

ET 264

Geothermal energy with two-well system



Description

- use of geothermal energy in an open system without thermal repercussion
- simulation of the energy balance of a heat pump

The scope of geothermal energy is the study and use of the heat and the temperature distribution in the ground. A geothermal plant uses the thermal energy stored below the earth's surface. Using a two-well system, for example, thermal energy is extracted from the near-surface groundwater for heating purposes. ET 264 demonstrates the operation of such a two-well system.

The trainer contains a closed water circuit with storage tank and pump. The core element is a sand bed through which water flows with a production well and an absorption well. Water (groundwater) flows in and out via two side-mounted chambers.

In the experiment, the groundwater is delivered from the production well to a heat exchanger and the thermal energy is transmitted from the groundwater to the working medium.

The water then flows into an absorption well. From here, the water is delivered via the drain chamber into the storage tank, is heated and returned to the experimental section. The groundwater temperature in the storage tank is adjusted by means of a controlled heater. The flow rate of the pump in the production well can be adjusted. The groundwater flow through the sand bed is adjusted using height-adjustable discharges. The working medium is added either via the laboratory supply or via the WL 110.20 water chiller.

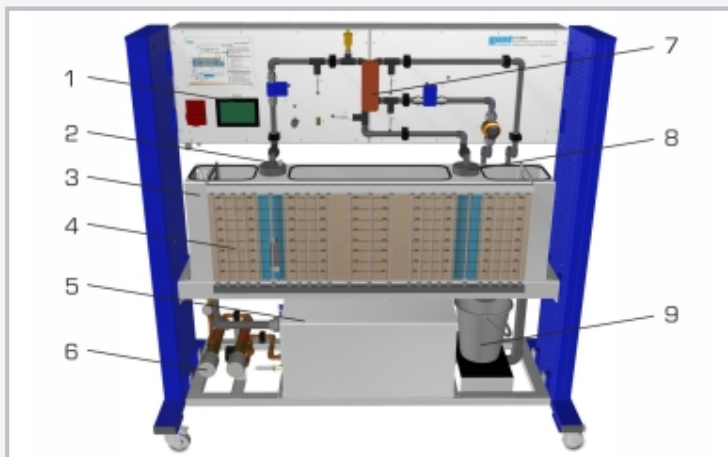
From the measured temperatures and the flow rate, the transmitted thermal output is determined. A multi-tube manometer visualises the groundwater levels of both wells. The measured values are displayed on the trainer and can be transmitted simultaneously via USB directly to a PC, where they can be analysed using the GUNT software included. By means of the measured values, a heat pump which is connected to the two-well system is simulated.

Learning objectives/experiments

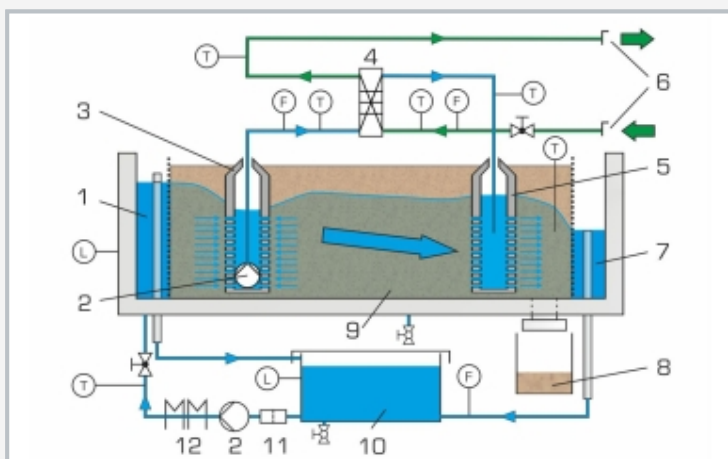
- fundamentals of geothermal use
- operating behaviour of a two-well system
- hydraulic and thermal properties of the ground
- determination of the usable heat capacity
- fundamentals and energy balance of a heat pump

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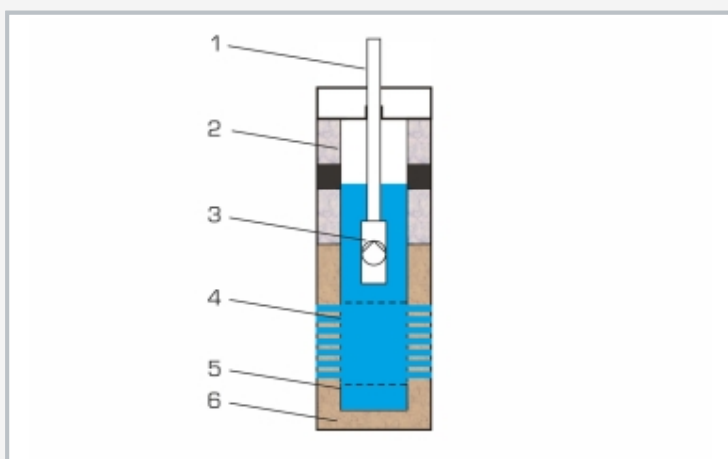
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1 display, 2 production well, 3 experimental tank, 4 multi-tube manometer, 5 storage tank, 6 heater, 7 heat exchanger, 8 absorption well, 9 tank



1 feed chamber, 2 pump, 3 production well, 4 heat exchanger, 5 absorption well, 6 working medium connection, 7 drain chamber, 8 tank, 9 experimental section, 10 storage tank, 11 filter, 12 heater; F flow rate, L level, T temperature, blue: water, green: working medium



Typical design of a production well: 1 rising pipe, 2 extension pipe, 3 pump, 4 filter pipe, 5 sump pipe, 6 filter gravel

Specification

- [1] demonstration and operation of a two-well system for using geothermal energy
- [2] temperature-controlled groundwater circuit
- [3] height-adjustable overflows for adjusting the groundwater flow
- [4] adjustable flow rate of the pump in the production well
- [5] measurement of temperature and flow rate to determine the transmitted heat capacity
- [6] multi-tube manometer for visualising the groundwater levels
- [7] supply of the working medium via laboratory supply or the WL 110.20 water chiller
- [8] calculation of the transmitted heat capacity and simulation of the energy balance of a heat pump
- [9] GUNT software for data acquisition via USB under Windows 10

Technical data

Experimental section

■ LxWxH: approx. 1600x270x470mm

Production well pump

■ power consumption: max. 72W

■ max. flow rate: approx. 16L/min

Storage tank pump

■ power consumption: approx. 70W

■ max. flow rate: approx. 18L/min

Storage tank

■ capacity: approx. 135L

Plate heat exchanger

■ heat transfer surface: 0,39m²

■ number of plates: 30

Heater

■ power consumption: max. 8kW

Measuring ranges

■ temperature: 0...50°C

■ flow rate:

▶ 2,5...16L/min (production well)

▶ 5...18L/min (groundwater circuit)

400V, 50Hz, 3 phases

230V, 60Hz, 3 phases; 400V, 60Hz, 3 phases

UL/CSA optional

LxWxH: 2000x790x1920mm

Empty weight: approx. 320kg

Required for operation

water connection, drain or WL 110.20, PC with Windows recommended

Scope of delivery

- 1 trainer
- 1 sand (250kg, grain size 1...2mm)
- 1 GUNT software + USB cable
- 1 set of instructional material

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Optional accessories

WL 110.20 Water chiller