

WL 302

Heat transfer in the tubular heat exchanger



Learning objectives/experiments

- record temperature curves
 - ▶ in parallel flow mode
 - ▶ in counterflow mode
- determine average heat flux for parallel flow and counterflow operation
- determine average overall heat transfer coefficients

Description

- **model of a tubular heat exchanger**
- **heat exchanger can be operated in parallel and counterflow**

Tubular heat exchangers are the simplest type of heat exchanger and are preferably used when heat is transferred at high pressure differences or between highly viscous media (e.g. sewage sludge). One advantage is that the pipe space is flowed through evenly and is free of flow dead zones.

The WL 302 trainer enables the study of the characteristic properties of heat transfer on the model of a tubular heat exchanger. The heat transfer takes place in coaxially arranged tubes with the hot water passing through the inner tube. Cold water flows in the outer tube. In doing so, the hot water emits some of its thermal energy to the cold water.

In experiments, both parallel flow and counterflow operation can be demonstrated, with their different temperature curves.

The non-linear temperature progression along the tubular heat exchanger is demonstrated by measuring the water temperatures in both tubes at the inlet, outlet and half of the transfer section. A measurement of the pipe wall temperature also allows the investigation of convective heat transfer at the wall. In the experiment analysis, the important variables such as heat flux, overall heat transfer coefficient and heat losses are determined.

The closed hot water circuit contains a tank with electrical heater and a pump. A thermostat keeps the hot water temperature constant. The cold water is supplied and disposed of via the laboratory network.

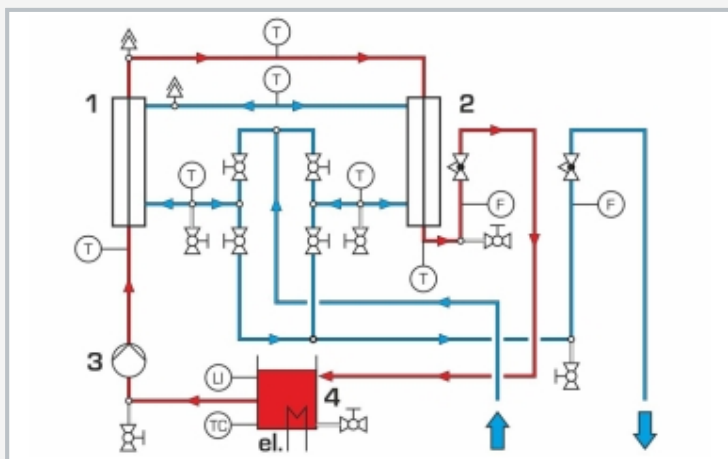
The flow rate and all relevant temperatures are recorded. The measured values are read from digital displays and can be transmitted simultaneously via USB directly to a PC, where they can be analysed using the software included.

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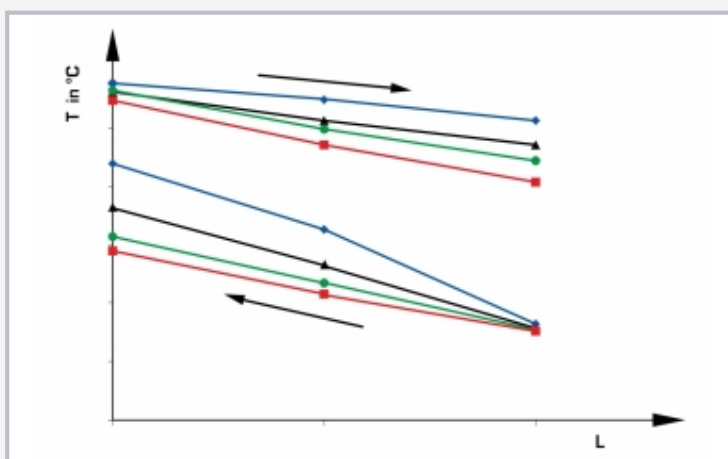
Heat transfer in the tubular heat exchanger



1 bleed valve, 2 temperature sensor, 3 heat exchanger, 4 ball valve for setting the operating mode, 5 tank with heater, 6 pump, 7 water connections, 8 flow meter, 9 valve for setting the flow rate, 10 displays and controls



1 and 2 heat exchanger, 3 pump, 4 tank
T temperature, F flow rate



Temperature profile in counterflow mode with different cold water flow rates at constant hot water flow rate

Specification

- [1] convective heat transfer on a model of a tubular heat exchanger
- [2] parallel flow or counterflow operation adjustable via ball valves
- [3] closed hot water circuit, insulated, with tank, pump and heater with thermostat
- [4] temperature sensors: inlet and outlet temperatures as well as after half the heat transfer path
- [5] flow measurement via 2 impeller flow rate sensors
- [6] GUNT software for data acquisition via USB under Windows 10

Technical data

Pump

- power consumption: 70W
- max. flow rate: 3300L/h
- max. head: 4m

Heater

- output: 2kW
- Thermostat: 20...85°C

Heat transfer surfaces

- hot side: 0,0306m²
- cold side: 0,0402m²
- average transfer surface: 0,0354m²

Tank: 20L

Measuring ranges

- temperature: 6x 0...100°C
- flow rate: 2x 0...360L/h

230V, 50Hz, 1 phase
 230V, 60Hz, 1 phase, 120V, 60Hz, 1 phase
 UL/CSA optional
 LxWxH: 1380x790x1950mm
 Weight: approx. 165kg

Required for operation

cold water connection, drain
 PC with Windows recommended

Scope of delivery

- 1 trainer
- 1 set of accessories
- 1 GUNT software + USB cable
- 1 set of instructional material