CE 610
Comparison of rectification columns

Learning objectives/experiments

- investigation and comparison of a sieve tray column and a packed column
  - in continuous operation
  - with different pressures
  - with different reflux ratios
  - with different feed levels
- determination of the proportion of ethanol in the feed and in the products
- determination of the tray efficiency of the sieve trays
- evaluation using the McCabe-Thiele Diagram
- evaluation using the HTU-NTU concept

Description

- **continuous rectification**
- **packed column and sieve tray column**
- **supply of process heat in the form of steam**
- **plant control with PLC via touch panel**
- **more than 40 measured quantities and 12 control loops**

The rectification columns are used for the separation of liquid phases. They operate according to the principle of distillation. Distillation is a separation process that includes the partial evaporation of a liquid phase and the condensation of the resulting gas phase. The separation process of rectification is an energy-efficient distillation process with several stages. The substance mix recommended for the operation of the experimental plant is water-ethanol.

The CE 610 experimental plant is designed for the continuous operation of one rectification column at a time. The rectification columns are a packed column with pall rings and a sieve tray column with ten trays.

You can adjust various process parameter for the investigation of the rectification columns. These include, for example, the reflux ratio and the temperature measuring point for the temperature control. The effects of the changes are determined by means of the proportion of ethanol in the products (gravimetric measurement) thus also determining the separating capacity. For the evaluation of the experiments the software can be used to determine the theoretical separation steps by means of a McCabe-Thiele Diagram and the HTU-NTU concept.

The experimental plant is equipped with a comprehensive range of functions for measurement, control and operation that are controlled by a PLC. A touch panel displays the measured values and operating states and can be used to control the plant. At the same time, the measured values can be transmitted directly to a PC via USB where they can be analysed with the software.

The steam supply is realised via the laboratory supply or the optionally available electric steam generator (CE 715.01).

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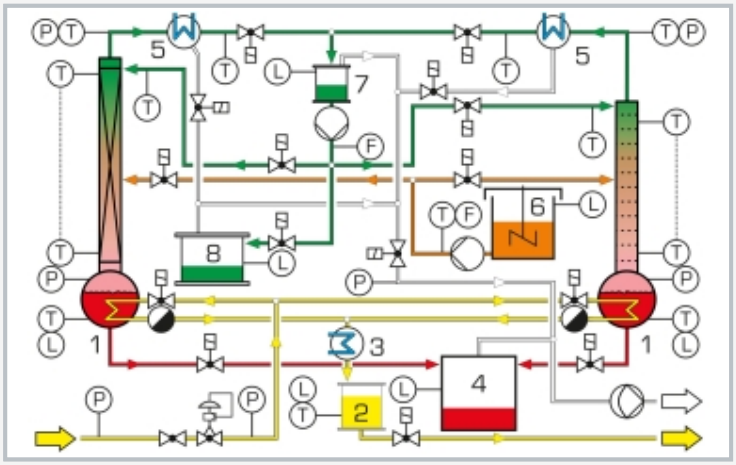
1 condensate tank, 2 bottom of column with evaporator, 3 bottom product tank, 4 feed tank, 5 sieve tray column with top condenser and column sump, 6 top product tank, 7 packed column, 8 top condenser, 9 platform, 10 switching cabinet with PLC and touch panel



1 evaporator with column, 2 condensate tank, 3 condensate cooler, 4 bottom product tank, 5 top condenser, 6 feed tank, 7 phase separation tank, 8 top product tank; F flow rate, L level, P pressure, T temperature; red: bottom product, green: top product, orange: feed, blue: cooling water, yellow: steam, white: vacuum

Specification

[1] continuous rectification with packed column or sieve tray column
[2] variable reflux ratio
[3] packed column with pall rings with 10 feed levels and temperature measurement
[4] sieve tray column with 10 trays; each tray with feed and temperature measurement
[5] tanks for feed, bottom and top product made of DURAN glass and stainless steel
[6] operation at up to 115°C and 1,5bar
[7] recording of all relevant variables with more than 40 sensors
[8] PLC with touch panel for control of the plant
[9] GUNT software for data acquisition via USB under Windows 11

Technical data

Packed column
- inner diameter: 100mm
- packing height: 3000mm

Sieve tray column
- inner diameter: 100mm
- number of sieve trays: 10

Feed pump
- max. flow rate: 19L/h

Tank
- feed: 20L

Measuring ranges
- temperature: 31x 0...150°C
- flow rate: 1x 1,5...20L/h (feed)
- flow rate: 1x 0,3...105L/h (distillate)
- flow rate: 1x 24...720L/h (cooling water)
- pressure:
  - 5x 0...2,5bar (abs.)
  - 1x 0...5bar
  - 1x 0...10bar

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase, 120V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 2030x850x4000mm
Weight: approx. 480kg

Required for operation

cooling water (min. 800L/h, min. 4bar, max. 25°C), steam (8kg/h, 4...6bar)
PC with Windows recommended

Scope of delivery

1 experimental plant
1 GUNT software + USB cable
1 set of accessories
1 set of instructional material

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Optional accessories

CE 715.01	Electrical steam generator 12kW