

## Hydrocracking and Hydrotreating Technologies: Principles, Functions, Methods, and Maintenance for Petrochemical Applications

### Course general description:

Hydrocracking and hydrotreating are critical processes in the petrochemical industry, playing a vital role in refining crude oil into high-value products such as clean fuels, lubricants, and chemical feedstocks. These technologies not only improve product quality but also address environmental regulations by reducing sulfur, nitrogen, and aromatic content. This course provides a comprehensive understanding of the principles, functions, methods, and techniques involved in hydrocracking and hydrotreating. Participants will also learn to identify operational malfunctions, troubleshoot issues, and implement effective maintenance strategies to ensure optimal performance and safety.

### Audience:

This course is designed for:

1. Process engineers and operators working in refineries and petrochemical plants.
2. Plant managers and supervisors overseeing hydrocracking and hydrotreating units.
3. Maintenance and reliability engineers responsible for equipment upkeep.
4. Graduates in chemical, petroleum, or process engineering disciplines

### Course objectives:

1. Understand the fundamental principles of hydrocracking and hydrotreating processes.
2. Learn the key functions and applications of these technologies in the petrochemical industry.
3. Master the methods and techniques used in process design, operation, and optimization.
4. Develop skills in diagnosing operational malfunctions and implementing troubleshooting strategies.
5. Gain knowledge of maintenance practices to enhance equipment reliability and longevity.
6. Explore advancements in catalysts, reactor design, and sustainability practices

### Course duration:

5 days

### Course location:

Dubai

### Course contents:

#### **Day 1: Fundamentals of Hydrocracking and Hydrotreating**

- Introduction to Hydrocracking & Hydrotreating – Overview, importance in refining, and key differences.
- Chemistry & Reaction Mechanisms – Hydrogenation, cracking, desulfurization, denitrogenation, and catalysts.
- Operating Conditions – Temperature, pressure, hydrogen-to-oil ratio, and their impact.
- Discussion & Case Study – Challenges in achieving high conversion rates and analysis of unit configurations.
- Pretest & Knowledge Assessment – Baseline knowledge evaluation through a pretest.

#### **Day 2: Process Design and Optimization**

- Reactor Design – Fixed-bed, ebullated-bed, and moving-bed reactor principles.
- Process Integration – Heat integration, energy recovery, feed preparation, and separation.
- Optimization Techniques – Yield maximization, hydrogen balance, and energy efficiency.
- Simulation & Practical Exercises – Use of Aspen HYSYS, ProMax for process modeling.
- Assessment & Review – Mass and energy balance tutorial, quiz on process design.

#### **Day 3: Operation Malfunctions and Troubleshooting**

- Common Operational Issues – Catalyst deactivation, fouling, pressure drops, and contamination.
- Troubleshooting Strategies – Root cause analysis, predictive maintenance, and digital monitoring.
- Real-Time Diagnostics – Use of advanced tools for identifying and mitigating issues.
- Case Study & Discussion – Troubleshooting a catalyst deactivation issue in a hydrotreater.
- Knowledge Evaluation – Quiz on troubleshooting techniques and best practices.

#### **Day 4: Maintenance and Reliability**

- Preventive & Predictive Maintenance – Strategies for reactors, heat exchangers, and compressors.
- Reliability Engineering – FMEA, risk-based inspection, and condition monitoring.
- Lifecycle Management – Advanced materials, coatings, and long-term equipment performance.
- Hands-On Simulation – Predicting equipment failure using software.
- Group Activity – Developing a maintenance plan for a hydrocracking reactor.

#### **Day 5: Advancements and Final Assessment**

- Innovations in Hydrocracking & Hydrotreating – New catalysts, membrane reactors, sustainability practices.
- Industry Trends & Career Opportunities – Emerging roles, continuous learning, and energy transition.
- Final Assessment – Comprehensive written test covering all course topics.
- Post-Test & Progress Analysis – Comparing pretest and post-test results.
- Course Wrap-Up & Feedback – Key takeaways, participant discussions, and certification distribution.

#### **Methodology:**

- 50% lectures & concepts
- 10% Videos
- 15% Case studies
- 15% Exercises & Quizzes.
- 10% Discussions

**Course code: (TPR0026)**