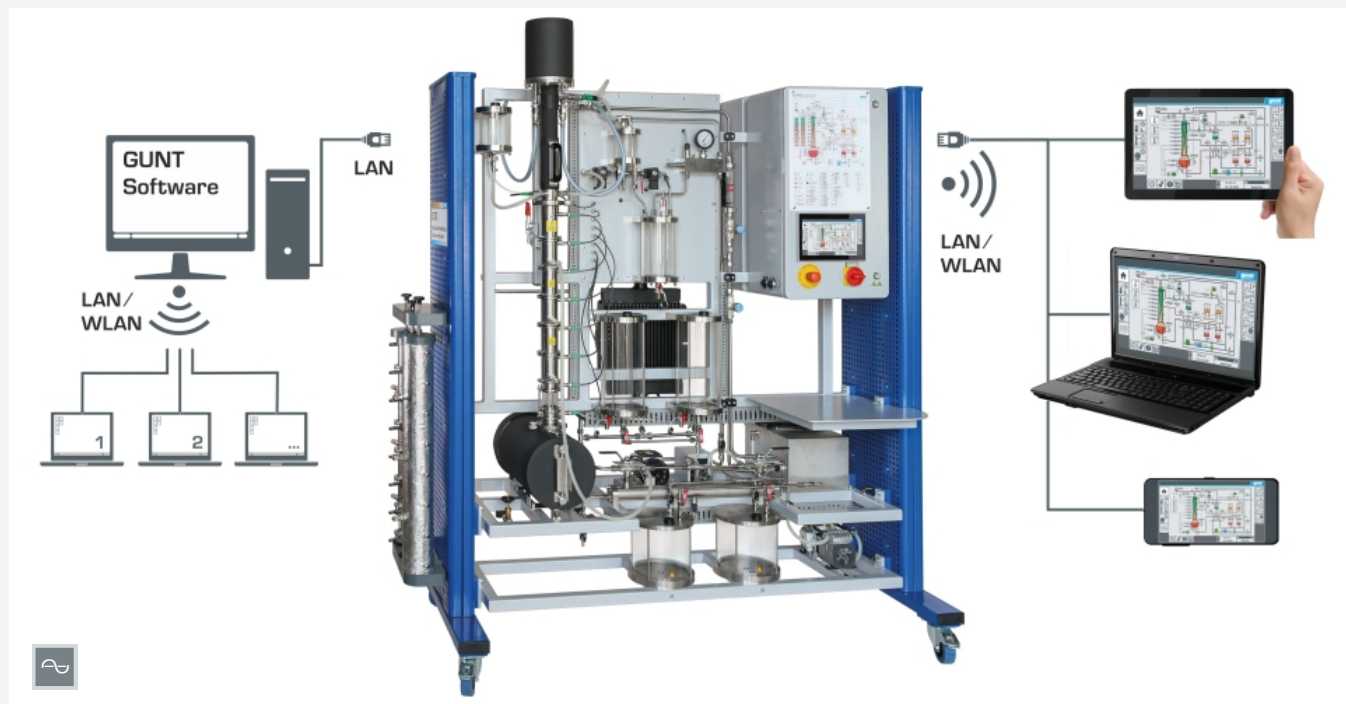# CE 600
Continuous rectification

The illustration shows the CE 600 with built in sieve tray column, screen mirroring is possible on different end devices

Description

- **comparison of packed, sieve tray and bubble cap tray column**
- **vacuum mode possible by diaphragm pump**
- **plant control using an integrated PLC**
- **integrated router for operation and control via an end device and for screen mirroring on additional end devices: PC, tablet, smartphone**

Rectification is an important thermal separation method in industry for separating homogeneous liquid mixtures, such as the fractionation of crude oil. Rectification represents an energy-efficient distillation process carried out in several consecutive stages.

CE 600 includes 3 interchangeable columns: a sieve tray column, a bubble cap tray column and a packed column. The separating liquid mixture can be fed to the columns at three different heights. The preheating of the feed is possible with the help of a heat exchanger. Ethanol/water is recommended as the liquid mixture for the CE 600.

The fed liquid mixture partially evaporates on its way to the bottom of the column where it is electrically heated to boiling. The mixed vapour produced then moves upwards in the column. The mixed vapour contains a higher concentration of the component with the lower boiling point (ethanol). It leaves the top of the column and is condensed using a condenser. Part of this condensate is collected in a tank while the rest is fed back into the column as reflux. On its way downwards, it undergoes an intensive heat and material exchange with the rising mixed vapour. This exchange causes the vapour phase to become richer in ethanol and the liquid phase to become richer in water. The liquid phase moves to the bottom and can be collected in two tanks.
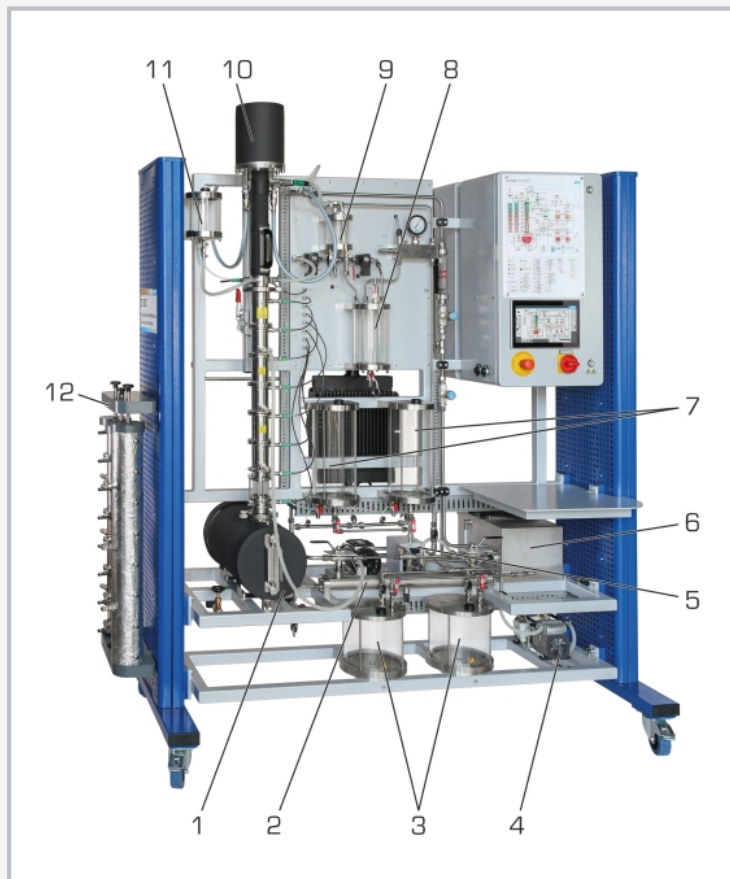
The trainer is controlled by the PLC via touch screen. By means of an integrated router, the trainer can alternatively be operated and controlled via an end device. The user interface can also be displayed on additional end devices (screen mirroring). Via the PLC, the measured values can be stored internally. Access to stored measured values is possible from end devices via WLAN with integrated router/LAN connection to the customer's own network. Via direct LAN connection the measured values can also be transmitted to a PC where they can be analysed using the GUNT software.

Learning objectives/experiments

- investigation and comparison of sieve tray, bubble cap tray and packed columns
  - in continuous mode
  - in discontinuous mode
  - in vacuum mode
  - with different inlet heights for the feed flow
  - with different numbers of trays (sieve tray and bubble cap tray column)
- practice-oriented temperature control in the column
  - reflux ratio as actuator for the top of the column
  - heating power as actuator for the column bottom
- determination of temperature profiles
- pressure loss over the column
- energy efficiency increase due to feed preheating
- screen mirroring: mirroring of the user interface on end devices
  - menu navigation independent of the user interface shown on the touch screen
  - different user levels available on the end device: for observing the experiments or for operation and control

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CE 600
Continuous rectification

1 evaporator with column on top, 2 heat exchanger feed preheating/bottom product cooling, 3 bottom product tank, 4 diaphragm pump, 5 feed pump, 6 storage tank for cooling water circuit, 7 feed tank, 8 top product tank, 9 phase separation tank, 10 top product condenser, 11 solvent tank, 12 holding device columns
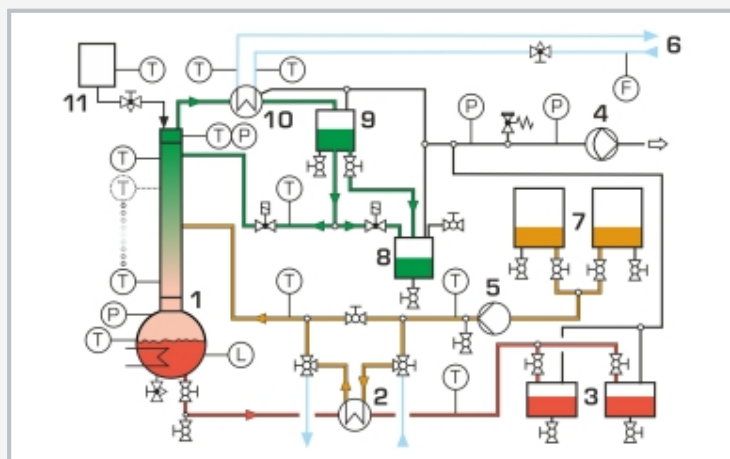
1 evaporator with column on top, 2 heat exchanger feed preheating/bottom product cooling, 3 bottom product tank, 4 diaphragm pump, 5 feed pump, 6 cooling water circuit, 7 feed tank, 8 top product tank, 9 phase separation tank, 10 top product condenser, 11 solvent tank;
F flow, L level, P pressure, T temperature;
orange: feed, red: bottom product, green: top product, blue: cooling water

Specification

[1] continuous and discontinuous rectification
[2] plant control with PLC via touch screen
[3] integrated router for operation and control via an end device and for screen mirroring: mirroring of the user interface on up to 5 end devices
[4] packed, sieve tray and bubble cap tray column, interchangeable
[5] sieve tray and bubble cap tray column with 8 trays
[6] packed column with Raschig rings
[7] 3 feed inlets and 8 temperature sensors per column
[8] electrically heated evaporator
[9] condenser and phase separation tank for top product
[10] adjustment of reflux ratio using valves
[11] heat exchanger for feed preheating by bottom product or bottom product cooling by cooling water
[12] water-saving due to closed cooling water circuit with water/air cooler
[13] vacuum mode possible with diaphragm pump
[14] areometer for determining the composition of feed/products included
[15] data acquisition via PLC on internal memory, access to stored measured values via WLAN/LAN with integrated router/LAN connection to customer's own network or direct LAN connection without customer network
[16] GUNT software for data acquisition via LAN under Windows 10

Technical data

PLC: Eaton XV303 with I/O system XN300
Columns: height x inner diameter: 780x50mm
Feed pump: max. flow rate: 320mL/min
Cooling water pump: max. flow rate: 10L/min
Diaphragm pump: final vacuum approx. 213mbar abs.
Tanks, feed: 2x approx. 5L
- bottom product: 2x approx. 5L
- top product: approx. 1,9L
Heat transfer surfaces
- feed preheating/bottom cooling: approx. 0,03m^2
- top product condenser: approx. 0,04m^2

Measuring ranges
- temperature: 33x 0...150°C
- pressure sensor: 2x 0...2,5bar (column), 1x -1...1bar
- manometer: -1...0,6bar
- reflux ratio: 0...100%
- power: 0...4kW (heater)
- flow rate: 30...320L/h (cooling water)
- density: 0,7...1g/mL

400V, 50Hz, 3 phases; 400V, 60Hz, 3 phases
230V, 60Hz, 3 phases; UL/CSA optional
LxWxH: 1905x790x2200mm
Weight: approx. 400kg

Scope of delivery

1 trainer, 1 set of accessories
1 GUNT software, 1 set of instructional material