CE 100
Tubular reactor

Description

- **tubular reactor with temperature control**
- **saponification reaction with conductivity measurement to determine the conversion rate**
- **preheating of the reactants**

Tubular reactors are continuously operated reactors. Tubular reactors make possible the cost-effective production of large product quantities with consistent quality.

The main component of CE 100 is the tubular reactor with ten temperature-controlled sections. Two pumps convey the reactants from the receiving tanks into the preheating sections and then into the reactor. The preheating sections consist of a coiled tube located in the hot water tank. After preheating, the reactants are mixed just before they enter the reactor. The electrical conductivity of the reaction mixture is measured at the inlet, in the centre and at the outlet of the reactor. While the reaction mixture flows through the reactor, the reactants react to the products. The mixture of products and unreacted reactants leaves the reactor and is collected in a tank.

The volumetric flow rates of the reactants and thus also the retention time in the tubular reactor are adjusted at the pumps. The ten sections of the tubular reactor consist of tubular heat exchangers. The reaction mixture flows in the inner tube of the heat exchanger and the hot water flows in the outer tube. This hot water circuit is temperature controlled. The controller on the switch cabinet makes it possible to set the desired temperature and displays the current temperature in the hot water tank. Three stirring machines ensure uniform mixing and temperature distribution in the reactant tanks and in the hot water tank.

Sensors record the temperatures and electrical conductivities. The measured values are read from digital displays and can be transmitted simultaneously via USB directly to a PC where they can be analysed using the software. The reaction is analysed using the measured electrical conductivities and the conversion rate calculated from this.

Learning objectives/experiments

- fundamentals of a saponification reaction
- conversion rate
  - as a function of retention time
  - as a function of temperature
  - as a function of reaction order

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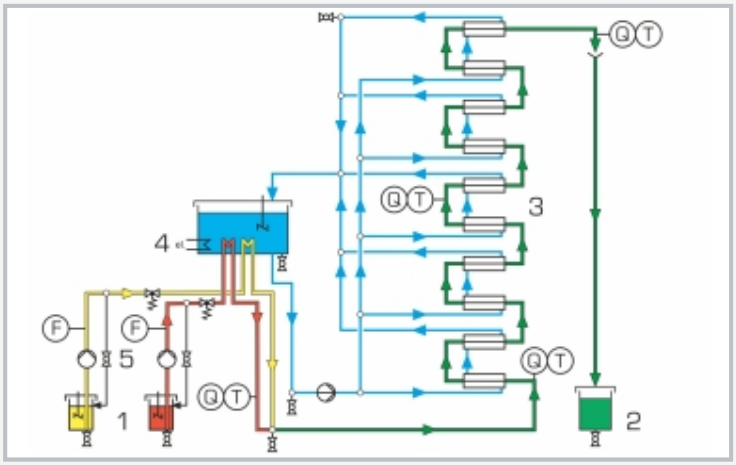
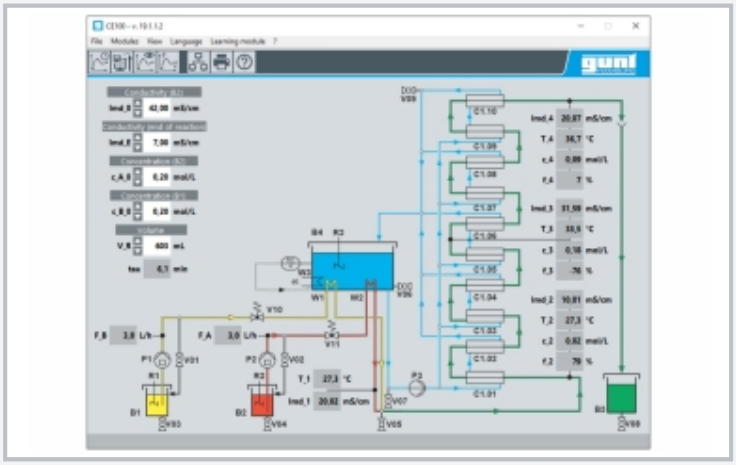
1 switch cabinet, 2 reactant pumps with volumetric flow rate measurement, 3 reactant tank, 4 hot water tank, 5 pump, 6 product tank, 7 measurement of temperature and electrical conductivity, 8 tubular reactor with 10 sections



1 reactant tank, 2 product tank, 3 tubular reactor with 10 sections, 4 heater, 5 reactant pumps, F flow rate, Q electrical conductivity, T temperature



Software screenshot

Specification

[1] continuous tubular reactor to carry out a saponification reaction
[2] 10 tubular heat exchangers as reactor
[3] 2 identical pumps to convey the reactants
[4] adjustment of the volumetric flow rates of the reactants at the pumps
[5] preheating of the reactants with 2 stainless steel coiled tubes
[6] T-piece for mixing the preheated reactants
[7] hot water tank with temperature control
[8] measurements for electrical conductivity: at the inlet, centre and at the outlet of the reactor
[9] measurement of conductivity and temperature with 3 combined sensors
[10] GUNT software for data acquisition via USB under Windows 10

Technical data

Tubular reactor
- Ø inner: approx. 8mm
- reactor volume: approx. 0,6L
- material: 1.4571

Reactant pump
- max. flow rate: 0,3L/min
- max. head: 20m

Tanks
- reactants: 2x 25L
- products: 1x 50L
- water: 1x 30L

Hot water circuit
- heater power: approx. 4kW
- temperature: max. 55°C

Stirring machines speed: max. 310min^{-1}

Measuring ranges
- volumetric flow rate: 2x 2...320mL/min
- temperature: 4x 0...80°C
- conductivity: 3x 0...100mS/cm

400V, 50Hz, 3 phases
400V, 60Hz, 3 phases, 230V, 60Hz, 3 phases
UL/CSA optional
LxWxH: 1900x790x1950mm
Weight: approx. 290kg

Required for operation

Ethyl acetate, caustic soda (for saponification reaction)
PC with Windows recommended

Scope of delivery

1 experimental unit
1 set of accessories
1 set of instructional material

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Optional accessories

for Remote Learning

010.10000	GU 100	Web Access Box
with		
083.10000W	CE 100W	Web Access Software