COURSE OVERVIEW FE0320-4D

Metallurgy, Corrosion and Prevention of Failures

Material Selection and Properties

Course Title

Metallurgy, Corrosion and Prevention of Failures: *Material Selection and Properties*

Course Reference

FE0320-4D

Course Duration/Credits

Four days/2.4 CEUs/24 PDHs

Course Date/Venue

Session(s)	Date	Venue
1	May 13-16, 2024	Ajman Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
2	August 12-15, 2024	Oryx Meeting Room, Double Tree by Hilton, Doha, Qatar
3	November 11-14, 2024	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

Course Description

This practical and highly-interactive course includes various practical sessions and. Theory learned will be applied using our state-of-the-art simulators.

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.

Course Objectives

Upon the successful completion of this course, each participant 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

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials, sample video clips of the instructor's actual lectures & practical sessions during the course conveniently saved in a **Tablet PC**.*

Who Should Attend

This course provides a wide understanding and deeper appreciation of material selection and properties 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 Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Fee

Abu Dhabi	**US$ 4,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Doha	**US$ 5,000** per Delegate. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Dubai	**US$ 4,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations:-

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **2.4 CEUs** (Continuing Education Units) or **24 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. George Poulos, MBA, MSc, BSc, CEng, is a **Senior Corrosion & Metallurgical Engineer** with over **45 years** of extensive experience within the **Oil & Gas, Petrochemical, Refinery, Construction, Aircraft & Shipbuilding** Industry. His wide experiences cover in the areas of **Metallurgical** Failure Analysis & Prevention, **Corrosion** Fabrication & Inspection, **Fabrication** & **Repair**, **Corrosion** Prevention, **Corrosion** Engineering, **Corrosion Control**, **Corrosion Inhibition**, **Corrosion** Management in Process Operations, **Corrosion** & Prevention of Failures, **Material** Selection, **Cathodic Protection** Systems, **Steel Metallurgy**, **Steel** Structure Welding, **Steelmaking** Slag, **Steel** Making Application, **Steel Making** Process, **Steel** Manufacturing, **Steel Forging**, **Steel** Manufacturing & Process Troubleshooting, **Hot Rolling** Process, **Hot Strip Mill**, **Mill** Operations, **Roll Mill**, **Electric Arc Furnace** (**EAF**), **Slit Rolling**, **Carbon Steel Pipe** Wall Thickness & Grade Selection, **Ferro-Alloys**, **Heat Treatment** & **Prevention Techniques** and **Post Weld Heat Treatment**. Further, he is also well-versed in **Welding** Inspection, **Welding** & **Machine** Techniques, **TIG** & **Arc Welding**, **Shielded Metal Arc Welding**, **Gas Tungsten** & **Gas Metal Arc Welding**, **Welding** Procedure Specifications & Qualifications, **Aluminium Welding**, **Hot Work-Safety**, **SMAW**, **GTAW**, **Welding** Techniques, **Pipeline Welding** Practices, **Welding** Engineering, **Welding** Fatigue & Fracture Mechanics, **Welding Inspection Technology**, **Welding Safety**, **Welding** Defects Analysis, **Welding Technology**, **Welding Problems**, **Welding & Non Destructive** Testing and **Metallurgy Techniques**.

During his career life, Mr. Poulos has gained his practical and field experience through his various significant positions and dedication as the **Chief Executive**, **Head of Technical Studies**, **Manager**, **Senior Consultant**, **Lead Welding Engineer**, **Senior Welding Engineer**, **Design Engineer**, **Sales Engineer**, **Author**, **Welding Instructor**, **Visiting Lecturer** and **Technical Proposal Research Evaluator** from various international companies such as Greek Welding Institute, Hellenic Quality Forum and International Construction Companies such as Shipbuilding, Aircraft Industry and Oil and Gas Industry.

Mr. Poulos is a **Registered Chartered Engineer** and has a **Master's** degree in **Naval Architecture**, a **Bachelor's** degree in **Welding Engineering** and a Master of Business Administration (**MBA**) from the **Sunderland University**, **Aston University** and **Open University**, **UK**, respectively. Further, he is a **Certified Trainer/Instructor**, an active Member of Chartered Quality Institute (**CQI**), The British Welding Institute (**TWI**), The Royal Institution of Naval Architects (**RINA**) and American Welding Society (**AWS**), a Registered **EWF/IW** (European Welding Federation-International Welding Institute W/E) and an **IRCA** Accredited External Quality Systems Auditor through BVQI. He is an **Author** of Technical Book dealing with Protection/Health/Safety in the Welding/Cutting domain and delivered various trainings, seminars, conferences, workshops and courses globally.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Metallurgy*** *Review of Ferrous Metals • Glossary*
0930 – 0945	*Break*
0945 – 1100	***Introduction to Steel*** *Classification of Steels • Heat Treatment of Steels*
1100 – 1245	***Physical & Mechanical Metallurgy*** *Haward Video 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*
1245 – 1300	*Break*
1300 – 1330	***Review of Nonferrous Alloys & Stainless Steels*** *Aluminium • Copper • Nickel-Based • Stainless Steel • Heat Treatment of Nonferrous & Stainless Steels • Practical Session • 'Turbine of the Times'*
1330 - 1420	***Materials & Metallurgy*** *Mechanical Properties • Metals & Alloys • General Characteristics of Metals • Alloying*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2

0730 – 0800	***Welding Metallurgy*** *Haward 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*
0800 - 0830	***Non-Destructive Examination*** *Haward Video VWE 11 Non Destructive Testing • Glossary • Quality Control • Standards for NDT • Welding • Inspection Techniques*
0830 – 0900	***Electrochemical Principles*** *Glossary • Overview • Anodes & Cathodes • Electron Flow • Electrolytes*
0900 – 0915	*Break*
0915 – 1030	***Forms of Corrosion*** *Haward 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*
1030 – 1200	***Passivity & Passive Films on Stainless Steels*** *Review of Fundamentals • Passive Film*

1200 – 1215	Break
1215 – 1315	***Corrosion by Water & Steam*** Role of Contaminants • Types of Water • Corrosion Materials • Cooling Systems • Water Treatment • Practical Session • Stress Corrosion Cracking
1420 – 1430	***Recap*** Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End of Day Two

Day 3

0730 – 0830	***Atmospheric Corrosion*** Types of Corrosion • Change of Environment • Design Considerations
0830 – 0930	***Cathodic Protection*** Haward 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
0930 – 0945	Break
0945 – 1115	***Cathodic Protection (cont'd)*** Impressed Current Systems • Design of Galvanic System • Theory • Sacrificial Anod System • Compound Current System
1115 – 1230	***Introduction to Protective Coatings*** Coating Fundamentals • Types of Coatings • Surface Preparation • Cathodic Protection • Application & Cure • Specification
1230 – 1245	Break
1245 – 1420	***Inhibitors*** Types of Inhibitors • Aqueous Systems • Other Considerations • Practical Session • Corrosion Fatigue • Protection
1420 – 1430	***Recap*** Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow
1430	Lunch & End Day Three

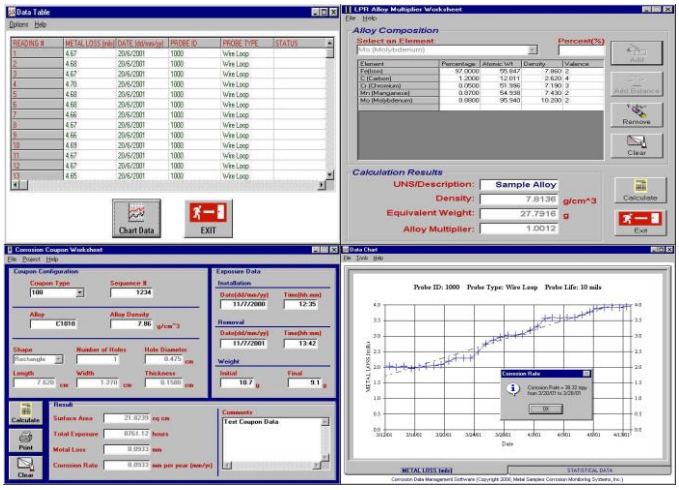
Day 4

0730 – 0830	***Damage & Failure Mechanisms*** Ductile & Brittle Fracture • Failure Mechanisms • How Components Fail
0830 – 0930	***Failure Prevention*** Introduction • Failures • Inspection
0930 – 0945	Break
0945 – 1045	***Preventative & Predictive Maintenance*** Haward Video VRE 3 Preventative & Predictive Maintenance • Process Safety Management • Occupational Health & Safety • Practical Session OSHA 29CFR1910.119(j)
1045 – 1200	***Mechanical Integrity - What OSHA Expects*** Haward Video VWE 6 Principles of Failure Analysis • Risk Based Inspection • Failure Analysis • Summary • References • Practical Session • Risk Based Inspection – Case Study & Worked Example
1200 – 1215	***Break***

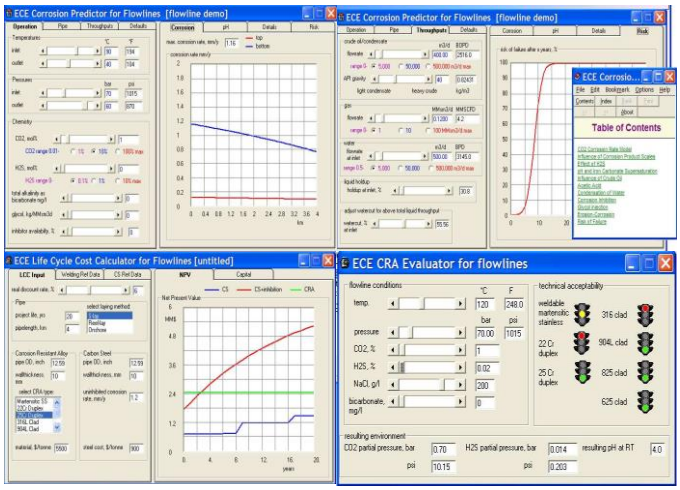
1215 – 1300	***Mechanical Integrity - What OSHA Expects (cont'd)*** *Practical Session • Risk Based Inspection – Case Study & Worked Example (cont'd)*
1300 – 1345	***Codes & Standards*** *International Standards • Industry Standards • Management Models • American Standards • API 579-1/ASME FFS-1*
1345 – 1400	***Course Conclusion***
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Simulator (Hands-on Practical Sessions)

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



Corrosion Data Management Software (CDMS)



Electronic Corrosion Engineer (ECE®) 5

Course Coordinator

Mari Nakintu, Tel: +971 230 91 714, Email: mari1@haward.org