

# Distillation Control

## Introduction

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.

## Course Objective

This course will guide the participants to develop key concepts and techniques to operate, control, and troubleshoot a distillation system. After completion of the course, participants are expected to gain:

- The fundamental knowledge of distillation control.
- The operation, control and trouble shooting of a distillation columns and it's associated equipment,
- An overview of distillation, practical solutions as well as theory
- An understating of essential distillation concepts.

## Who should attend

Managers, operators, facilities engineers, operating engineers, supervisory personnel, maintenance and technical personnel involved in the day to day operations of distillation processes.

## Course Content

### 1. Strategy for Distillation-Column Control

- 1.1 Distillation Control Objectives
- 1.2 Arrangements for Material-Balance Control
- 1.3 Fundamentals of Composition Control
- 1.4 Compensation for Various Disturbances
- 1.5 Start-up and Shutdown
- 1.6 Control System Design Philosophy
- 1.7 Procedure for Overall Control System Design
- 1.8 Column Design Philosophy and Control System Design
- 1.9 Existing Columns—Typical Practices and Troubleshooting

### 2. Fundamentals of Distillation

- 2.1 Introduction
- 2.2 Tray Hydraulics
- 2.3 Vapour—Liquid Equilibrium Fundamentals
- 2.4 Graphical Solution Techniques
- 2.5 Effects of Variables

### 3. Overhead System Arrangements

- 3.1 Introduction
- 3.2 Types of Condensers
- 3.3 Atmospheric Columns
- 3.4 Vacuum and Pressure Columns - Liquid Product
- 3.5 Pressure Columns - Vapour Product
- 3.6 Miscellaneous Pressure - Control Techniques
- 3.7 Gravity-Return Reflux Versus Pumped - Back Reflux
- 3.8 Control Techniques with Air - Cooled Condensers
- 3.9 "Tempered" Versus Once - Through Coolant
- 3.10 Level Control of Condensate Receiver and Required Hold-up

### 4. Column-Base and Reboiler Arrangements

- 4.1 Introduction
- 4.2 Vertical Thermosyphon Reboilers
- 4.3 Flooded Thermosyphon (Steam-Side) Reboilers
- 4.4 Forced-Circulation Reboilers
- 4.5 Flooded-Bundle Kettle Reboilers
- 4.6 Internal Reboilers
- 4.7 Steam Supply and Condensate Removal
- 4.8 Required Hold-up for Level Control
- 4.9 Miscellaneous Column-Base Designs
- 4.10 Miscellaneous Reboiler Designs

### 5. Feed System Arrangements

- 5.1 General Comments
- 5.2 Feed Flow Control
- 5.3 Feed Temperature Control
- 5.4 Feed Enthalpy Control
- 5.5 Feed Tray Location
- 5.6 Feed Tank Sizing
- 5.7 Feed System for Double-Column Systems
- 5.8 Feeds with Makeup/Purge to Tank age
- 5.9 Feed Systems in Sequences of Columns With and Without Recycles

### 6. Level Control and Feed forward Options

- 6.1 Introduction
- 6.2 Material-Balance Control in Direction Opposite to Flow
- 6.3 Material-Balance Control in Direction of Flow
- 6.4 Unfavourable Control Schemes
- 6.5 Unreasonable Control Schemes

### 7. Control of Side stream Draw off Columns

- 7.1 Introduction
- 7.2 Side-Draw Columns with Large Side streams
- 7.3 Side-Draw Columns with Small Side streams
- 7.4 Composition Control of Side-Draw Columns
- 7.5 An Improved Approach to Composition Control of Draw Columns
- 7.6 Prefractionator Plus Side stream Draw off Column
- 7.7 Other Schemes

## 8. Minimizing Energy Requirements

- 8.1 Introduction
- 8.2 Conservation
- 8.3 Design Considerations in Heat-Recovery Schemes
- 8.4 Multiple Loads Supplied by a Single Source
- 8.5 Single Source, Single Load
- 8.6 Split Feed Columns
- 8.7 Combined Sensible and Latent Heat Recovery
- 8.8 Energy Recovery by Vapour Recompression

## 9. Application of Protective Controls to Distillation Columns

- 9.1 Introduction
- 9.2 Overrides and Interlocks
- 9.3 Implementation of Overrides
- 9.4 Controllers in Override Circuits
- 9.5 Anti Reset-Windup
- 9.6 Feed forward Compensation with Overrides
- 9.7 Overrides for Column Overhead System
- 9.8 Overrides for Column-Base System
- 9.9 Automatic Start-up and Shutdown
- 9.10 "Idle" or Total Reflux
- 9.11 Miscellaneous Overrides
- 9.12 Design Considerations
- 9.13 Overrides for Side-Draw Columns

## 10. Indirect Composition Measurements

- 10.1 Introduction
- 10.2 Single-Tray Temperature
- 10.3 Differential Temperature
- 10.4 Differential Vapour Pressure
- 10.5 Pressure-Compensated Temperature
- 10.6 Multicomponent Compositions Computed from Temperature and Pressure Measurements
- 10.7 Double-Differential Temperature
- 10.8 Average Temperature
- 10.9 Composition Estimators

## 11. Miscellaneous Measurements and Controls

- 11.1 Introduction
- 11.2 Calculation of Distillation-Column Internal Reflux
- 11.3 Temperature and Pressure Compensation of Gas Flow Meters
- 11.4 Heat-Flow Computations
- 11.5 Column-Base Level Measurements
- 11.6 Control Valves
- 11.7 Column LP Measurement
- 11.8 Temperature-Measurement Dynamics
- 11.9 Flow and Flow-Ratio Conventions
- 11.10 Control-Valve Split Ranging

**For any further information please contact us at:**

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