CE 520
Cooling crystallisation

Description

- **crystallisation from solutions**
- **investigation of crystal growth in a fluidised bed**
- **transparent materials for observation of processes**

Crystallisation enables dissolved substances from solutions to be transformed into a solid and separated.

This trainer has been developed in cooperation with the **Chair of the Thermal Process Technology at the Martin-Luther University, Halle-Wittenberg (Prof. Dr. Ulrich)**.

A pump delivers a saturated potassium sulphate solution in a circuit with a tank. To prevent premature crystallisation, the solution is heated above saturation temperature using a heating circuit. Both circuits are connected by two heat exchangers. A small amount of this undersaturated solution is fed through the crystallisation cell as a bypass. To crystallise this part of the solution, it is cooled by cooling water using two heat exchangers. Reducing the temperature converts the solution into an oversaturated, metastable state.

The crystallisation cell is a tube fitted with porous filter media at both the inlet and outlet. The removable cell can be opened to allow the addition of seed crystals. The porous filter media are selected in a way that the crystals can't escape from the cell. The flow conditions cause a fluidised bed in the cell. The dissolved potassium sulphate crystallises out of the metastable solution at the seed crystals. The crystals grow. The growth rate can be determined by weighing the crystals before and after the experiment and by measurement of time.

A stirred tank with heat exchanger is available to prepare a saturated potassium sulphate solution. The temperatures in the two tanks and the temperature required in the bypass for crystallisation are recorded and controlled using sensors.

A drying chamber, a balance, a screening machine and a microscope are recommended for evaluating the experiments. Potassium sulphate is not included.

Learning objectives/experiments

- fundamental principle of cooling crystallisation
- investigation of the factors influencing crystal growth
  - oversaturation
  - saturation time

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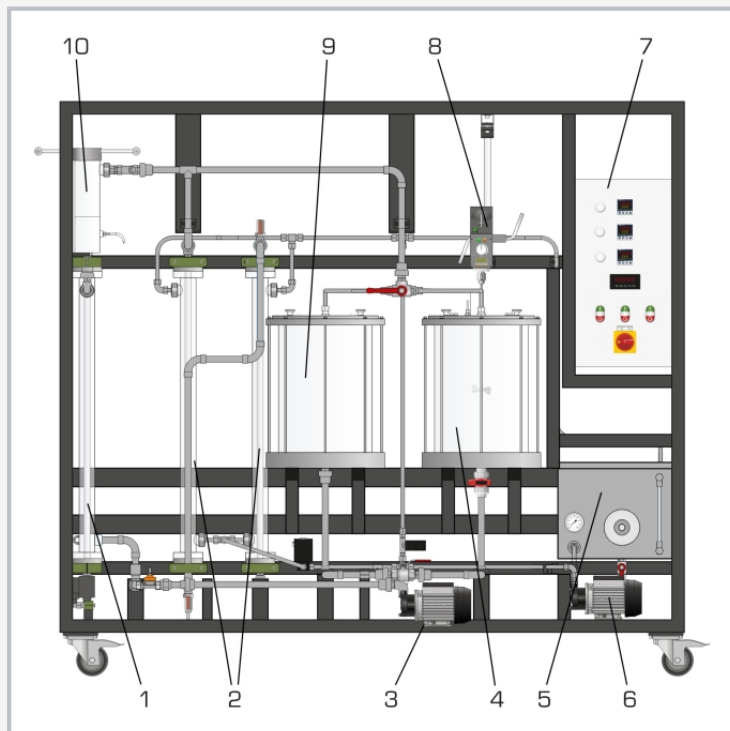
1 heat exchanger for cooling, 2 heat exchanger for heating, 3 solution pump, 4 tank for preparation of saturated solution, 5 tank with regulated heater, 6 heating circuit pump, 7 switch cabinet, 8 stirring machine, 9 tank for undersaturated solution, 10 crystallisation cell
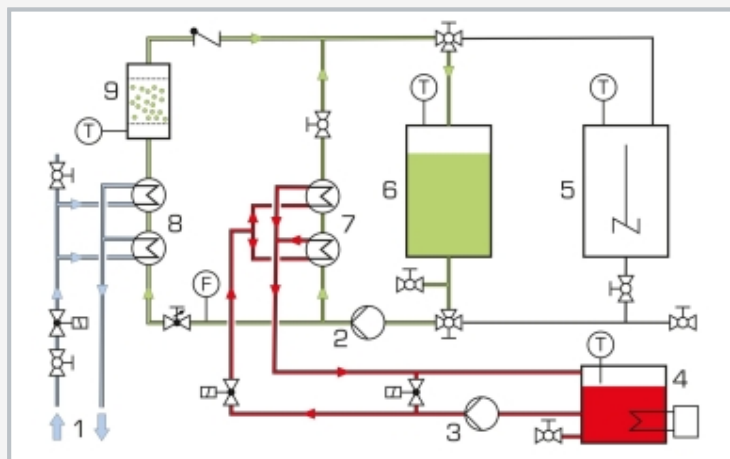
1 external cooling water, 2 solution pump, 3 heating circuit pump, 4 tank with regulated heater, 5 stirred tank for preparation of saturated solution, 6 tank for undersaturated solution, 7 heat exchanger for heating, 8 heat exchanger for cooling, 9 crystallisation cell; T temperature, F flow rate

Specification

[1] crystallisation from solutions in fluidised bed
[2] stirred tank for preparation of a saturated solution
[3] circuit for undersaturated solution with tank, 2 heat exchangers for heating and pump
[4] bypass for oversaturated solution with crystallisation cell and 2 heat exchangers for cooling
[5] removable and fillable crystallisation cell, PMMA
[6] heating circuit with pump, tank, regulated heater
[7] adjustment of flow rate in bypass using valves
[8] measurement and control of temperatures in stirred tank, tank for undersaturated solution and in crystallisation cell

Technical data

Tanks
- stirred tank: approx. 25L
- for undersaturated solution: approx. 25L
- heating circuit: approx. 32L

Pump (solution)
- max. flow rate: approx. 21L/min
- max. head: approx. 38m

Pump (heating circuit)
- max. flow rate: approx. 6L/min
- max. head: approx. 9m

Crystallisation cell
- diameter: approx. 40mm
- height: approx. 80mm

Heater power output: approx. 2kW

Measuring ranges
- temperature: 3x 0...100°C, 1x 0...80°C
- flow rate: 1x 0...12L/min

230V, 50Hz, 1 phase
230V, 60Hz, 1 phase
230V, 60Hz, 3 phases
UL/CSA optional
LxWxH: 2000x800x1850mm
Weight: approx. 255kg

Required for operation

cold water connection: min. 3bar, max. 15°C; drain

Scope of delivery

1   trainer
1   hose
1   set of tools
1   set of instructional material