

### General Principles of Materials Selection and Control

- Overview of the principles relating to the selection of materials from the definition of the required properties to the selection of the candidate materials and the determination of the required processing route.
- Subsea environment:
  - H<sub>2</sub>S-containing environments
  - CO<sub>2</sub> containing environments
  - Chloride Ion environment
  - Erosion
  - Chemical treatment
  - Mercury
  - Seawater
- Preferential Weld Corrosion
- Hydro-testing and commissioning environments
- Identification of the main materials and material classes used in the offshore and subsea industry.

### Metallic Materials

- The chemistry, metallurgy and properties of mild steel, stainless steel and corrosion resistant alloys relating the composition and metallurgy to the required properties.

### Non-Metallic Materials

- The use of non-metallic materials and composite materials in the subsea industry and the properties of polymers and composites that make their use attractive.

### Mechanical Testing

- An introduction to typical mechanical testing are used in Subsea for characterisation of the mechanical properties of the subsea materials including Tensile, Charpy, Hardness, Fracture toughness and fatigue testing

### Principles of Corrosion

- An introduction to corrosion fundamentals including corrosion reactions, polarisation, corrosion cells and electrode potentials.

### Corrosion and Corrosion Protection Offshore

- An overview of corrosion mechanisms including sweet and sour corrosion, microbial attack and stress corrosion cracking, identifying the vulnerable areas of the system
- Cathodic Protection
  - Conventional Sacrificial Anode CP Design
  - Low voltage Cathodic Protection
  - Anode materials specifications

## Welding and Joining Technology

- The use of welding in subsea systems, particularly for pipe manufacture.
- Development of microstructure in welded joints and the properties of the weld, heat affected zone and parent plate.

## Subsea Production Systems Materials Selection

### Wellheads and Christmas Trees

- Introduction
- Relevant Standards/Design codes
- Major Components
- Material Considerations
- Material option

### Manifold Piping and Equipment

- Introduction
- Relevant Standards/Design codes
- Major Components
- Materials option

### Flowline and Risers

- Introduction
- Relevant Standards/Design codes
- Installation Methods
- Welding of flowlines
- Risers

### Valves

- Introduction
- Relevant Standards/Design codes
- Materials option
- Materials Specifications and Testing

### Fasteners and Gaskets

- Introduction
- Relevant Standards/Design codes
- Materials option for bolting, clamps and gaskets
- Non-metallic seals

### Flexible Pipes

- Introduction
- Relevant Standards/Design codes
- Flexible pipes construction
- Materials issue for flexible pipes
- End fittings
- Bend Stiffeners

# Subsea Materials Selection Course

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- Flexible pipe integrity management

## Hydraulic Control and Chemical Injection Systems

- Introduction
- Materials option
- Tubing connections
- Injection valves
- Injection couplers
- Tubing design and supports

## Umbilicals

- Introduction
- Relevant Standards/Design codes
- Materials option

## Protective Coating and Insulation

- Introduction
- Protective coatings
  - Surface preparation
  - Selection of coatings
  - Coating of fasteners
- Thermal insulation
- Field Joint Coating

## Course Outcomes

On successful completion of this course, students will be able to demonstrate knowledge and understanding of:

- The material selection process and the principle materials used subsea
- The industry guidance and codes governing materials selection.
- The properties and structures of metallic and non-metallic materials.
- Corrosion principles and corrosion control measures used offshore.
- Welding and manufacturing processes and the relationship to material properties