Training Course on Material Selection in Oil and Gas Upstream

Professional Development Training Course Outline

Category	Oil and Gas	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

The **oil and gas upstream** sector operates in highly demanding environments characterized by extreme pressures, temperatures, and corrosive substances. Therefore, **material selection** is a critical engineering discipline that directly impacts the safety, efficiency, and longevity of all assets, from drilling equipment and well completions to pipelines and processing facilities. Choosing the right materials minimizes the risk of failures, reduces operational downtime, and ensures environmental protection. This training course provides a comprehensive understanding of the principles and practices of material selection specifically tailored for the unique challenges of the oil and gas upstream industry. Participants will gain expertise in identifying degradation mechanisms, interpreting industry standards, evaluating material properties, and implementing effective corrosion control strategies, ultimately contributing to safer and more cost-effective operations.

Effective **material selection** in the **oil and gas upstream** domain requires a multidisciplinary approach, integrating knowledge of metallurgy, corrosion science, mechanical engineering, and industry regulations. This course delves into the fundamental aspects of material science relevant to the industry, covering various material types including metals, polymers, and composites, and their performance under diverse operational conditions. Emphasis will be placed on understanding the impact of environmental factors such as sour gas, high temperatures, and subsea environments on material integrity. By exploring real-world case studies and applying learned principles, participants will develop the ability to make informed material choices, contributing to asset reliability, minimizing environmental impact, and optimizing project economics throughout the lifecycle of upstream oil and gas assets.

Programme Curriculum

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Course Duration

5 days

Course Objectives

This training course on Material Selection in Oil and Gas Upstream aims to equip participants with the following key skills and knowledge:

1. **Understand corrosion mechanisms** prevalent in upstream oil and gas environments, including sweet corrosion, sour corrosion, and microbiologically influenced corrosion (MIC).
2. **Identify key environmental factors** such as temperature, pressure, salinity, and the presence of corrosive gases (H2?S, CO2?) that influence material degradation.
3. **Interpret relevant industry standards and specifications** (e.g., API, NACE, ISO) for material selection and corrosion control in upstream operations.
4. **Evaluate the mechanical properties of materials** (e.g., yield strength, tensile strength, toughness) and their suitability for specific upstream applications.
5. **Gain knowledge of various material types** used in upstream, including carbon steels, stainless steels, corrosion-resistant alloys (CRAs), polymers, and composites.
6. **Develop methodologies for material selection** based on service requirements, cost considerations, and lifecycle analysis.
7. **Assess the effectiveness of different corrosion prevention and mitigation methods**, such as coatings, inhibitors, cathodic protection, and material upgrades.
8. **Learn about welding and fabrication considerations** for different materials used in upstream construction and repair.
9. **Understand the principles of non-destructive testing (NDT)** methods used for material integrity assessment in operating assets.

10. **Analyze failure case studies** related to material selection in the oil and gas upstream sector to learn from past experiences.
11. **Apply risk-based approaches** to material selection and corrosion management to prioritize critical assets and mitigation strategies.
12. **Explore the impact of material selection on asset integrity management (AIM)** and overall operational safety.
13. **Keep abreast of the latest advancements in material technology** and their potential applications in the oil and gas upstream industry.

Organizational Benefits

Implementing effective material selection practices through trained personnel offers significant benefits to oil and gas organizations:

- **Reduced operational downtime:** Proper material selection minimizes equipment failures and leaks caused by corrosion or mechanical degradation, leading to less unscheduled downtime and increased production.
- **Enhanced safety performance:** Selecting materials that can withstand the harsh operating conditions reduces the risk of catastrophic failures, protecting personnel and the environment.
- **Lower maintenance costs:** Corrosion-resistant materials and effective corrosion management strategies decrease the frequency and cost of repairs and replacements.
- **Improved asset integrity:** A systematic approach to material selection contributes to the overall integrity and reliability of critical assets throughout their lifecycle.
- **Compliance with regulations:** Understanding and applying industry standards ensures adherence to safety and environmental regulations, avoiding potential penalties.
- **Optimized project economics:** Making informed material choices considering cost, performance, and longevity can lead to significant savings in capital expenditure and operational expenses.
- **Better risk management:** Proactive material selection and corrosion management help identify and mitigate potential risks associated with material degradation.
- **Knowledge retention and transfer:** Training ensures that critical knowledge about material selection and corrosion control is retained within the organization and can be effectively transferred to new personnel.

Target Audience

This training course is designed for professionals involved in the material selection and asset integrity management within the oil and gas upstream sector. The target audience includes:

1. **Materials Engineers:** Professionals directly responsible for material selection, corrosion control, and materials testing.
2. **Corrosion Engineers:** Specialists focused on understanding, preventing, and mitigating corrosion in oilfield assets.
3. **Pipeline Engineers:** Engineers involved in the design, construction, and maintenance of oil and gas pipelines.
4. **Process Engineers:** Professionals responsible for the design and operation of processing facilities, where material compatibility is crucial.
5. **Mechanical Engineers:** Engineers involved in the design and maintenance of mechanical equipment used in upstream operations.
6. **Asset Integrity Managers:** Individuals overseeing the overall integrity and reliability of oil and gas assets.

7. **Project Engineers:** Engineers responsible for the material aspects of new upstream development projects.
8. **Quality Assurance/Quality Control Personnel:** Professionals involved in ensuring the quality and integrity of materials used in the oil and gas industry.

Course Outline

This comprehensive training course is structured into eight modules to provide a thorough understanding of material selection in the oil and gas upstream sector:

Module 1: Fundamentals of Material Science for Oil and Gas

- Introduction to material science and engineering principles relevant to the oil and gas industry.
- Overview of different material types: metals (ferrous and non-ferrous), polymers, ceramics, and composites.
- Atomic structure, crystal systems, and microstructure of engineering materials.
- Mechanical properties of materials: stress, strain, elasticity, plasticity, strength, hardness, toughness, fatigue, and creep.
- Material testing methods: tensile testing, hardness testing, impact testing, and non-destructive evaluation (NDE) techniques.

Module 2: Corrosion Mechanisms in Upstream Environments

- Introduction to corrosion: electrochemical principles, thermodynamics, and kinetics of corrosion.
- Types of corrosion: uniform corrosion, pitting corrosion, crevice corrosion, galvanic corrosion, erosion corrosion, and stress corrosion cracking (SCC).
- Sweet corrosion: mechanism, influencing factors (CO2? partial pressure, temperature, flow rate), and mitigation strategies.
- Sour corrosion: mechanism, influence of H2?S partial pressure, pH, and temperature, sulfide stress cracking (SSC), and hydrogen-induced cracking (HIC).
- Microbiologically influenced corrosion (MIC): types of microorganisms, mechanisms of MIC, and prevention methods.

Module 3: Environmental Factors and Material Degradation

- Impact of temperature and pressure on material performance in upstream operations (high-pressure high-temperature environments).
- Effects of salinity, water chemistry, and produced fluids on material degradation.
- Influence of flow rates and turbulence on erosion and erosion-corrosion.
- Considerations for subsea environments: hydrostatic pressure, seawater corrosion, and biofouling.
- Atmospheric corrosion in onshore and offshore facilities.

Module 4: Material Selection Strategies and Criteria

- Methodologies for material selection: a systematic approach considering service requirements, environmental conditions, and cost.
- Key criteria for material selection: corrosion resistance, mechanical strength, weldability, availability, and cost-effectiveness.
- Lifecycle cost analysis in material selection decisions.

- Material selection for specific upstream applications: drilling equipment, well completion components, pipelines, and processing facilities.
- Case studies illustrating material selection processes for different scenarios.

Module 5: Corrosion Prevention and Mitigation Methods

- Material upgrades: selection and application of corrosion-resistant alloys (CRAs) such as stainless steels, duplex stainless steels, and nickel-based alloys.
- Coatings and linings: types of coatings (organic, inorganic, metallic), application methods, and performance evaluation.
- Chemical inhibition: types of inhibitors, mechanisms of action, application methods, and monitoring.
- Cathodic protection (CP): principles of CP, sacrificial anodes, impressed current cathodic protection (ICCP) systems, and design considerations.
- Corrosion monitoring techniques: electrochemical methods, weight loss coupons, and online monitoring systems.

Module 6: Welding and Fabrication of Oilfield Materials

- Welding processes commonly used in the oil and gas industry: SMAW, GTAW, GMAW, and SAW.
- Weldability of different materials: carbon steels, stainless steels, and CRAs.
- Welding consumables and their selection based on base material and service requirements.
- Welding procedures and qualification.
- Post-weld heat treatment (PWHT) and its importance for material integrity.

Module 7: Non-Destructive Testing and Material Integrity Assessment

- Overview of non-destructive testing (NDT) methods: visual inspection, liquid penetrant testing (LPT), magnetic particle testing (MPT), ultrasonic testing (UT), and radiographic testing (RT).
- Application of NDT methods for detecting material defects and corrosion damage.
- Interpretation of NDT results and acceptance criteria.
- Fitness-for-service (FFS) assessments for evaluating the integrity of aging assets.
- Risk-based inspection (RBI) methodologies for prioritizing inspection efforts.

Module 8: Advanced Materials and Emerging Technologies

- Applications of polymers and elastomers in upstream oil and gas: seals, gaskets, coatings, and flexible pipelines.
- Use of composite materials in offshore structures and downhole tools.
- Additive manufacturing (3D printing) for specialized components and rapid prototyping.
- Nanomaterials and their potential applications in corrosion protection and enhanced oil recovery.
- Emerging trends in material science and their relevance to the oil and gas upstream industry.

Training Methodology

This training course will employ a blended learning approach to maximize participant engagement and knowledge retention:

- **Interactive Lectures:** Engaging presentations incorporating real-world examples, case studies, and videos to illustrate key concepts.

- **Class Discussions:** Facilitated discussions to encourage participants to share their experiences and perspectives.
- **Case Study Analysis:** In-depth analysis of real-world material failure incidents and successful material selection strategies.
- **Group Exercises:** Collaborative problem-solving activities to apply learned principles to practical scenarios.
- **Practical Demonstrations:** Where feasible, demonstrations of material testing and corrosion monitoring techniques.
- **Q&A Sessions:** Dedicated time for participants to ask questions and clarify their understanding.
- **Course Materials:** Comprehensive handouts, presentations, and reference materials will be provided.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org **or call** *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price

23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

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