# Advanced Distillation Simulation Software Training Course

## Introduction

The success of every company depends of each employee's understanding of the business's key 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.

It is strategically important that your operations group understands the fundamentals of process simulation software. 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.

There are times when the virtual world of computers needs to be taken to the real world. Is should be remembered that machine calculations are for the purpose of improving only the speed of the calculation – the engineer must supply correct input data and correct judgment of results. Without the key concepts of the correct input data and estimates of the results, the two worlds may collide.

## Course Objective

This course will guide the participates to develop key concepts and techniques to confirm that their process engineering simulation software results can be utilized in the field (real world). A conversed solution can be extremely far from reality. The correct selection of actual field efficiencies, vapor and liquid equilibrium data, feed modeling, and hydraulic behavior will influence the accuracy of the model's results.

These key concepts can be utilized to make process engineering simulation software a troubleshooting tool to help solve distillation tower problems. The key concepts taught in this course are independent of the clients chosen software and will apply to all the industry standard simulation packages.

## Course Duration and Delivery

Typical course duration is 3 to 5 days based on the background of the participates. 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 for these topics – for a first course consider attending our introduction course.

**Course Syllabus**

The goal of the course would be to refresh the knowledge of those who have a basic understanding of process simulation software techniques and to build a foundation to those who are new to the process simulation software.

Typical Course Outline

A. Introduction

1. Safety for the Process Industry
2. Overview of the Process Industry

B. General Distillation Overview

1. 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
- The keys of column inlets and outlets

2. Tray Column Design

- The major design differences between tray types
- The operational limits for trays – operating window
- Size a distillation column for a given vapor rate
- Calculate the turndown ratio
- Calculate a tray pressure drop
- Calculate a tray downcomer capacity

3. Packed Column Design

- The different types of packing and their characteristics
- The best type of packing for a given system
- Size a packed column diameter
- Calculate the packed bed pressure drop
- Design an effective distributor system for both liquid and vapor handling

4. Distillation Column Control

- Typical process variables in a distillation column
- Select appropriate composition and column pressure control schemes
- Process settings during column operation

5. Distillation Design

- Designing for Fouling Service
- Designing for Vacuum Service
- Desinging Quench Towers
- Designing for Extractive Distillation
- Designing for Operation and Mainantance

C. 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
- Break multi-component designs into simpler systems with binary pairs
- 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
- Adapt binary design methods to multi-component systems
- Design separation process for an azeotrope and multiple components
- Set-up and troubleshoot rigorous calculations using simulation programs

3. Stage Efficiency

- 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
- How Hydraulics affect efficiencies and capacities

D. Simulation Basics

1. Basic Simulation Principles
   a. Number of Specifications
   b. What to Specify
   c. Heat Exchanger Specifications
2. In – Out Routine
3. Introduction to Flow Sheeting
4. Develop Estimates
   a. Fenske equation gives minimum stages
   b. The Gilliland correlation is used to estimate actual stages from minimum stages and reflux ratio
   c. Underwood minimum reflux method
5. Feed Modeling Techniques
6. Converging Techniques

E. Workshops (which are mixed in the lectures)

1. Simulation of DePropanizer

   - Comparison of VLE
   - Choosing distillation device
   - Selection of stage efficiency
   - Preliminary hydraulics

2. Simulation of Crude Tower

   - Comparison of VLE
   - Choosing distillation device
   - Selection of stage efficiency
   - Preliminary hydraulics

3. Simulation of Gas Plant

- Comparison of VLE
- Choosing distillation device
- Selection of stage efficiency
- Preliminary hydraulics

## 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

- An engineer or chemist who must troubleshoot and solve distillation problems in a plant, an engineering office or laboratory.

- Technical Engineers, Operating Engineers, Process Support Personnel, Chemist, and Managers

- 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.

**What You Can Expect to Gain**

- An overview of distillation, practical solutions as well as theory
- Development of key concepts for simulation in the real world
- How to select the proper input data
- How estimate realistic stage efficiencies, variables affecting separation
- Proper selection of VLE Data
- Feed modeling techniques
- How to make difficult operations converge
- Hydraulic analysis techniques
- Methods to cross check the results