

*WebCorr Corrosion Consulting Services Presents*

# Environmental Cracking (HB/HIC/SWC/SOHIC/SSC/SZC/HSC/HE/SCC)

Date: As published on website    Venue: As published on website

## Course Overview

Environmental Cracking is one of the key factors that can affect the structural integrity or limit the life of metallic structures. Environmental cracking is a general term that includes: stress corrosion cracking (SCC), caustic cracking, liquid metal cracking, corrosion fatigue, hydrogen blistering, hydrogen embrittlement (HE), hydrogen-induced cracking (HIC), stepwise cracking (SWC), stress-oriented hydrogen-induced cracking (SOHIC), sulfide stress cracking (SSC), soft-zone cracking (SZC), and hydrogen stress cracking (HSC).

This 5-day corrosion short course systematically and thoroughly covers the recognition, mechanisms, test methods and prevention of the various types of cracking phenomena. Also discussed in this corrosion short course is the NACE MR0175/ISO 15156 standard for the selection of crack-resistant materials for use in H<sub>2</sub>S-containing oil and gas environments.

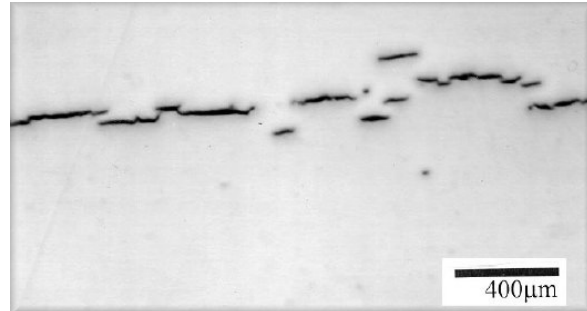
This course is available for in-house training, online and distance learning worldwide. It can also be customized to meet the specific needs of your organization.

## Who Should Attend

Designers and engineers who are involved in the selection and evaluation of materials for use in H<sub>2</sub>S-containing environments in oil and gas production.

## Course Outline

1. Introduction
2. Corrosion Basics
3. Overview of Environmental Cracking
4. HB/HIC/SWC/SOHIC/SSC/SZC/HSC/HE/SCC: Recognition, Mechanisms and Prevention
  - 4.1 Overview of Hydrogen Damage
  - 4.2 Hydrogen Blistering (HB) and HIC/SWC
  - 4.3 High Temperature Hydrogen Attack (HTHA)
  - 4.4 Hydrogen Embrittlement
  - 4.5 Hydride Embrittlement



## 4.6 Hydrogen Induced Cracking (HIC), Stepwise Cracking (SWC) & SOHIC

- 4.6.1 Definition
- 4.6.2 Recognition
- 4.6.3 Mechanisms
- 4.6.4 Factors Influencing HIC, SWC & SOHIC
  - 4.6.4.1 Environmental Factors
  - 4.6.4.2 Metallurgical Factors
- 4.6.5 Prevention and Control

## 4.7 Sulfide Stress Cracking (SSC) and Soft Zone Cracking (SZC)

- 4.7.1 Definition
- 4.7.2 Recognition
- 4.7.3 Mechanisms
- 4.7.4 Factors Influencing SSC and SZC
  - 4.7.4.1 Environmental Factors
  - 4.7.4.2 Metallurgical Factors
- 4.7.5 Prevention and Control

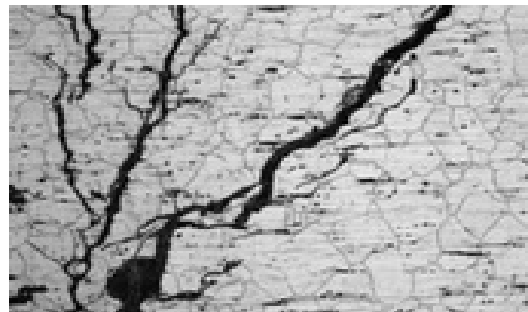
## 4.8 Hydrogen Stress Cracking (HSC) and Hydrogen Embrittlement (HE)

- 4.8.1 Definition
- 4.8.2 Recognition
- 4.8.3 Mechanisms
- 4.8.4 Factors Influencing HSC and HE
  - 4.8.4.1 Environmental Factors
  - 4.8.4.2 Metallurgical Factors
- 4.8.5 Prevention and Control

## 4.9 Stress Corrosion Cracking (SCC)

- 4.9.1 Definition
- 4.9.2 Recognition
- 4.9.3 Mechanisms
- 4.9.4 Factors Influencing SCC

- 4.9.4.1 Environmental Factors
- 4.9.4.2 Metallurgical Factors
- 4.9.5 Prevention and Control
- 4.10 Stress Corrosion Cracking of Pipeline Steels
- 4.11 Comparison of HIC/SWC, SOHIC, SSC, SZC, HSC, HE and SCC
- 4.12 HIC/SOHIC/SSC/HSC/SCC Test Methods
- 5. Understanding NACE MR0175/ISO 15156
  - 5.1 Objective
  - 5.2 Background
    - 5.2.1 Abbreviated Terms
  - 5.3 NACE MR0175 / ISO 15156 Interpretation and Maintenance
  - 5.4 From NACE MR0175 to NACE MR0175/ISO15156
    - 5.4.1 Significant changes to previous MR0175:
      - 5.4.1.1 Responsibilities for Various Users of the Document
      - 5.4.1.2 Changes that affect only the Carbon Steel Alloys
      - 5.4.1.3 Changes that affect only the Corrosion Resistant Alloys
      - 5.4.1.4 Other Options for Material Qualifications
      - 5.4.1.5 Requirements for Marking (Part 2, Section 9; Part 3, Section 7)
  - 5.5 Structure of New Document
    - 5.5.1 Part 1 - General Principles for Selection of Cracking-Resistant Materials
      - 5.5.1.1 Scope of the Standard - Equipment and Component Design (Section 1)
      - 5.5.1.2 Service Conditions: Evaluation and Definition (Section 6)
      - 5.5.1.3 Pre-Qualified Materials Selection Guide (Section 7)
      - 5.5.1.4 Material Qualification Alternatives and Implementation
      - 5.5.1.5 Materials Qualification Documentation (Section 9)
    - 5.5.2 Part 2: Cracking-Resistant Carbon and Low Alloy Steels
      - 5.5.2.1 Scope of the Standard – Equipment and Component Design
      - 5.5.2.2 Carbon and Low Alloy Steels in H<sub>2</sub>S environments (Section 6)
      - 5.5.2.3 Qualification and Selection (Section 7)
      - 5.5.2.4 Evaluation for resistance to HIC and SWC (Section 8)
      - 5.5.2.5 Marking (Section 9)
      - 5.5.2.6 Annexes
    - 5.5.3 Part 3: Cracking-Resistant CRAs and Other Alloys
      - 5.5.3.3 Qualification and Selection (Section 6)
      - 5.5.3.4 Purchasing Information and Marking (Section 7)
      - 5.5.3.5 Annexes
- 5.6 End User's Application Guideline for MR0175/ISO 15156
  - 5.6.1 Select Qualification Method
    - 5.6.1.1 Scope of MR0175/ISO 15156
    - 5.6.1.2 Existing Facilities vs. New Projects
    - 5.6.1.3 Existing Facilities
    - 5.6.1.4 New Projects
    - 5.6.1.5 Alternative Materials Qualification
  - 5.6.2 Qualification By Field Experience
    - 5.6.2.1 Material Qualification by Field Experience
    - 5.6.2.2 Describe and document the materials to be qualified
    - 5.6.2.3 Describe and document the service environment
    - 5.6.2.4 Compile the Service History for a minimum of 2 years
    - 5.6.2.5 Inspection of the in-service material
    - 5.6.2.6 Intended Service Environment
    - 5.6.2.7 Report and file documentation
  - 5.6.3 Qualification by Laboratory Testing
    - 5.6.3.1 Material Qualification by Laboratory testing
    - 5.6.3.2 Select material type and refer to the applicable part of NACE/ISO standard
    - 5.6.3.3 Select the laboratory qualification option that best fits the application
    - 5.6.3.4 Identify the Qualification Required
    - 5.6.3.5 Select the Test Method
    - 5.6.3.6 Establish the Test Conditions
    - 5.6.3.7 Specify the Acceptance Criteria for each test method
    - 5.6.3.8 Report the Test Results
- 5.7 Other Issues
- 5.8 References
- 5.9 Questions (175) and interpretations for NACE MR0175/ISO 15156
- 5.10 Case Studies



### Course Registration

Please register online at [www.corrosionclinic.com](http://www.corrosionclinic.com)  
Or use the form below (photocopies of this form may be used for multiple bookings).

Dr/Mr/Ms \_\_\_\_\_

Organization \_\_\_\_\_

Contact Person \_\_\_\_\_

Contact Dept \_\_\_\_\_

Telephone \_\_\_\_\_ Fax \_\_\_\_\_

Email \_\_\_\_\_

Payment should be made by TT or online banking. Currencies in Australian Dollar, Canadian Dollar, US Dollar, Euro and Sterling Pound can be transferred directly without conversion. Our bank details can be found at the link below:

<https://www.corrosionclinic.com/payment.html>

### Course Fee and Discount

**Standard:** \$4,950      **Discount:** \$4,455

The fee includes a hardcopy of course note, certificate, light lunch, coffee breaks each day during the course.

Discount applies to a group of 3 or more persons from the same organization registering at the same time, or early-birds making payment at least 8 weeks before the course commencing date.

### Cancellation and Refunds

Cancellation or replacement should be conveyed to WebCorr in writing (email or fax). An administration charge of 50% of the course fee will be levied if the cancellation notice is received from 14 to 7 days before the course commencing date. No refund will be made for cancellation notice received 6 days and less. No refunds will be given for no-shows. Should WebCorr find it necessary to cancel a course, paid registrants will receive full refund. Refund of fees is the full extent of WebCorr's liability in these circumstances.



WebCorr has NACE certified Corrosion Specialist (#5047) providing customized in-house training, online and distance learning corrosion courses, corrosion seminars and workshops on corrosion, materials, metallurgy, paints and metallic coatings. Our corrosion courses are developed and taught by NACE certified Corrosion Specialist with over 30 years of practical experience in the field. Our training success is measured by your learning outcome.

