



Heat Transfer: Augmentation Techniques in
the Process Industry



Heat Transfer: Augmentation Techniques in the Process Industry

Introduction:

Progress in the development of high-performance thermal systems has stimulated interest in methods to improve heat transfer, popularly called "heat transfer augmentation". It has become second generation heat transfer technology. New techniques are primarily employed in a variety of thermal apparatuses encountered in the process and chemical industries, including oil refineries and gas production plants as well as in power generation plants thermal, nuclear, solar, geothermal, ocean thermal, etc..

This course describes the most important and practical issues related to the optimum selection of various types of augmentation techniques employed for heat exchangers working with single-phase fluids heaters or coolers or with phase change fluids evaporators, reboilers, condensers, etc. The course will briefly survey the basics of fluid flow and heat transfer in thermal apparatuses and continue with a detailed explanation of the most efficient passive extended surfaces, fins, swirl flow devices, etc. and active techniques surface and fluid vibration, etc. for single-phase flow as well as for fluids with phase-change two-phase flows. Performance evaluation criteria PEC related to these techniques, as well as technical and economical issues, such as manufacturing costs, problems in operation, maintenance issues, and others, will be covered

Course Objectives:

At the end of this course the participants will be able to:

- Understand the heat transfer processes and fluid flow in thermal equipment to apply suitable heat augmentation techniques
- Learn how to be familiar with principles of thermal design of heat exchangers
- Select the optimal heat transfer augmentation techniques for a given industrial application
- Gain skill in estimating the degree of deterioration and inefficiency of heat exchangers and the ways to improve it by heat augmentation method
- Understand how to analyze problems in everyday operation and how to combine heat exchanger alteration technique with heat transfer augmentation

Targeted Audience:

- Supervisors and Operators
- Process Plant Shift Leaders
- Environmental and Safety Technicians
- Mechanical Technicians
- Maintenance Engineers

Course Outlines:

Unit 1: Overview of Heat Transfer Equipment in the Process Industry:

- Thermal Efficiency of Heat Transfer equipment
- Performance Indicators
- Analysis of Costs: Operating and Maintenance costs
- Need for Heat Transfer Augmentation

- Classification of Augmentation Techniques
- Performance Evaluation Criteria PEC

Unit 2: Basics of Heat Transfer and Fluid Flow Mechanisms in Thermal Equipment:

- Conduction Heat Transfer - Concept of Thermal Resistance
- Basics of Fluid Flow in various Geometries
- Pressure drop calculation and selection of Pumps and Compressors
- Convection Heat Transfer
- Heat transfer with phase change: Boiling and Condensation
- Solutions to various Heat Transfer problems

Unit 3: Augmentation Techniques for Single Phase Fluid Flow:

- Most Efficient Passive Techniques
- Extended Surfaces and Fins
- Swirl Flow Devices and Fluid Additives
- Most Efficient Active Techniques
- Stirring devices and Rotating surfaces
- Surface and Fluid Vibration
- Applications of Finned Surfaces in Forced Convection

Unit 4: Augmentation Techniques for Fluids with Phase Change:

- Most Efficient Passive Techniques
- Treated and Rough Surfaces
- Extended Surfaces and Displaced Enhanced Devices
- Swirl Flow Devices and Fluid Additives
- Most Efficient Active Techniques
- Surface and Fluid Vibration
- Electromagnetic Field
- Solutions to problems of Boiling and Condensation

Unit 5: Technical and Economical Issues:

- Application of Compound Augmentation
- Cost-benefit Analysis: Manufacturing Costs vs. Benefits of Augmentation Techniques
- Problems in Operation
- Maintenance Issues
- Future Trends