



MU024: Heat Exchanger Design, Operation, Performance, Inspection, Maintenance & Repair

Training Description:

The design, performance and operation of modern heat exchangers require an understanding of the principles of heat transfer and fluid flow, coupled with access to numerically based techniques and supporting data.

This intensive training course will review heat transfer fundamentals as applied to tubular and plate devices. Included will be sessions on the practical aspects of shell and tube heat exchanger design with ASME and TEMA codes.

Upon completion of this course, participants will gain an understanding of the basic principles of heat transfer and fluid flow and their application to the design, operation and maintenance of shell and tube heat exchangers as well as compact and air-cooled heat exchangers.

Participants will gain an understanding of TEMA and ASME codes and learn how to numerically analyze the different heat exchanger configurations. Attention will be paid to the recognition and solving of a wide variety of industrial problems, taking existing case studies.

The course will also address the ways in which systematic techniques of inspection and maintenance (including Fouling Control) can alleviate major problem areas. Further, the course will explain the energy balance in heat exchangers and discuss the new technologies of heat transfer and heat exchanger within the industry.

There will be troubleshooting workshops devoted to the discussion of regularly occurring heat exchanger problems, performance assessment and methods to improve the overall thermal efficiencies of these devices. The course will also cover current methods of inspection and maintenance.

Training Objectives:

By the end of the training, participants will be able to:

- ✓ Design, operate, inspect, maintain and repair heat exchangers and analyse their performance in a professional manner
- ✓ Employ the concepts of heat transfer coefficients and determine their overall effect on heat exchanger fouling
- ✓ Differentiate between the various types of heat exchangers and learn more of their industrial features and other relevant information
- ✓ Discuss the industrial features and other information that explain distributed types in relation to power cycles, distillation, recuperators and regenerators
- ✓ Carryout heat exchanger analysis for counter flow, cross flow and multipass heat exchangers and to apply the well-known correction factors
- ✓ Conduct a heat energy balance for different types of counter flow heat exchangers
- ✓ Practice the process of heat exchanger selection for a given application and its costing in line with the advantages and disadvantages of its types and scopes of its applications
- ✓ Determine the cooling performance of a range of heat exchangers, including an automotive/industrial compact radiator

- ✓ Establish insights on the effectiveness/NTU method for heat exchanger analysis in terms of capacity ratios
- ✓ Interpret TEMA standards and terminologies for present-day shell and tube heat exchangers
- ✓ Enhance comprehension of the practices and principles of heat exchanger maintenance and inspection techniques with its common inspection tools and codes

Training Designed for:

This course is intended for Project Engineers, Process Engineers, Plant and Maintenance Engineers and Supervisors to gain an excellent numerical problem-solving skills in the practical approach of the course. The course is also useful to those generally knowledgeable on the subject, but who may require a refresher or update. No prior knowledge of heat transfer is required. Participants will be taken through an intensive primer of heat transfer principles as they apply to shell and tube heat exchangers.

Training Requirement:

“Hand’s on practical sessions, equipment and software will be applied during the course if required and as per the client’s request.”

Contents can be adapted to your specific wishes. It is therefore possible to focus on specific modules of the training course as per client’s learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

Training Program:

DAY ONE:

- ❖ PRE-TEST
- ❖ Introduction and Definition of Heat Transfer Coefficients
 - Conduction, Convection, Overall Heat Transfer, Logarithmic Temperature Differences, Correction Factors, Fouling, Effectiveness
- ❖ Types of Heat Exchangers
 - Double-Pipe, Parallel-Flow and Counter-Flow, Compact, Shell and Tube, Plate and Frame, Regenerative, Condensers, Boilers, Space Radiators, Addition of Fins
- ❖ Worked Examples
 - Calculation of Overall Heat Transfer Coefficient for a Heat Exchanger, Effect of Fouling on the Overall Heat Transfer Coefficient, Introduction to Condensation of Steam in a Condenser
- ❖ Industrial Features and Additional Information
 - Industrial Distribution of Different Types, Condensation, Evaporation, Heat Recovery, Heat Rejection, Power Cycles, Distillation, Recuperators, Regenerators

DAY TWO:

- ❖ Heat Exchanger Analysis in Detail
 - Logarithmic Mean Temperature Difference Method, Effectiveness-NTU Method
- ❖ Counter Flow, Cross Flow and Multipass Heat Exchangers
 - Application of Correction Factors, Worked Example
- ❖ Heat Exchanger Energy Balance

- Pre-heat Calculation, Energy Moduling
- ❖ **Counter Flow Heat Exchanger**
 - Worked Example for Double-Pipe Arrangement
- ❖ **Heat Exchanger Selection for a Given Process**
 - Course and Fine Filters, General Points on Material Selection and Pressures, Thermal Effectiveness, Advantages and Disadvantages of Double-Pipe Arrangements and Scope of Application, Common Materials Used, Shell and Tube Heat Exchangers, Plate and Frame, Heat Exchangers, Advantages and Disadvantages of these Types and Scopes of Application

DAY THREE:

- ❖ **Heat Exchanger Selection for a Given Process (cont'd)**
 - Air-Cooled Heat Exchangers, Plate-fin heat Exchangers, Printed Circuit Heat Exchangers, Advantages and Disadvantages of these Types and Scopes of Application
- ❖ **Heat Exchanger Costing**
 - Scoping, Quick-sizing, Correction Factors, Estimation of the Overall Heat Transfer Coefficient, Estimating Cost, ESDU Data, Logarithmic, Interpolation, Worked Example
- ❖ **Multipass Heat Exchanger**
 - Worked Examples in Determining Heat Transfer Rate With and Without Effects of Fouling
- ❖ **Problem Session**
 - Numerical Exercise on Multipass Heat Exchangers
- ❖ **Cooling of an Automotive/Industrial Compact Radiator**
 - Determination of Overall Heat Transfer Coefficient

DAY FOUR:

- ❖ **Effectiveness/NTU Method for Heat Exchanger Analysis**
 - Heat Transfer Effectiveness, Capacity Ratios, Worked Examples
- ❖ **Upper Limit of Heat Transfer in a Heat Exchanger**
 - Counter Flow Heat Exchanger, Effectiveness as a Function of NTU, Worked Examples
- ❖ **Shell and Tube Heat Exchangers**
 - Heat Exchanger Inspection, Scope, Construction, TEMA Standards and Terminologies, Fluid Allocation, Design Problems, Design Enhancement, Examples
- ❖ **Heat Exchanger Maintenance**
 - Planning, Precautions Required, Plugging, Ferruling, Sleeving, Shell, Side Repairs, Retubing
- ❖ **Fouling Control of Heat Exchanger**
- ❖ **Simulator (Hands-on Practical Sessions)**
 - Practical sessions will be organized during the course for participants to practice the theory learnt. Participants will be provided with an opportunity to carry out various exercises using the simulator "Heat Exchanger Tube Layout"

DAY FIVE:

- ❖ **Heat Exchanger Inspection Techniques**
 - Visual, NDT, Common Failures, Inspection Tool, Inspection Codes
- ❖ **Design of Shell and Tube Heat Exchangers**
 - Achievement of Duty Required, Developing Design Envelope, Choosing the Best Design, Pressure Drop and Tube Vibration Issues

- ❖ **Worked Example on a Multipass Heat Exchanger**
 - Determination of Heat Transfer and Outlet Stream Temperatures
- ❖ **New Technology in Heat Exchanger**
- ❖ Course Conclusion
- ❖ POST-ASSESSMENT and EVALUATION

Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Gamification, Software & General Discussions
- Pre and Post Test

Training Certificate(s):

CMCT Internationally recognized certificate(s) will be issued to each participant who completed the course.

Training Fees:

TBA as per the course location - This rate includes participant's manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01st of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

Training Timings:

Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:00	Recess (Prayer Break & Lunch)
13:00 - 14:00	Last Session

For training registrations or in-house enquiries, please contact:

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