

<p><b>KLM Technology Group</b></p> <p>Practical Engineering Guidelines for Processing Plant Solutions</p>	<table border="1"><tr><td><b>KLM</b></td><td><b>Technology Group</b></td></tr></table> <p><b>Engineering Solutions Consulting, Guidelines, and Training</b></p> <p><a href="http://www.klmtechgroup.com">www.klmtechgroup.com</a></p>	<b>KLM</b>	<b>Technology Group</b>	<p>Page 1 of 9</p> <p>Rev 1.0</p>
<b>KLM</b>	<b>Technology Group</b>			

## **Advanced Unit Operations Fundamentals and Troubleshooting Training Course**

### **Introduction**

The success of every company depends of 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 team understands the fundamentals of unit operations. This is the difference between being in the best quartile of operational excellence 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 are 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 safety 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

Today's processing plants are under increasing pressure to increase safety, reliability, reduce costs and improve profits. Engineers and production professionals need practical training to assist their companies to accomplish these goals. Generally, universities teach fundamental concepts, and then the professional will need to learn to apply these concepts to their field.

This training course will use practical technical know-how to guide participants in these key concepts with Case Studies. These key concepts may be utilized right away in their operations to increase profits. Our Senior Technical Professional will share his 25+ years of engineering experience with the students to show them how to optimize the unit operations at their facility. Many time process improvements require only small amount of capital with exceptionally large return on investment (ROI)

### Key Unit Operations

Mass Transfer (Separation)  
Momentum Transfer (Fluid Flow)  
Heat Transfer  
Reaction

## 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 webinar.

This course is an advanced course for these topics – for an introductory course consider attending our Introduction to Unit Operations Course.

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## Course Syllabus

**Introduction to the Processing Industry**

**Safety for the Processing Industry**

**Mass Transfer**

**Distillation**

1. Introduction to distillation
2. Liquid level basics
3. Trays
  - A. Tray efficiency review
  - B. Downcomers
  - C. Seal trays, special trays, etc.
  - D. Feed trays
4. Random and Structured Packing
  - A. Distributors
5. When to utilize trays and packing
6. Reboiler return piping configurations
7. Gamma scans/studies
8. Design Guidelines for Fouling Services
9. Design Guidelines for Vacuum Distillation
10. Design Guidelines for Extractive Distillation
11. Design Guidelines for Quench Towers

**Troubleshooting Distillation**

1. Troubleshooting Techniques
2. Drawings vs. field measurements
3. Instruments and their limitations
4. Design sensitivity
5. Distillation Case Study
6. Vacuum Tower Case Study

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### **Momentum Transfer - Fluid Dynamics Fundamentals**

1. Review of the fluid flow basics
  - A. Laminar and Turbulent Flow
  - B. Reynolds Number
  - C. Two Phase Flow
  - D. Liquid Hammer
  - E. Friction
2. Guidelines for Velocity and Pressure Drop
3. Review of Pipe Specifications
4. Fluid Flow Measurement

### **Fluid Dynamics Troubleshooting**

1. Fluid Dynamics Troubleshooting and Case Study

### **Pump Fundamentals**

1. Introduction to Pumps
2. Pump Efficiencies
3. Positive displacement pumps
4. Centrifugal pumps
  - A. Pump impellers
  - B. Suction specific speed,  $N_{ss}$
  - C. pump curve considerations
  - D. Hydraulic requirements
  - E. NPSH
  - F. Cavitation

### **Pump Troubleshooting**

1. Pump Troubleshooting and Case Study

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### **Compressor Fundamentals**

1. Introduction to Compressors
2. Positive displacement compressors
3. Centrifugal compressors
4. Surge and Stonewall
5. Operating Point
6. Compressor Efficiencies

### **Compressor Troubleshooting**

1. Compressor Troubleshooting and Case Study

### **Heat Transfer Fundamentals**

#### Introduction to Heat Transfer

1. Radiation
2. Conduction
3. Convection

### **Furnaces and Boilers**

#### Introduction to Furnaces and Boilers

1. Fire Box
2. Convection
3. Stack
4. Burners
5. Fluid Flow
6. Heat Transfer
7. Fuels
8. Design Guidelines

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### Improve the Efficiency of Fired Heaters and Boilers

1. Excess Air
2. Burner Types
3. Flame types

### Introduction to Fired Heater Control / Burner Management Systems

#### Troubleshooting Furnaces and Boilers

1. Furnace and Boiler Troubleshooting
2. Furnace Damage Case Study
3. Boiler Damage Case Study
4. Boiler Video
5. Hydrotreater Furnace Damage Case Study

### Heat Exchangers

#### Introduction to Heat Exchangers

1. Shell and Tube
2. Fin Fan
3. Spiral
4. Plate Heat Exchanger
5. High Heat Flux

#### Applications / Design Considerations

1. Single-phase
2. Boiling/evaporating
3. Condensation

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### Practical heat exchanger performance review

1. Pressure Drop
2. Fouling
3. Cooling water
4. Vibration
5. Venting and draining
6. Temperature pinch

### Troubleshooting Heat Exchangers

1. Heat Exchanger Troubleshooting
2. Heat Exchanger Case Study
3. Heat Exchanger Safety Video

### Reaction

1. Introduction to Reactors
  - A. Batch Reactors
  - B. Continuous Stirred Tank Reactor (CSTR)
  - C. Plug Flow Reactor (PFR)
  - D. Packed Bed Reactor (PBR)
  - E. Fluidized Reactors
  - F. Single Phase vs. Multiphase
  - G. Endothermic vs. Exothermic
  
2. Catalyst
  - A. Catalyst properties and classification
  - B. Steps in catalysis preparation
  - C. Adsorption isotherm
  - D. Catalyst Deactivation

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### 3. Reactor Flow Types

- A. Radial Flow
- B. Down flow
- C. Continuous regeneration
- D. Fluidized Flow

### Troubleshooting Reactors

1. Reactor Troubleshooting
2. Reactor Case Study

### Who Should Attend

- People who are making day to day decisions regarding operation, design, and economics of processing plants;
  1. 1<sup>st</sup> Line Operations personnel,
  2. Operation Supervisors,
  3. 1<sup>st</sup> Line Maintenance personnel,
  4. Maintenance Supervisors,
  5. Senior Plant Supervisors,
  6. Operations Engineers
  7. Process Support Engineers,
  8. Design Engineers,
  9. Cost Engineers
- People who are making day to day decisions regarding operation, design, maintenance, and economics of process industry plants.
- 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**

- A detailed understanding of unit operations
- An understanding of process parameters that affect unit operations
- Design guidelines for unit operations
- Troubleshooting Strategies and Case Studies
- Gain an insight to optimization strategies