

Heat Exchanger Fouling

Consultant / Trainer

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The **Petrogenium. Heat Exchanger Fouling** course will focus on understanding how and why heat exchangers foul, how the fouling can be mitigated, how to monitor fouling and conduct predictive maintenance, and how to make cleaning decisions including the choice of cleaning methods. The cost and benefits associated with monitoring, mitigating, and cleaning will be explained so that fouling can be addressed using quantified costs and benefits. All material is based on field-proven and applied techniques.



Participants

This Petrogenium. course will benefit professionals managing the performance and reliability of shell and tube heat exchangers, including:

- Process, Maintenance, Reliability, Mechanical & Utilities Engineers
- Inspectors, Energy management teams, Operations engineers
- Technical Services & Equipment Specialists

Participants can be from a diverse spectrum of both young and experienced engineers. The training can also be structured to address specific issues faced by a particular refinery / operating unit.



Learning Objectives

Understand heat exchanger fouling mechanisms, prevention, cleaning, design, monitoring, and energy efficiency effects, enabling improved optimization and troubleshooting:

Fouling Prevention Strategies – design choices, operational adjustments, mitigation techniques

- Cleaning Technologies – High-pressure water jetting, ultrasonic cleaning, chemical cleaning
- Cleaning Validation/benefit techniques
- Optimize Energy Efficiency & Cost Savings – Impact of fouling on fuel consumption, CO₂ emissions, and plant performance
- Predictive Maintenance – How to monitor fouling in real time.
- Troubleshoot & Solve Common Fouling Challenges – Diagnose root causes, implement best practices

Programme – Day 1

Fouling Related Basics of Shell-and-Tube Design and Operation

- Shell & Tube Heat Exchanger Types – TEMA classifications, flow patterns, introduction to how heat exchangers foul
- Key Design Factors Influencing Fouling Tendencies
- Design Trade-offs Between Cost, Heat Transfer Efficiency, and Fouling
- Common Operating Conditions and Maintenance Challenges

How Heat Exchangers Foul

- What is Fouling? Definition and Root Causes
- Fouling Mechanisms: Single phase, Boiling, Condensing
- Factors critical to fouling - Velocity, temperature, surface characteristics
- Chemistry of Fouling - Deposit Analysis, How to identify the mechanism
- Impact of Fouling on Heat Transfer, Pressure Drop, and Process

Fouling Mitigation Strategies and Performance Optimization

- Heat Exchanger Design Strategies to Minimize Fouling Risk
- Operational Practices to Minimize Fouling Formation
- Retrofitting Existing Heat Exchangers to Mitigate Fouling
- Use of Anti-Fouling Coatings
- Examples of Successful Fouling Mitigation Projects
- Cost vs. Benefit Analysis – Balancing cleaning costs with energy
- Savings and performance gains

Programme – Day 2

Cleaning Techniques - Effectiveness and Optimization

- Overview of Mechanical and Chemical Cleaning Techniques
- High-Pressure Water Jetting (parameters and best practices)
- Chemical Cleaning (acid, solvent, neutralizing rinses)
- Ultrasonic Cleaning
- Cleaning Validation
- Thermal performance recovery tracking
- Cleaning Effectiveness for Different techniques
- Consequences of Incomplete Cleaning

Energy Efficiency, Emissions & Cost Impacts

- Understanding the Energy Penalty of Fouling
- Quantifying the Impact of Fouling on: Fuel Consumption/emissions
- Building the Business Case for Proactive Fouling Control and Cleaning
- Economic Payback Analysis – Cleaning costs vs energy savings
- Sample Calculation – Impact of Fouling on Energy Costs/Emissions

Monitoring and Predictive Maintenance

- Traditional Monitoring – Manual logs, inspections, spreadsheets
- Real-Time Monitoring – Using Temperature, Flow, and Pressure
- Heat Duty and Fouling Resistance Trend Analysis
- Predictive Maintenance for Heat Exchangers: Principles, Automated
- Cleaning Interval Optimization
- Introduction to Predictive Analytics Platforms
- Software – Required capabilities, brief intro to available products

Group Discussion - Case Studies, Lessons Learned

- Case Studies - Fouling Diagnosis and Root Cause Investigations,
- Application of New Cleaning Technologies, Impact of Optimized
- Cleaning Cycles on Plant Profitability and Reliability
- Lessons Learned from Major Turnaround and Cleaning Failures
- Participant Sharing of Specific Fouling & Cleaning Challenges at Their Facilities

Programme – Day 3

Resolution of Current Critical Fouling Problems

- Develop specific action plans for current critical fouling problems
- Participants will bring background information as much as possible - history, operating data, heat exchanger drawings, past analysis, process information, economic penalties of fouling, timing for problem resolution
- Using the techniques from the workshop we will develop a path forward to understand the cause of the problem, decide on the options for mitigation, and make an estimate of the benefit/cost of each potential option

Why select Petrogenium.?

The above support will be provided by principal consultants with 30+ years world-class experience in the technology and hands-on know-how from operation of refinery units.

Contact Petrogenium.:

Email: training@petrogenium.com

Website: <https://www.petrogenium.com/training/>

Because Experience Matters