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

0.5 d

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.

1 d

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

0.5 d

OPERATING PARAMETERS OF AN INDUSTRIAL DISTILLATION COLUMN
Material balance, separation quality, graphical representation.

0.25 d
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.