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Heat Exchangers: Types and Application, Design, Operation and Maintenance

19 August - 6 Septembe

Rome (Italy)

Heat Exchangers: Types and Application, Design, Operation and Maintenance

course code: E6040 From: 19 August - 6 September 2024 Venue: Rome (Italy) - course Fees: 6750 Euro

The Course

Heat exchangers are important and expensive items of equipment that are used in a wide variety of industries. A better understanding of the basic principles of heat transfer and fluid flow and their application to the design and operation of shell and tube heat exchangers as well as plate heat exchangers, air cooled exchangers and other specialty heat exchangers that you gain from this course will enable you to improve their effectiveness and extend their life.

The course provides in depth presentation of the main types of industrial heat exchangers, their key features and aspects, and provides practical guidelines for selecting the appropriate type for specific applications.

You will better understand how to use the applicable API, TEMA and ASME codes, standards and recommended practices. Discussions cover fabrication, materials of construction and costs of tubular units; condensers and reboilers; effect and mitigation of fouling; and causes and prevention of exchanger tubes vibration and damage.

The workshops include practical worked examples to reinforce the key learning.

The Goals

The objectives of the course are:

- To highlight the pivotal function and significance of heat exchangers in cost-effective plant operations
- To provide a clear understanding of the fundamentals of heat transfer and hydraulics and fluid flow and their application in the thermal design of heat exchangers.
- To provide methodologies for the mechanical design of heat exchangers in accordance with industry codes, standards and best practices, specifically ASME BPVC Section VIII, TEMA, and API 660, 661, and 662.
- To make delegates aware of cost-effective technologies and best practices for improving performance of heat exchangers

The Process

The course is comprehensive and highly interactive. It combines structured and focused presentations and discussions of topics covered with actual relevant examples. It combines sound engineering principles, methods, and applicable codes & standards and best industry practices with workshops that cover worked examples to enforce the learning. To maximize learning, optional Question & Answer sessions are available at the end of each day to avail participants the opportunity to ask questions relating to topics discussed and specific heat exchanger problems they may experience.

All delegates will receive a complete set of all course presentations as well as detailed lecture notes

which will provide an invaluable reference document.

The Results

The company will achieve improved financial performance through the proper selection and application of the appropriate type of heat exchangers that achieve optimum balance between capital investment and energy costs.

The company will be able to achieve measurable improvement in energy efficiency through effective interaction between engineering, operation and maintenance functions throughout the life cycle of heat exchange equipment.

The company will be able to enhance its ability to use best industry practices in inspection, maintenance, and repairs resulting in lower life cycle costs while complying with applicable codes and standards, and other regulatory requirements.

The Core Competencies

Participants will enhance their competencies in the following areas:

- Gain essential and integrated knowledge about the hydraulic, thermal and mechanical design of heat exchangers
- Understand, predict and identify causes of performance degradation and damage mechanisms that affect heat exchangers fitness for continued service and thereby reduce the risk of potential failures and waste of energy
- Awareness of best industry practices in debottlenecking and improving performance of heat exchangers
- Enhance competence and productivity thereby enhancing their competence and performance level and making additional value added contributions to their organizations

The Programme Content

Types and Application of Heat Exchangers

- Overview and basic fundamentals
    - Significance of heat exchange in the petroleum, petrochemical, and process industries
- Heat Transfer Fundamentals and Heat Transfer Coefficients
- Heat Exchanger types and application
- Shell and Tube heat exchangers
- Compact heat exchangers
    - Plate heat exchangers
    - Printed circuit heat exchangers
    - Heat pipes
- Air-cooled heat exchangers
- Regenerative heat exchangers
- Geometry of Shell & Tube Heat Exchangers (STHE) and Double Pipes - TEMA nomenclature, front end head types, shell types, rear end types, double pipe units, selection guidelines
- **Workshop 1:** Worked examples – heat transfer

Thermal and Hydraulic Design of Heat Exchangers

- Sizing and Specifying the heat exchanger

- Temperature Difference In STHE
    - Countercurrent, co-current, and cross-current
    - TEMA flow arrangements, comparisons
    - worked example
        - Velocity Triangles and Performance Derivation from First Principles
        - Pump performance curves: head-capacity, power, efficiency
        - System curve: static, friction, pressure head components
- Fluid Flow and Pressure Drop
- Shell & Tube heat exchangers
- Plate heat exchangers
- Types and application
- General design considerations
- Condensers and Reboilers
- **Workshop 2:**Worked examples: Thermal design and rating shell & tube heat exchangers

Mechanical Design of Heat Exchangers

- Design and construction codes and best practices
    - ASME B&PVC Section VIII
    - API 660, 661, and 662
    - TEMA
- Basic design of heat exchangers - S&THE, PHE, ACHE
- Special design considerations
- Piping loads on exchanger nozzles
- Impact of service conditions on material selection
- Shell & tube heat exchangers
- Plate heat exchangers
- Materials of construction for heat exchangers
- Fabrication of heat exchangers
- **Workshop 3:** Worked examples: Mechanical design of STHE

Operation and Maintenance of Heat Exchangers

- Fouling In Heat Exchangers
    - Types and mechanisms, economic impact on design and operation
    - Fouling mitigation by design
    - Fouling mitigation by operation and maintenance
- Corrosion and erosion in heat exchangers
- Heat Exchanger Inspection Methods
- Operation and Troubleshooting
- Performance monitoring and Testing
- Flow-induced vibration, mechanisms, vibration prediction, damage numbers, design procedure to avoid vibration including baffle selection, rod baffle exchangers, twisted tube exchangers
- Cleaning strategies and methods: S&THE, PHE, ACHE
- Heat Exchanger Repairs
- Removal and Replacement of Heat Exchangers
- Cost-effective maintenance and repair of heat exchangers

Performance Enhancement and Optimization of Heat Exchangers

- Heat transfer augmentation techniques
    - Finned tubes

    - In-tube Enhancement - Tube inserts, sintered coatings
- Tube Bundle Replacement - Alternative enhanced tube bundle designs
- rodbaffle
- heli baffle
- twisted tube
- Pinch technology
- heat exchanger train optimization
- Heat Integration Basics
- **Workshop 4:** Illustrative example: Heat exchanger network optimization