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Fundamentals of Process & Mechanical Technology

9 - 20 December 2024

Amsterdam (Netherlands)

Fundamentals of Process & Mechanical Technology

course code: E6033 From: 9 - 20 December 2024 Venue: Amsterdam (Netherlands) - course Fees: 6750 Euro

The Course

Process engineering is at the heart of much of the chemical, oil, gas, and petrochemical industries. It requires familiarity not only with chemical engineering principles, but also with many of the other engineering disciplines including electrical and instrumentation, but especially mechanical.

The process engineer is interested in the transportation and transformation of solids, liquids and gases. Of specific importance are separation processes including distillation, heat transfer, hydraulics and fluid flow, reaction engineering, but also process control and economics.

The mechanical engineer is interested in safe containment and movement of solids, liquids and gases, often at high temperature and pressure. Of specific importance are failure modes such as fracture, fatigue and creep, corrosion and corrosion minimization, material properties, design standards, static & rotating equipment design, inspection and repair as well as an understanding of maintenance strategies and condition monitoring. Sound mechanical engineering principles, together with other engineering techniques including inspection, monitoring and condition evaluation, enable the mechanical engineer to design and maintain the equipment required by the process engineers.

The Structure

Module 1 - **Fundamentals of Process Technology: Upstream and Downstream Process Control & Optimisation**

Module 2 - **Fundamentals of Mechanical Technology: Compressors, Pumps, Static Equipment and Materials**

The Goals

This seminar focuses on the central areas of process engineering and mechanical engineering and guides the delegates in developing both fundamental and practical understandings of key issues and the links between the two engineering disciplines.

The course introduces the process engineering basics first, and the mechanical engineering aspects follow on.

Workshop examples will be drawn from the oil and gas processing, petrochemicals and chemical manufacturing industries and their related equipment.

The Process

In addition to formal lectures and discussions, the delegates will learn by active participation through the use of problem-solving exercises, group discussions, analysis of real-life case studies, and industry best practices.

The Benefits

Upon completion of this workshop, the delegates will develop both fundamental and practical understanding of central issues in processes used in oil, gas, petrochemical, chemical, and allied facilities together with a practical understanding of central issues in mechanical engineering as applied in those industries.

The Results

The seminar provides a practical introduction to the fundamentals of both process and mechanical engineering thereby developing mutual understanding, perspective and focus from a company viewpoint.

The Core Competencies

Key competencies include practical understanding of essential process units and classes of units involved in separations, heat exchange, and reactions as well as hydraulics and fluid flow. Delegates will be able to perform relevant calculations and analyses to assist in operation, sizing, and troubleshooting of processes and process equipment.

Delegates will also enhance their competencies in the areas of:

- Mechanical design of pressure equipment and piping systems in compliance with applicable codes, standards, and regulations
- Engineering materials properties and selection criteria for specific applications
- Identification and assessment of active degradation mechanisms and the failures they may cause
- An understanding of the various static and rotating equipment used in the petrochemical environment
- Application of maintenance strategies and philosophies
- Condition monitoring, inspections and assessments

The Programme Content

Module 1:

Fundamentals of Process Technology: Upstream and Downstream Process Control & Optimisation

Introduction and Fundamentals of Process Engineering

- Process engineering basics
    - Mass and energy balances
    - Batch and continuous processes
    - Reactor types
    - Process equipment and flow diagrams
    - P&IDs
- Flammability
- Electrical area classification
- Risk Management and Hazard Studies

- Hydraulics and Fluid flow
    - Pressure and head

    - Bernoulli's theorem and its field applications
    - Flow of liquids
    - Reynolds number and pressure drop in pipes
    - Two-phase and multi-phase flow
- Enthalpy and thermodynamics
- Principle of process relief devices and process design of relief systems
- Principles of pressure vessel and piping design
- Pumps
- Compressors
- Mixers
- Mechanical Equipment - Types and application guidelines

Heat Transfer and Reaction Engineering

- Heat Transfer
    - Thermal conductivity
    - Conduction and convection
    - Insulation
    - Heat transfer coefficients and calculation
    - Heat exchangers, type and sizing
    - Steam reboilers
    - Condensers and sub-cooling
    - Introduction to energy recovery
- Catalysis and Reaction Engineering
- Chemical reactions
- Reaction kinetics
- Introduction catalysis
- Green Chemistry and Engineering
- Reactor Design and Operation

Distillation Processes and Equipment

- Distillation basics
    - Phase behavior and vapor/liquid equilibria
    - Gas/Liquid separation
- Distillation equipment - Columns and vessels
- Columns and vessels - Sizing and selection guidelines
- Column and vessel internals - Types and selection guidelines
- Troubleshooting of process equipment
- Reactor Design and Operation

Separation Processes and Equipment

- Overview of Other Separation Processes
    - Absorption and adsorption
    - Amine sweetening
    - Solid Liquid separation
    - Effluent treatment [in refinery and petrochemical] industries

Process Control and Economics

- Process Control Basics
    - Classification of control systems

    - Measured variables
    - Simple feedback control
- Process Economics
- Preliminary economic analysis
- Fixed and variable costs, break even analysis
- Calculating raw materials usage
- Estimating the cost of process equipment and plants

Module 2:

Fundamentals of Mechanical Technology: Compressors, Pumps, Static Equipment and Materials

Introduction & Fundamentals

- Engineering Material Properties
    - Stress and Strain
    - Fracture failure, Modes, Stress concentration, Fracture toughness
    - Fatigue failure, testing and mechanism
    - Temperature Considerations and Creep Failure
    - Identification of Damage Mechanisms
- Mechanical Design
- ASME & API
- Codes & Standards
- Design for static strength

Materials Selection and Inspection

- Materials Selection
    - Materials of Construction
    - Carbon Steels
    - Alloy Steels
    - Stainless Steels
    - Nickel Based and Titanium Alloys
- Inspection techniques
- Visual
- Penetrant
- Magnetic Flux
- Eddy Current Inspections
- X-Ray & Gamma ray
- Ultrasonics – TOFD & Pulse-Echo

Valves, Piping & Fitness for Service

- Valves
    - Valve Types
    - Valve Characteristics
    - Valve Applications
    - Valve Selection
    - Valve Actuators
- Piping & Pipelines
- ASME B31
- Pipe Types, construction and Schedules

- Steel Pipes
- Welded Types and Sections
- Flanges and Gaskets
- Plastic Pipes, Composite Pipes
- Pipe Coatings and Linings
- Pipe Supports and insulation blocks
- Stress relief in Piping Design
- Pigging
- Water hammer
- Overview of API 570 - Inspection & repair of Pipelines & Piping
- API 579 overview
- Fitness for Service

Corrosion

- Corrosion Fundamentals
- Types of Corrosion
- Corrosion Inspection and Monitoring
- Corrosion Minimization
- Coatings
- Inhibitors
- Cathodic Protection

Compressors

- Types of Compressors – Reciprocating, Centrifugal and Screw
- Blading and Staging
- Performance Curves
- Compressed Air Usage and instruments
- Glands and Mechanical Seals

Mechanical Maintenance

- Strategies & Philosophies
    - Maintenance system optimisation
    - Maintenance Management Systems
- Condition Monitoring
- Vibration Analysis
- Shaft Alignment
- Practical Examples