CE 220
Fluidised bed formation

Learning objectives/experiments

- fundamentals of the fluidisation of bulk layers
- observation and comparison of the fluidisation process in water and air
- pressure loss dependent on
  - flow velocity
  - type and particle size of the bulk solid
- determination of the fluidisation velocity and comparison with theoretically calculated values (Ergun equation)
- dependency of the height of the fluidised bed on the flow velocity
- verification of Carman-Kozeny equation

Description

- **experimental investigation of the fluidisation process**
- **comparison of fluidised bed formation in gases and liquids**
- **pressure loss in fixed beds and fluidised beds**

If liquids or gases flow through a layer of solid particles and the fixed bed is loosened to such an extent that the solid particles can move freely, the fixed bed is transformed into a fluidised bed. The pressure loss of the fluid that is flowing through can be used to characterise a fluidised bed. Typical areas of application of fluidised beds include the drying of solids or roasting and combustion processes.

The fluidised bed formation in water and air can be observed using CE 220.

The continuous phase (water or air) flows upwards through the fixed, dispersed phase above a porous sintered-metal plate. If the velocity of the fluid is less than the so-called fluidisation velocity, the flow merely passes through the bulk layer without causing the particles to move. This state is referred to as a fixed bed. At higher velocities, the bed is loosened and the particles begin to move. The fixed bed is thereby transformed into a fluidised bed. An increase in the velocity results in a vertical expansion of the fluidised bed. Once the velocity is sufficiently high, the particles are carried out of the fluidised bed.

In practice, the particles are transported in pipes, for example. In CE 220, filters and the sintered-metal plate hold the particles back.

The fluids' currents are read on rotameters. The water flow rate is adjusted via the speed on the pump. The air volume flow can be adjusted via a separate flow control valve. An electronic, hand-held unit for measuring the pressure loss is included in the scope of delivery. The height of the fluidised beds is read on the scales of the tanks.

The tanks are removable, making it easy to change the bulk solid. Glass-shot beads in a range of particle sizes are provided as the bulk solid.

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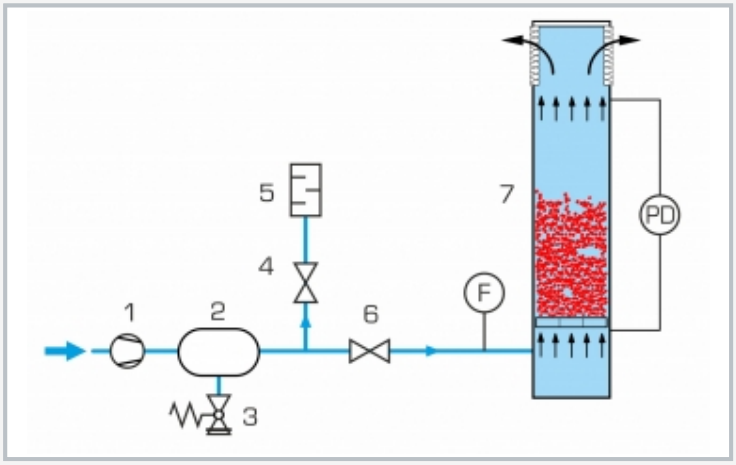
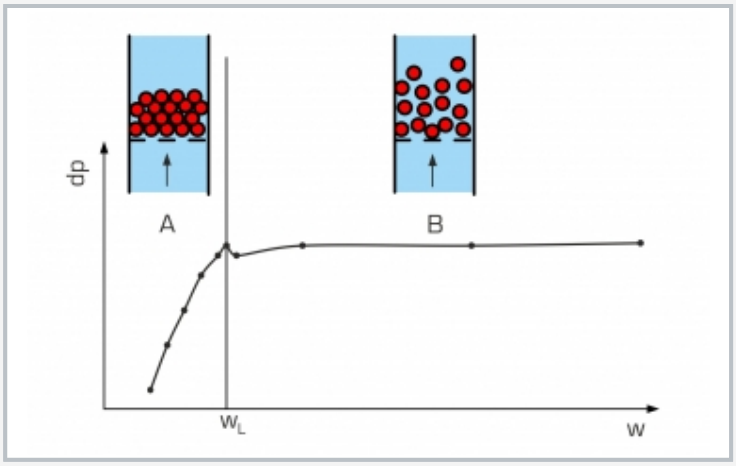
1 water overflow, 2 tank for water, 3 rotameter for water, 4 hand-held measuring unit pressure loss, 5 rotameter for air, 6 tank for air, 7 filter



Experimental setup for fluidised bed formation with air
1 diaphragm compressor, 2 compressed air accumulator, 3 safety valve, 4 bypass valve, 5 silencer, 6 needle valve, 7 tank (air);
F flow rate, PD differential pressure



Pressure loss of a fluidised bed with air flowing through
dp pressure loss, w flow velocity, w_L fluidisation velocity;
A fixed bed, B fluidised bed

Specification

[1] investigation of the transformation from fixed bed to fluidised bed
[2] experiments with air and water next to each other
[3] both tanks removable
[4] scales on the tanks to measure the height of the fluidised bed
[5] water supply via storage tank with diaphragm pump
[6] compressed air supply via compressed air accumulator and diaphragm compressor
[7] volumetric flow rate for air adjustable via valves
[8] flow rate for water adjustable via speed on the diaphragm pump
[9] measurement of pressure loss using electronic, hand-held unit

Technical data

2 tanks
- length: 380mm
- inside diameter: 44mm
- graduation: 1mm
- material: PMMA

diaphragm pump (water)
- max. flow rate: 1,7L/min
- max. head: 70m

diaphragm compressor (air)
- max. volumetric flow rate: 39L/min
- max. pressure: 2bar

water storage tank: approx. 5,5L
compressed air accumulator: 2L

Measuring ranges
- pressure: 0...200mmWC
- flow rate: 0,2...1,6L/min (water)
- volumetric flow rate: 4...33NL/min (air)
- height: 25...370mm

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase; 120V, 60Hz, 1 phase
UL/CSA optional
LxWxH: 750x610x1010mm
Weight: approx. 80kg

Scope of delivery

1 experimental unit
1 packing unit of glass-shot beads (180...300µm; 1kg)
1 packing unit of glass-shot beads (420...590µm; 1kg)
1 set of instructional material

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Optional accessories

020.30009	WP 300.09	Laboratory trolley