quality profile
- Role of certifying authorities

#### Subsea Systems: Corrosion

- Ramifications infrastructure
- Inspection and corrosion monitoring

#### Oilfield and Oil Treating Facilities

- Offshore platforms
- Downhole equipment
- Surface equipment
- Terminals