

<p style="text-align: center;">KLM Technology Group</p> <p style="text-align: center;">Practical Engineering Guidelines for Processing Plant Solutions</p>	<div style="text-align: center;"><p>Engineering Solutions Consulting, Guidelines, and Training</p><p>www.klmtechgroup.com</p></div>	<p style="text-align: center;">Page 1 of 9</p> <p style="text-align: center;">Rev 1.0</p>
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Advanced Distillation Operation, Control, and Troubleshooting Training Course

Introduction

The success of every company depends on each employee's understanding of the key business components. Employee training and development will unlock the companies' profitability and reliability. When people, processes, and technology work together as a team developing practical solutions, companies can maximize profitability and assets in a sustainable manner. Training and development are an investment in future success - give yourself and your employees the keys to success.

It is strategically important that your operations group understands the fundamentals of process tank design, operations and troubleshooting concepts. This is the difference between being in the best quartile of operational ability and being in the last quartile. There is vast difference in the operational ability of operating companies and most benchmarking studies have confirmed this gap in operational abilities.

Whether you have a team of new or seasoned employees, an introduction or review of these concepts is greatly beneficial in closing the gap if you are not in the best quartile or maintaining a leadership position. Most studies show that a continuous reinforcement of best practices in operational principles is the most effective way to obtain the desired results. Training and learning should be an ongoing continuous lifelong goal.

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Course Objective

Distillation is the most common separation technique and is energy intensive. Distillation can consume more than 50% of a process plant's operating energy cost. A way to improve an existing plant's operating cost or to reduce a new distillation system's operating cost is to improve the efficiency and operations by correct equipment selection, process optimization and control.

This course will guide the participants to develop key concepts and techniques to operate and troubleshoot a distillation system. These key concepts can be utilized to make design and operating decisions. Training and development are an investment in future success - give yourself and your employees the keys to success.

Product recoveries, purities and energy utilization can be improved in most distillation systems. This cannot be achieved without first an understanding of distillation principles and design. These principles need to be understood in advance of designing, operating, and troubleshooting a distillation column for the operator, designer, or problem solving to be effective.

Course Duration and Delivery

Typical course duration is 3 to 5 days based on the background of the participants. One of our Senior Technical Professional with over 25 years of experience would lead the class. Instruction can be in house or in an online seminar.

This course is an advanced course for these topics – for a more introductory course consider attending our introduction course.

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Typical Course Outline

A. Introduction

- Introduction to the Processing Industry
- Safety for the Processing Industry

B. General Column Design

- The components of a distillation system, more than just a tower – it is a system of different components
- History of distillation
- Different types of distillation columns
- Differences among batch, flash, and multistage distillation process
- Relative advantages of tray and packed columns
- Steps in the process design

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C. Column Design and Operation

1. Tray Column Design and Operation

- The major design differences between tray types
 1. Baffle Trays
 2. Bubble Cap Trays
 3. Sieve Deck Trays
 4. Valve Trays
 5. Downcomer Types
 6. Feed Nozzles on trays
- The operational limits for trays – operating window
- Tray Hydraulics

2. Packed Column Design and Operation

- The different types of packing and their characteristics
 1. Grids
 2. Random Packing
 3. Structured Packing
- The best type of packing for a given system
- Packing Hydraulics

3. Optimizing Columns for improved operation and maintenance

4. Conducting a High Load Test

5. Operating columns in fouling service

6. Operating columns in vacuum service

7. Operating columns in quench service

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8. Separation Concepts

- Material balance of the column
- Separation quality and concept of fractionation capability
- Column pressure: pressure control and pressure profile along the column
- Heat balance. Reflux and reboiling ratio and selectivity assessment
- Internal flow rates profiles, concentration, and temperature profiles. Concentration peaks.

9. Simulation Software Review

D. Thermodynamics and Equilibrium

1. Vapor Liquid Equilibrium

- Select the correct vapor-liquid equilibrium equation for your system
- Review vapor pressure and equilibrium diagrams
- Interpret mole fraction equilibrium curves, commonly called y-x diagrams
- Azeotropes and the challenges they create for distillation

2. Stages & Transfer Units Efficiencies

- Calculate the number of equilibrium stages using short cut methods
- Calculate minimum reflux and stages using graphical & analytical methods
- Determine number of theoretical stages needed in a distillation column

3. Stage Efficiency

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- Methods for determining efficiency
- Calculate an overall column efficiency for tray columns
- Calculate point and tray efficiencies, and their difference
- Calculate the number and height of transfer units for packing
- Effects on distillation column by changing amount of reflux and reflux temperature
- How flooding and foaming affects efficiencies and capacities

E. Process Control

1. Distillation Column Control
 - Functions of Process Control
 - Characteristics of a Continuous Process
 - Select appropriate composition and column pressure control schemes
 - Process settings during column operation
2. Typical controlled and manipulated process variables
 - Level
 - Pressure
 - Composition
 - Temperature
 - Flow
3. Controller Performance Criteria
4. Feed Forward Control of an Ideal Process
 - Feedback and Feed forward Control Loops
5. Process Control to Manage Risk

- Safety Integrity Levels

F Commissioning

1. Tower Pre Commissioning Guidelines
2. Tower Start Up Guidelines
 - Common startup problems and understand how to correct them
3. Tower Shut Down Guidelines

H. Troubleshooting

1. Introduction
 - Evaluate operation of a packed column
 - Evaluate operation of a tray column
 - Use tools to diagnosis problems
2. Installation
 - Common column installation mistakes
 - List tasks to insure a proper installation
 - Installation Case Study
3. Case Studies
 - Vacuum Tower Scan Case Study

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Who Should Attend?

- People who are making day to day decisions regarding operation, design, maintenance, and economics of process industry plants.
 1. 1st Line Operations personnel,
 2. Operation Supervisors,
 3. 1st Line Maintenance personnel,
 4. Maintenance Supervisors,
 5. Senior Plant Supervisors,
 6. Operations Engineers
 7. Process Support Engineers,
 8. Design Engineers,
 9. Cost Engineers
- Engineer, chemist, or operations personnel who must troubleshoot and solve distillation problems in a plant, an engineering office or laboratory.
- Plant Operation Support Engineers / Operations Staff checking plant performance under different operating conditions, and who are involved in design of new facilities or revamps of existing facilities.
- Ideal for veterans and those with only a few years of experience who want to review or broaden their understanding of process safety.
- Other professionals who desire a better understanding of the subject matter.

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What You Can Expect to Gain.

- The operation, control and trouble shooting of a distillation column and its associated equipment,
- An overview of distillation, practical solutions as well as theory
- An understating of essential distillation concepts,
- Valuable practical insights for trouble free design and field proven techniques for commissioning, start up and shutdown of distillation operation.
- The fundamental knowledge of distillation control.
- To tailor your approach to specific design, analysis and troubleshooting problems.