Distillation Column Design

Overview

**LEVEL**
Proficiency

**PURPOSE**
To provide a comprehensive knowledge of the design methods of an industrial distillation tower.

**LEARNING OBJECTIVES**
Upon completion of the course, the participants will be able to:
- know the operation of refining separation processes based on L/V equilibrium: distillation, absorption, stripping, azeotropic and extractive distillations, columns with side draw off,
- know the short cut methods and how to get all the necessary information for final design,
- be able to design an industrial classical distillation tower,
- know the operating variables and control systems used for industrial distillation columns and to be able to choose the relevant process control scheme.

**WAYS AND MEANS**
Lectures with a lot of practical exercises related to industrial situations and case studies (by simulation).
Specific and detailed documentation.

**LEARNING ASSESSMENT**
Quiz.

**Agenda**

**REMINDER ABOUT SEPARATION PROCESSES USED IN THE PETROLEUM INDUSTRY**

**STEPS INVOLVED IN THE DESIGN OF A CLASSICAL DISTILLATION COLUMN**
Study basis: feed characteristics, pseudo-components, products specifications), other constraints, key components, estimated material balance. Operating pressure: selection, profile, control.
Heat balance: condenser and reboiler duties, industrial configurations.
Separating power: number of theoretical trays, liquid and vapor traffics, feed inlet location.
Basics for economic optimization.

**SHORT CUT METHODS FOR HYDROCARBON SEPARATION**
Practical application to the predesign of simple refinery towers.

**OPERATING PARAMETERS OF AN INDUSTRIAL DISTILLATION COLUMN**
Material balance, separation quality, graphical representation.
Pressure.
Heat balance.
Flow rates.
Concentration and temperature profiles.

**SEPARATING POWER OF AN INDUSTRIAL DISTILLATION COLUMN**
Parameters related to the separating power: L/V ratio, reflux ratio, reboiling ratio, number of theoretical stages, efficiency of the real trays, location of the feed inlet.
Change of separating power at a constant material balance.
How to optimize the operation. Prominence of the process control quality.

**EQUIPMENT TECHNOLOGY**
Trays: way they act, technology, performances, flexibility.
Packings: way they act, structured or random packings, limitations, pressure drop, distribution and channeling phenomenon.
Distribution systems.

**PROCESS CONTROL**
Adaptability of process control to actual disturbances.
Troubleshooting of disturbances: origin (feed, condenser, reboiler) and consequences (liquid vapor flow rates disturbances, material balance modification, off-spec. products).
Material balance control: use of a sensitive tray.
Temperature control systems: implementation of a temperature-reflux rate cascade or temperature-reboiler duty cascade, examples with a debutanizer and a benzene-aromatics column.
Impact of feed changes: temperature (optimization of the heat balance), flow rate (feed forward control), composition (tuning of the material balance and the separating power).
Change of operating conditions: implementation of control systems based on product quality measurement.