



Heat Transfer: Augmentation
Techniques in the Process Industry



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Introduction

Progress in the development of high-performance thermal systems has stimulated interest in methods to improve heat transfer, popularly called heat transfer augmentation. This advanced heat transfer enhancement techniques course has become a pivotal focus within advanced heat transfer. New techniques are primarily employed in a variety of thermal apparatuses encountered in the process industry, including oil refineries, gas production plants, and various power generation plants such as thermal, nuclear, solar, geothermal, and ocean thermal.

This heat transfer training course provides a comprehensive heat transfer course description of the most critical and practical issues related to the optimum selection of various types of heat transfer augmentation techniques for heat exchangers working with single-phase fluids or with phase change fluids.

The advanced heat transfer enhancement techniques course will briefly survey the basics of fluid flow and heat transfer in thermal apparatuses, proceed with a detailed explanation of the most efficient passive and active heat transfer enhancement techniques for single-phase flow, and cover those for fluids with phase change two-phase flows. Performance evaluation criteria PEC and technical and economic issues, including manufacturing costs, problems in operation, and maintenance issues, among others, will also be thoroughly examined.

Active Heat Transfer Enhancement Techniques

Active heat transfer enhancement techniques play a crucial role in augmenting the performance of heat transfer equipment. In this advanced heat transfer enhancement techniques course, participants will delve into a range of dynamic methods that can significantly boost the efficiency of thermal systems.

Techniques such as stirring devices, rotating surfaces, and the use of electromagnetic fields will be expounded, providing attendees with the knowledge to identify and apply these active techniques in industrial heat transfer machines effectively. Understanding these active methods is part of mastering the process of heat transfer and leveraging cutting-edge technology to improve heat transfer processes in the industry.

Targeted Groups

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

Course Objectives

By the end of this advanced heat transfer enhancement techniques course, participants will be able to:

- Understand the heat transfer processes and fluid flow in thermal equipment to apply suitable heat transfer techniques.
- Gain familiarity with the principles of thermal design of heat exchangers.
- Select the optimal heat transfer enhancement techniques for a given industrial heat transfer application.
- Estimate the degree of deterioration and inefficiency in heat exchangers and learn how to improve it through heat augmentation methods.
- Analyze problems in everyday operation and combine heat exchanger alteration techniques with heat transfer augmentation.

Targeted Competencies

At the end of this advanced heat transfer enhancement techniques course, the participants will be able to:

- Understand the basics of selecting the most appropriate heat transfer augmentation technique for the given application.
- Learn about guidance for performance evaluation criteria, which are the basis for selection.
- Practical, real-life examples where finned tubes and tube inserts require careful operation and maintenance.
- Understand the interplay of various influencing design parameters and how compound augmentation works.
- Know about economic issues, including cost-benefit analysis.

Course Content

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

- Learn about the Thermal efficiency of heat transfer equipment.
- Performance Indicators.
- Analysis of Costs: Operating and Maintenance.
- Understand the need for heat transfer augmentation.
- Learn about the classification of heat transfer enhancement techniques.
- Performance Evaluation Criteria PEC.

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

- What is conduction heat transfer and the concept of Thermal resistance?
- Learn about the basics of fluid flow in various geometries.
- Understand pressure drop calculation and selection of pumps and compressors.
- Convection heat transfer.
- Heat transfer with phase change: Boiling and condensation.
- Learn about solutions to various heat transfer problems.

Unit 3: Augmentation Techniques for Single-Phase Fluid Flow

- Most efficient passive techniques.
- Extend surfaces and fins.
- Learn about swirl flow devices and fluid additives.
- Most efficient active techniques: Stirring devices and rotating surfaces.
- Surface and fluid vibration.
- Apply finned surfaces in forced convection.

Unit 4: Augmentation Techniques for Fluids with Phase Change

- Most efficient passive techniques: Treated and rough surfaces.
- Extend surfaces and displaced enhanced devices.
- Learn about swirl flow devices and fluid additives.
- Understand the most efficient active techniques: Surface and fluid vibration.
- Electromagnetic field.
- Understand solutions to problems of boiling and condensation.

Unit 5: Technical and Economic Issues

- Application of compound augmentation.
- Cost-benefit analysis: Manufacturing costs vs. benefits of augmentation techniques.
- Problems in operation.
- Maintenance issues.
- Future trends.