WL 230
Condensation process

Description

■ visualisation of different condensation processes

Condensation forms when steam meets a medium with a lower temperature than the saturation temperature for the existing partial pressure of the steam. Factors such as the material and surface roughness of the medium influence the heat transfer and thus the type of condensation. In practice, it is usually film condensation. Dropwise condensation only forms when the cooling surface is very smooth and poorly wettable, e.g. Teflon. Knowledge of condensation processes is applied e.g. in steam power plants or at distillation processes.

The WL 230 experimental unit can be used to demonstrate the different condensation processes using two tubular shaped water-cooled condensers made of different materials. Dropwise condensation can be demonstrated by means of the condenser with a polished gold-plated surface. Film condensation forms on the matt copper surface of the second condenser, thus making it possible to examine film condensation.

The tank can be evacuated via a water jet pump. The boiling point and the pressure in the system are varied by cooling and heating power. Sensors record the temperature, pressure and flow rate at all relevant points. The measured values can be read on digital displays. At the same time, the measured values can also be transmitted directly to a PC via USB. The data acquisition software is included. The heat transfer coefficient is calculated from the measured values. The influence of non-condensing gases, pressure and the temperature difference between the surface and steam can be examined in further experiments.

Learning objectives/experiments

- ■ dropwise and film condensation
- ■ determination of the heat transfer coefficient
- ■ effect of pressure, temperature and non-condensable gases on the heat transfer coefficient
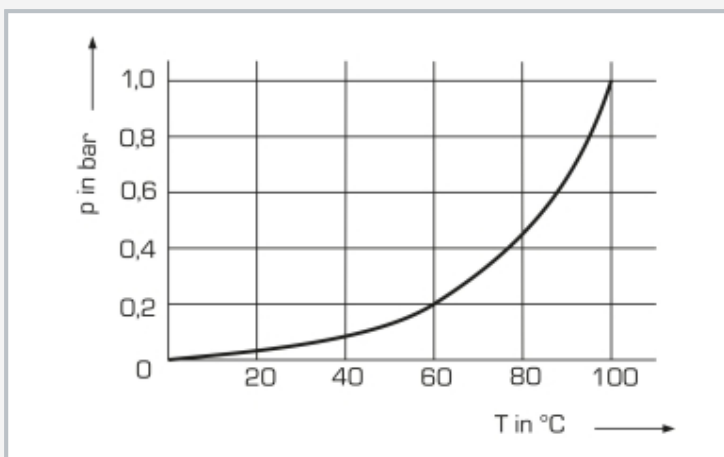
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1 condensers, 2 heat exchanger, 3 steam trap, 4 displays for temperature, flow rate and pressure, 5 heater, 6 cooling water connections, 7 water jet pump, 8 temperature sensor, 9 valve for adjusting the cooling water, 10 cooling water flow rate sensor
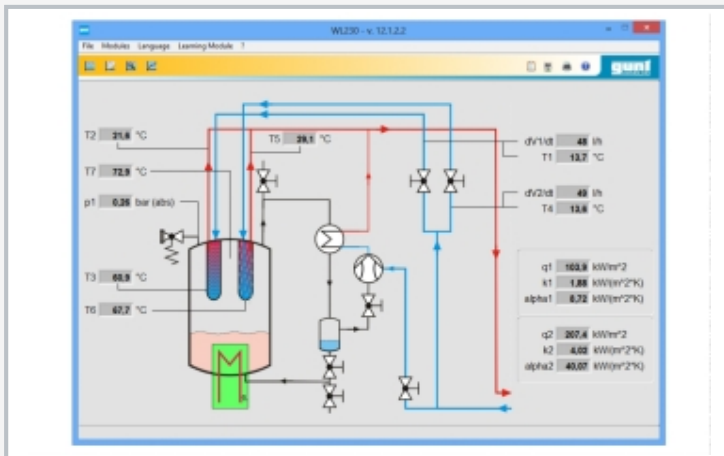
Software screenshot

Vapour pressure curve for water: p pressure, T temperature

Specification

[1] visualisation of the condensation process of water in a transparent tank
[2] two water-cooled tubes as condensers with different surfaces to realise film condensation and dropwise condensation
[3] controlled heater to adjust the boiling temperature
[4] water jet pump to evacuate the tank
[5] pressure switch and safety valve for safe operation
[6] sensors for temperature, pressure and flow rate with digital display
[7] GUNT software for data acquisition via USB under Windows 10

Technical data

Heater
■ output: 3kW, freely adjustable

Condenser
■ 1x tube with matt copper surface
■ 1x tube with a polished gold-plated surface

Water jet pump
■ flow rate: 4...12L/min
■ pressure: 16mbar

Safety valve: 2200mbar absolute

Measuring ranges
■ pressure: 0...10bar abs.
■ flow rate: 0,2...6L/min
■ temperature: 4x 0...100°C, 3x 0...200°C

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase
230V, 60Hz, 3 phases
UL/CSA optional
LxWxH: 1000x550x790mm
Weight: approx. 85kg

Required for operation

water connection: 1bar, max. 1000L/h, drain
PC with Windows recommended

Scope of delivery

1 experimental unit
5L distilled water
1 GUNT software + USB cable
1 set of hoses
1 set of instructional material

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Optional accessories

for Remote Learning
010.10000   GU 100   Web Access Box
with
060.23000W   WL 230W   Web Access Software

Other accessories
020.30009   WP 300.09   Laboratory trolley

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