WL 225

Heat transfer in the fluidised bed

Description

- **fluidised bed formation with air in a glass reactor**
- **illuminated glass reactor for optimal observation of the fluidisation process**

Fluidised beds are used in a broad range of applications, e.g. for industrial drying, fluidised bed combustion or heat treatment of materials. Bulk solids are transformed from a fixed bed into a fluidised bed when fluids pass through them. In terms of fluid mechanical and thermodynamic properties, the fluidised bed behaves like an incompressible fluid.

The heat transfer between hot fluid and a fixed bed occurs mainly through heat conduction. Due to the movement of the particles, the fluid and the particles are very well mixed in the fluidised bed. This enables optimum heat transfer between fluid and particles and ensures an even temperature distribution in the reactor.

The core element in WL 225 is a backlit glass reactor which enables students to observe the fluidisation process. Compressed air flows upwards through a porous sintered-metal plate. On the sintered-metal plate is a fixed bed. If the velocity of the air is less than the so-called fluidisation velocity, the flow merely passes through the fixed bed.

At higher velocities the bed is loosened to such an extent that individual solid particles are suspended by the fluid and form a fluidised bed. The air escapes through a filter at the top end of the glass reactor.

The air flow rate is set via a valve. A submersible heating element in the reactor enables examination of the heat transfer in the fluidised bed.

Sensors record the pressure at the inlet into the reactor and in the fluidised bed, the air flow rate, the heating power, pressure and temperatures at the air inlet of the reactor, on the surface of the heating element and in the fluidised bed. 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.

Aluminium oxide in various particle sizes is included in the scope of delivery as bulk solid.

Learning objectives/experiments

- basic information on the fluidisation of fixed beds
- pressure curve within the bed
- pressure losses depending on
  - flow velocity
  - particle size of the bulk solid
- determination of the fluidisation velocity

- heat transfer in the fluidised bed
  - influence of the air flow rate on the heat transfer
  - influence of the heater position
  - influence of the particle size
  - determination of the heat transfer coefficient

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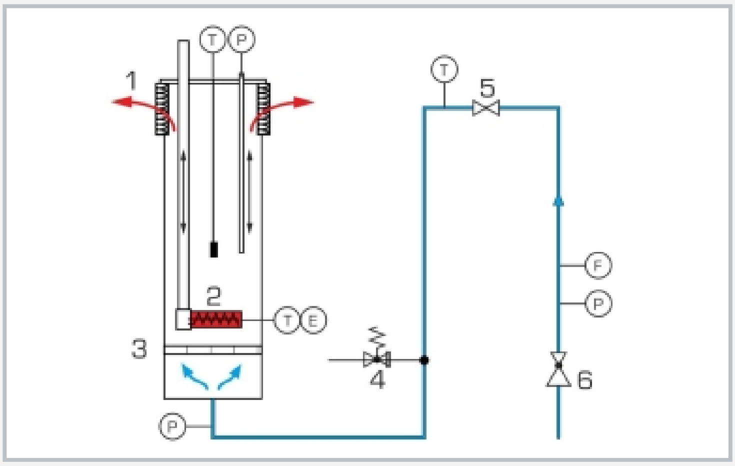
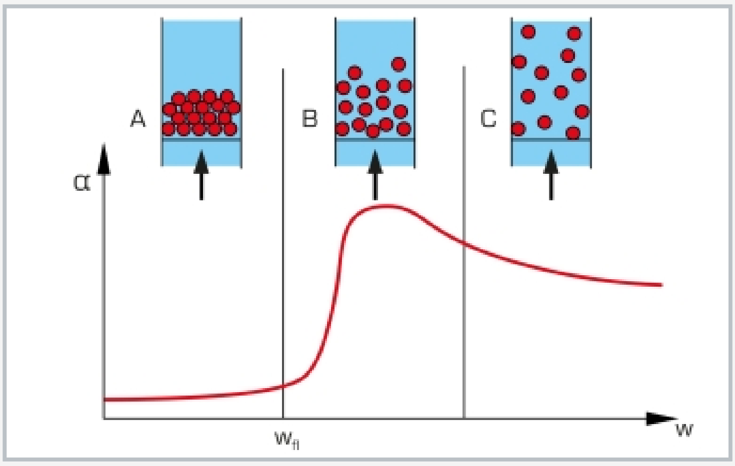
1 display and control panel, 2 air filter, 3 backlit glass reactor, 4 compressed air connection, 5 safety valve, 6 manometer, 7 flow meter, 8 valve for adjusting the air flow rate



1 air filter, 2 moveable heating element, 3 sintered-metal plate, 4 safety valve, 5 valve for adjusting the air flow rate, 6 pressure reducing valve, E power output, F flow rate, T temperature



Dependency of the heat transfer coefficient α on the flow velocity w: A fixed bed, B fluidised bed, C sediment discharge, w_{fl} fluidisation velocity

Specification

[1] examination of the fluidised bed formation and the heat transfer in the fluidised bed
[2] fluidised bed of compressed air and aluminium oxide, particle sizes either 100µm or 250µm
[3] glass reactor, backlit
[4] glass reactor with sintered-metal plate at the inlet and air filter at the outlet
[5] heating element, submersible and with adjustable power output
[6] manual setting of the air flow rate via valve and flow meter
[7] sensors with digital displays for temperature at heater, air inlet, in fluidised bed, pressure upstream of the reactor and in the fluidised bed, air flow rate, heating power
[8] steel rulers for measuring the immersion depth of the heating element and the height of the fluidised bed
[9] safety valve, temperature switch at the heater, air filter at the outlet
[10] GUNT software for data acquisition via USB under Windows 10

Technical data

Glass reactor

- capacity: 2150mL
- filling volume: approx. 1000mL
- operating pressure: 500mbar

Heating element

- power: 0...100W

Measuring ranges

- temperature: 1x 0...100°C, 2x 0...400°C
- flow rate: 0...15Nm³/h
- pressure: 1x 0...25mbar, 2x 0...1600mbar
- power: 0...200W

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 910x560x890mm
Weight: approx. 65kg

Required for operation

compressed air connection: min. 2bar

Scope of delivery

1	experimental unit
2kg	aluminium oxide, 100µm
2kg	aluminium oxide, 250µm
1	steel ruler
1	GUNT software + USB cable
1	hose
1	set of instructional material

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Optional accessories

for Remote Learning
GU 100 Web Access Box
with
WL 225W Web Access Software

Other accessories
WP 300.09 Laboratory trolley