Cost

The registration fee of the workshop will be £750 + VAT (UK only) which includes course notes and lunches. You should make your own arrangements for accommodation.

Payment

Payments can be made by cheque (made payable to ASRANet Ltd.), cash or bank transfer. Please enquire for details.

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Corrosion and Fatigue

(A Maritime Company for Courses, Conferences and Research)

Paris, France

ABOUT THE COURSE

Corrosion science is often viewed as a “heavy” subject, usually highly chemical in nature and demanding understanding of thermodynamics and electricity. As a consequence many shun the theoretical aspects and find solace in the practical issues, such as the methods used to recognize it, measure it, and protect against it. This practical branch of corrosion study is described as corrosion engineering. However an ignorance of the fundamental theories of corrosion can lead to a limited understanding of the atomistic level mechanisms in operation and hence an inability to deal with cases of corrosion that do not conform to “typical” situations. The lectures therefore aim to introduce and explain these fundamentals in a way which should remain accessible to the majority of participants.

Following a general introduction to fatigue and fracture, with examples of service failures, current and developing fatigue design and assessment methods will be described. The course will go on to explain the importance of crack/flaw analysis in structural design and safety assessment and illuminate its wide range of applicability. It will give a deep understanding of the major results and criteria underpinning modern fracture mechanics, the assumptions behind them and important limitations. Attendees will gain a better understanding of material selection for fatigue and fracture resistance and learn about codified procedures for flaw evaluation

WHO SHOULD ATTEND

Engineers and scientists involved in the design, operation and assessment of both onshore and offshore structures. Personnel from oil companies, consultancy organisations, classification societies and certifying authorities will benefit from attending this course.

PROGRAMME

Day 1

08.30 - 09.00	Delegate Registration
09.00 - 10.30	Lecture 1: Some relevant and preliminary materials theory. Fundamental mechanisms relevant to corrosion.
10.30 - 10.45	*Break*
10.45 - 12.15	Lecture 2: Dry corrosion – the oxidation of metals and alloys. Wet corrosion – the concept of the electrochemical cell and the significance of electrode potentials.
12.15 -13.30	*Lunch*
13.30 – 15.00	Lecture 3: Types of corrosion cell: composition, stress & concentration. Corrosion in practice with examples and case studies related to offshore.
15.00 - 15.30	*Break*
15.30 - 17.00	Lecture 4: Corrosion engineering and general methods of protection & mitigation. Methods & case studies applicable to offshore. Corrosion as precursor to other failure processes.

Day 2

09.00 - 10.30	Lecture 5: Introduction and S – N Curve
10.30 - 10.45	*Break*
10.45 - 12.15	Lecture 6: Effect of Stress Concentration specific to offshore structures
12.15 -13.30	*Lunch*
13.30 - 15.00	Lecture 7: Rules for Fatigue design of Welded Structures, Effects of Random Loads, Mean Stress, Thickness and Material Strength
15.00 - 15.30	*Break*
15.30 - 17.00	Lecture 8: Application of Fracture Mechanics and Post Weld Improvement Techniques

Lecture Content:

Lecture 1: Some preliminary materials theory

The structure of metals, from atoms to grains
Fundamental mechanisms relevant to corrosion
Corrosion as the loss of ions & transfer of electrons
Complimentary cathodic reactions

Lecture 2: Dry and wet corrosion

The oxidation of metals and alloys
The nature of oxides on metals
The Pilling-Bedworth ratio
Wet corrosion in metals
The concept of the electrochemical cell
The significance of electrode potentials
The electrochemical and the galvanic series

Lecture 3: Types of corrosion cell

The workings of the composition or galvanic cell
The stress cell and stress corrosion
The concentration cell and the Nernst equation
Corrosion cells in engineering practice
Examples and case studies related to offshore

Lecture 4: Corrosion engineering

General methods of protection & mitigation. Methods & case studies applicable offshore
Cathodic protection and impressed current methods
Corrosion as a precursor to failure by other processes such as fatigue and creep
Corrosion testing in the lab and in the field
Potentiostatic and other advanced methods

Lecture 5: Introduction and S-N Curve

- Fatigue mechanism of materials
- Fatigue mechanism of welded structures
- Fatigue design principles
- Fatigue damage models
- Uncertainties in fatigue damage prediction
- Major factors affecting fatigue life
- Origin of SN curve & Fatigue test
- Segments of SN curve
- SN curve for welded structural details

Lecture 6: Effect of Stress Concentration

- Introduction and lessons learned from the past
- Definition of stress concentration factor (SCF)
- Methods for assessing SCF
- Stress concentration in hull structural details
- Stress concentration at welds
- Finite element modelling for SCF

Lecture 7: Rules for Fatigue design of Welded Structures

- Fatigue assessment process for hull and offshore structures
- Assessment of local stress in structural details for fatigue analysis
- Evaluation of hot-spot stress
- Secondary stress
- Design SN curve

Strain-Life Criterion-based Approach Basics and Application

- Local Strain Methodology
- Strain Life Cyclic Curves
- Strain-Life Criterion for Fatigue
- Evaluation of Local Strain
- Applications

Lecture 8: Application of Fracture Mechanics

- Fracture Mechanics: Basic concepts
- Fatigue crack propagation
- Stress intensity factor
- Evaluation of stress intensities
- Evaluation of (residual) fatigue life
- Fatigue Crack Propagation: Consequences

Weld Improvement Techniques

- Welding Improvement Techniques
- Loading and Environmental Conditions
- Limitations