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FE142-3D:
Corrosion, Metallurgy & Prevention of Fatigue

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Training Description:

Metallurgy: this section of the course discusses metals and the metallurgical characteristics of various metals. It provides an explanation of physical characteristics of metals, including the reason metals behave differently than non-metals. This section of the course also explains how and why different metals are selected for specific environmental purposes, including resistance to wear, corrosion, heat, cold, repeated stress, and impact. This is a lecture and problem-solving section that also deals with the metallurgical aspects of welding. Emphasis will be placed on mechanical metallurgy, materials selection, and the fundamentals of welding technology, welding metallurgy, inspection and quality of welds.

Corrosion: this section of the course focuses on the fundamentals of corrosion as well as the potential problems caused by corrosion. It provides a review of the causes of corrosion and the methods for identification, monitoring and control. An understanding of corrosion and its control is vital for any company hoping to avoid the high costs that can be directly or indirectly attributed to corrosion. This section of the course also presents fundamental principles of corrosion and assists participants in recognizing corrosion problems, determining their causes, and understanding and selecting control methods. Emphasis is on the practical applications of corrosion technology to solve industrial corrosion problems.

Prevention of failures: this section of the course is concerned with the prevention of failures, the assessment of the state of damage in plant and equipment, and the use of failure analyses, inspection data, and operating history in predicting safe operating life or determining necessary remedial measures. Maintenance requirements, risk-based inspection (RBI) procedures, and the fitness-for-service (FFS) approach will be discussed along with the various mechanisms leading to damage and potential failure, mechanisms of accumulation, and predictive methods.

Training Objectives:

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

- ✓ Apply systematic techniques in metallurgy, corrosion and prevention of failure for plant, equipment and pipelines including material selection and properties
- ✓ Reduce corrosion and prevent failure of plant and equipment at the design stage or during the operation of the facility
- ✓ Assess the state of damage in plant, equipment and pipelines and implement the relevant repair technique
- ✓ Acquire a good background knowledge on the metallurgy of ferrous metals, nonferrous alloys and stainless steels as well as recognize the classification and heat treatment of steels and explain passivity and passive films on stainless steels
- ✓ Develop a good understanding on physical and mechanical metallurgy including crystal structure, phase diagrams, diffusion, phase transformations, T-T-T diagrams and C-C-T diagrams
- ✓ Discuss the materials, metallurgy and the general characteristics and mechanical properties of metals and alloys and describe welding metallurgy, non-destructive examinations and electrochemical principles
- ✓ Discuss the fundamentals of corrosion and identify its different forms in varying circumstances including atmospheric corrosion and corrosion by water and steam

- ✓ Describe cathodic protection, protective coatings and inhibitors as well as discuss the various aspects of high temperature corrosion, the prediction and control thereof
- ✓ Identify the different damage and failure mechanisms and the methods of failure prevention & inspection as well as carryout preventative and predictive maintenance
- ✓ Recognize the OSHA requirements for mechanical integrity as well as the API and ASME codes and standards related to the in-service, construction and repair

Training Designed for:

This course is intended for those who are responsible for metallurgy, corrosion and prevention of failures in plant and equipment. Facility integrity engineers, inspection engineers, metallurgy and corrosion engineers, materials engineers, design engineers, mechanical engineers, chemical engineers, corrosion field personnel, supervisors and other technical staff will find the course very attractive. Senior engineers and managers will be able to develop their interpretive skills in data analysis. Furthermore, the course is ideal for all engineers and technical staff whose responsibilities include the reduction of corrosion and the prevention of failure either at the design stage or during operation of the facility.

Training Requirement:

"Hand's on practical sessions, equipment and software will be applied during the course if required and as per the client's request".

Practical sessions will be organized during the course for participants to practice the theory learnt. Participants will be provided with an opportunity to carryout various exercises using the simulators "Corrosion Data Management Software (CDMS)" and "Electronic Corrosion Engineer (ECE®) 5".

Contents can be adapted to your specific wishes. It is therefore possible to focus on specific modules of the training course as per client's learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Program:

DAY ONE:

- ❖ Metallurgy
  - Review of Ferrous Metals, Glossary
- ❖ Introduction to Steel
  - Classification of Steels, Heat Treatment of Steels
- ❖ Physical & Mechanical Metallurgy
  - VWE 7 Introduction to Phase Diagrams, Crystal Structure, Phase Diagrams, Diffusion, Phase Transformations, T-T-T Diagrams, C-C-T Diagrams, Practical Session, Isothermal, TTT & CCT Diagrams
- ❖ Review of Nonferrous Alloys & Stainless Steels
  - Aluminium, Copper, Nickel-Based, Stainless Steel, Heat Treatment of Nonferrous & Stainless Steels, Practical Session, 'Turbine of the Times'
- ❖ Materials & Metallurgy
  - Mechanical Properties, Metals & Alloys, General Characteristics of Metals, Alloying
- ❖ Welding Metallurgy

- Video VWE 8 Welding Inspection & Quality Control, Glossary, Fundamentals, Characteristics of Weld Solidification, Weld Microstructure, Temperature Changes in Welding, Residual Stresses, Welding Processes, Heat Input, Shrinkage & Distortion in Weldments, Weld Defects, Practical Session, Liberty' Ships, Welding & Metallurgy

❖ Non-Destructive Examination
- Video VWE 11 Non-Destructive Testing, Glossary, Quality Control, Standards for NDT, Welding, Inspection Techniques

❖ Electrochemical Principles
- Glossary, Overview, Anodes & Cathodes, Electron Flow, Electrolytes

❖ Recap

DAY TWO:

❖ Forms of Corrosion
- Video VWE 13 Forms of Corrosion Parts 1 & 2, General Corrosion, Localized Corrosion, Galvanic Corrosion, Dealloying, Intergranular Corrosion Cracking, Stress Corrosion Cracking, Velocity Effects, High Temperature Corrosion, Practical Session, Principles & Forms of Corrosion

❖ Passivity & Passive Films on Stainless Steels
- Review of Fundamentals, Passive Film

❖ Corrosion by Water & Steam
- Role of Contaminants, Types of Water, Corrosion Materials, Cooling Systems, Water Treatment, Practical Session, Stress Corrosion Cracking Atmospheric Corrosion Types of Corrosion, Change of Environment, Design Considerations

❖ Cathodic Protection
- Video VWE 19 Corrosion & Corrosion Prevention, How Cathodic Protection Works, Galvanic Anodes, Impressed Current Systems, Design of Galvanic System, Theory, Sacrificial Anod System, Compound Current System

❖ Practical Sessions
- This hands-on, highly-interactive training includes real-life case studies and exercises

DAY THREE:

❖ Introduction to Protective Coatings
- Coating Fundamentals, Types of Coatings, Surface Preparation, Cathodic Protection, Application & Cure, Specification

❖ Inhibitors
- Types of Inhibitors, Aqueous Systems, Other Considerations, Practical Session, Corrosion Fatigue, Protection

❖ Damage & Failure Mechanisms
- Ductile & Brittle Fracture, Failure Mechanisms, How Components Fail

❖ Failure Prevention
- Introduction, Failures, Inspection

❖ Preventative & Predictive Maintenance
- Video VRE 3 Preventative & Predictive Maintenance, Process Safety Management, Occupational Health & Safety, Practical Session OSHA 29CFR1910.119(j)

❖ Mechanical Integrity - What OSHA Expects

- Video VWE 6 Principles of Failure Analysis, Risk Based Inspection, Failure Analysis, Summary, References, Practical Session, Risk Based Inspection – Case Study & Worked Example

❖ Codes & Standards
- International Standards, Industry Standards, Management Models, American Standards, API 579-1/ASME FFS-1

❖ Course Conclusion
❖ POST-ASSESSMENT and EVALUATION

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Gamification, Software & General Discussions
- Pre and Post Test

Training Certificate(s):

CMCT Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Fees:

TBA as per the course location - This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:00	Recess (Prayer Break & Lunch)
13:00 - 14:00	Last Session

For training registrations or in-house enquiries, please contact:
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