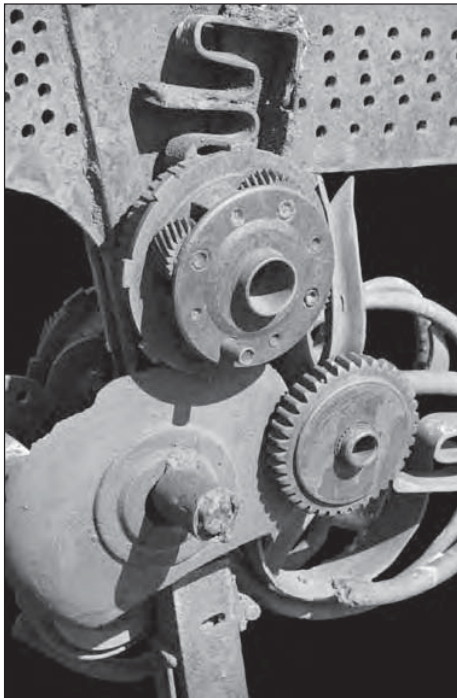


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# PRACTICAL CORROSION, METALLURGY AND PREVENTION OF FAILURES



## WHAT YOU WILL LEARN:

- Corrosion mechanism, concepts and types.
- Metal defects, metallurgical factors and electrical concepts.
- Oxidation principles and its effect on metals.
- Corrosion forms and characteristics.
- Corrosion under specific environmental conditions.
- Chemical properties of materials and proper material selection for minimizing the impact of corrosion.
- Corrosion protection methods, failure analysis and prevention.
- Evaluation of various techniques used for testing and monitoring corrosion.
- Corrosion and its impact with regard to different industries.

## WHO SHOULD ATTEND:

This course is designed for personnel who want to learn, understand and effectively implement the principles related to corrosion management, metallurgy and failure prevention. Those who will benefit the most from this workshop include the following:

- Mechanical Engineers.
- Metallurgical Engineers.
- Chemical Engineers.
- Project and Design Engineers.
- Process Control Engineers.
- Technical Managers.
- Material Procurement Personnel.
- Equipment Designers and Engineers.
- Consulting Engineers.
- Plant Inspection and Maintenance Personnel.
- Quality Control Engineers.
- Weld Inspectors.

## The Workshop

The practical corrosion, metallurgy and failure prevention course is a comprehensive, highly practical and interactive workshop. You will have an opportunity to learn and discuss the fundamental principles of corrosion and the related metallurgical aspects. You will be able to differentiate between the various forms of corrosion and specifically understand the impact of corrosion in relation to specific environmental conditions. During the course of the discussion, you will learn to appreciate the important role that material selection plays in minimizing the impact of corrosion, along with obtaining a good understanding of various corrosion protection mechanisms. You will also get to understand the rudiments of corrosion failure analysis and prevention and the manner in which corrosion testing and monitoring techniques are implemented. Practical examples from actual projects will be used extensively to illustrate the various principles involved and drive home the point. You will also be provided with a high quality course manual that IDC is known for. This course manual will be useful for many years after the course.

## Practical Sessions

This is a practical, hands on workshop enabling you to work through practical exercises which reinforce the concepts discussed.

***To gain full value from this workshop, please bring your laptop/notebook computer.***

## The Program

### INTRODUCTION TO CORROSION

- Definition of corrosion - types of corrosion, cost of corrosion

### CORROSION FUNDAMENTALS

- Thermodynamic aspects of aqueous corrosion
- Aqueous corrosion kinetics
- Effect of concentration
- Electrode potentials, anodic and cathodic reactions
- Utilities Potential measurement with reference electrode, standard redox Potential
- EMF series
- Exchange current density
- Mixed potential theory
- E-log (i) Evans diagram
- Corrosion cells
- Tafel equation and Tafel plot for corrosion rate determination
- Linear polarization and Stern-Geary equation
- Types of polarization and rate controlling step
- Passivity and passivation behavior of iron in nitric acid
- Effect of temperature and pressure on rate of corrosion
- Effect of velocity on rate of corrosion
- Definition and effect of pH
- Dissolved gases and importance of dissolved oxygen

### BASIC METALLURGY AND ELECTRICAL CONCEPTS

- Introduction to metallurgy
- Principles of Metallurgy
- Defects in metals
- Metallurgical factors affecting corrosion
- Iron-carbon phase diagrams
- Common ferrous and non-ferrous metals/alloys
- Microstructure of common metals/alloys
- Weldment metallurgy
- Basic electrical concepts

### OXIDATION

- Oxidation of metal and alloys
- Oxidation resistance of low alloy steel
- Environments
- High temperature corrosion

### CORROSION FORMS

- Uniform corrosion
- Aqueous corrosion
- Atmospheric corrosion
- Galvanic corrosion
- De-alloying and graphitization
- Stray current corrosion
- Pitting corrosion
- Crevice corrosion
- Filiform corrosion
- Effects of metallurgical variables on aqueous corrosion
- Effects of metallurgical variables on the corrosion of stainless steels, Aluminum alloys and de-alloying corrosion
- Erosion corrosion, impingement attack and cavitation damage
- Stress corrosion cracking, stress corrosion
- Inter-granular stress corrosion cracking, weld decay and knife-line attack
- Hydrogen damage, hydrogen embrittlement
- Selective leaching
- Liquid metal induced embrittlement
- Solid metal induced embrittlement
- Sulfide stress cracking
- Exfoliation
- Caustic embrittlement
- Corrosion fatigue
- Fretting
- Microbiologically influenced corrosion in metals

### CORROSION UNDER SPECIFIC ENVIRONMENTAL CONDITIONS

- Corrosion in atmospheres
- Corrosion in portable water, natural waters and sea water systems
- Corrosion in soils
- Corrosion of reinforcement and concrete

### DESIGN AND MATERIAL SELECTION FOR CORROSION PREVENTION

- Introduction to methods of corrosion protection
- Corrosion resistance properties of stainless steels
- Corrosion resistance properties of cast iron

- Corrosion resistance properties of carbon steel and low alloy steels
- Nickel and nickel alloys
- Aluminum and aluminum alloy
- Magnesium and magnesium alloys
- Copper and copper alloys
- Titanium and titanium alloys
- Zinc and zinc alloys
- Tin and tin alloys
- Corrosion resistance of non-metallic materials

### CORROSION PROTECTION METHODS

- Surface treatment and conversion coatings
- Ceramic, glass and oxide coatings
- Metal coatings
- Coatings and linings
- Electrochemical corrosion control methods
- Cathodic and Anodic protection
- Corrosion inhibitors

### FAILURE ANALYSIS AND PREVENTION

- General approach to failure analysis
- Rudiments of Corrosion Failure Analysis
- General methods of failure prevention
- Preventing Corrosion Failures by Design

### CORROSION TESTING AND MONITORING

- Basics of corrosion monitoring
- Corrosion testing and monitoring techniques
- NDT for off-line monitoring

### BRIEF DISCUSSION ON CORROSION FOR DIFFERENT INDUSTRIES

- Marine corrosion
- Food industry
- Pulp and paper industry
- Aerospace industry
- Mining industry
- Electronics industry

### SUMMARY, OPEN FORUM AND CLOSING