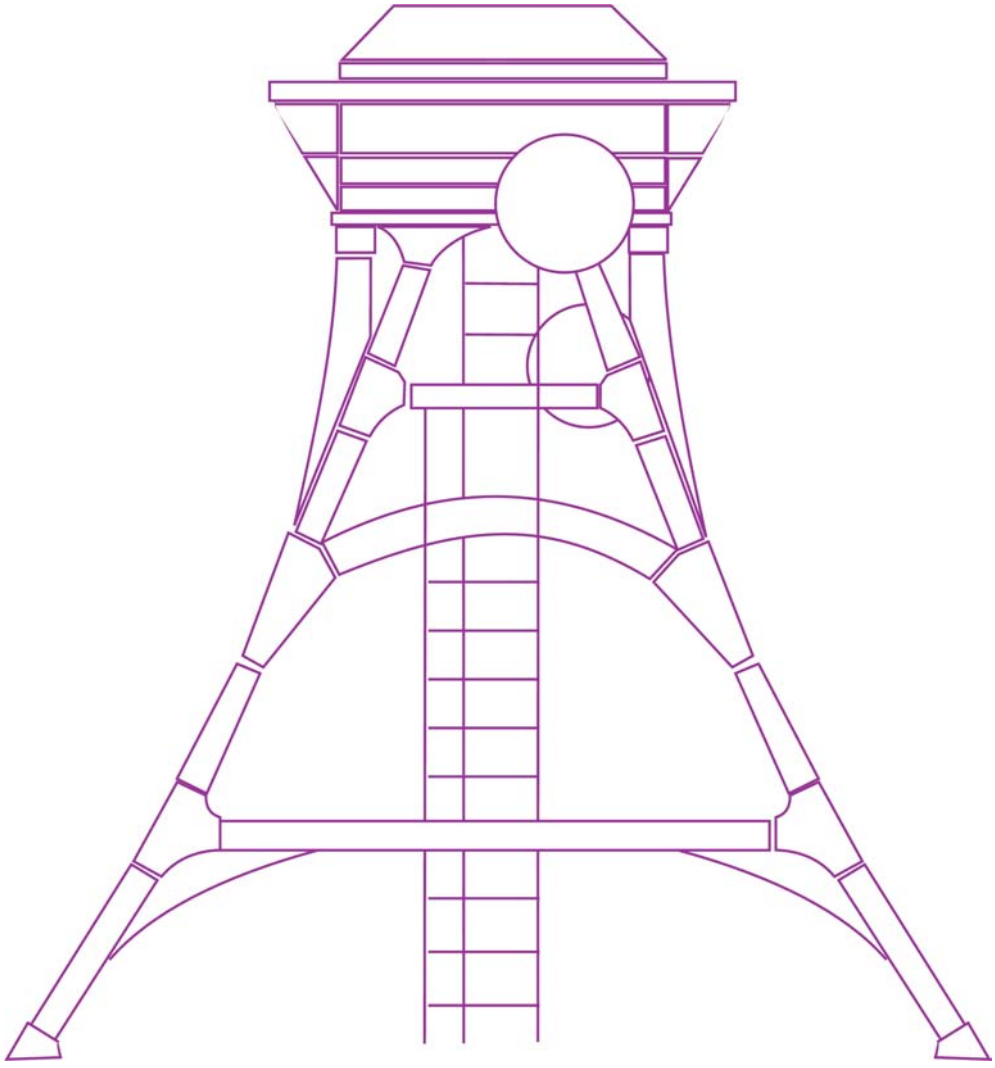
K-UTEC
SONDERSHAUSEN



Crystallisation of Coarse Graines by Means of Cooling Crystallisation or Reaction Crystallisation

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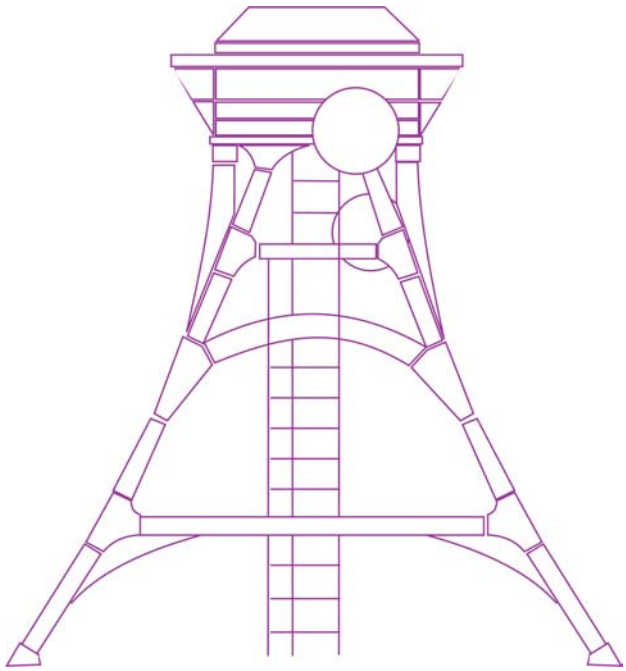


COARSE GRAIN CRYSTALLISATION

By means of Cooling- or reaction-crystallisation

Conventional Technology

Cooling-Crystallisation

- Heat exchange by tube bundle heat exchanger or vacuum evaporation
- Circulation of suspension in closed apparatuses
- Grain size range 0,2 – 1,0 mm in accordance to material system and product requirements

Reaction crystallisation

- Reaction crystallisation is not controllable at normal process solid content
- Residence time of solid and liquid are equal
- Growthing crystals leave the apparatus after a short time
- Crystals are mainly fine grained and sharp edged
- Process must be interrupted frequently, caused by incrustations
- Grain size range 0,1 – 0,5 mm

K-UTEC-Technology

Cooling-Crystallisation

- Heat exchange by tube bundle heat exchanger or heating jacket
- Circulation of suspension in open vessels with integrated clarification area
- grain size range 0,2 – 1 mm in accordance to material system and product requirements
- Advantages for smaller and larger plants

Reaction crystallisation

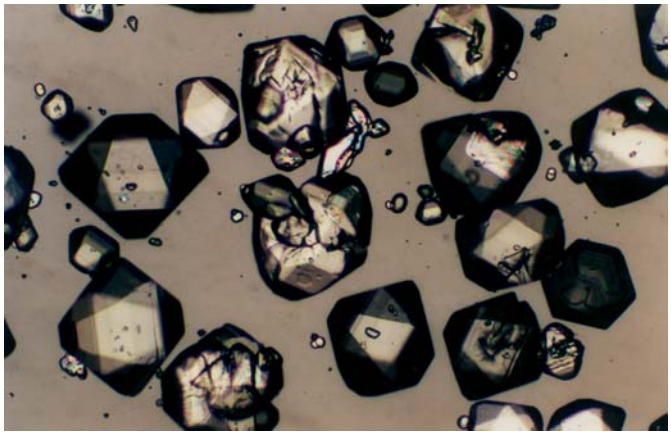
- controlled running of reaction crystallisation in a reactor with integrated clarification area and high concentration of solids in the reaction zone
- residence time of solid and liquid are different; growthing crystals remain longer in the apparatus
- crystalline crop is coarse grained on often spherical
- long operation periods are possible (practical experiences up to 6 month without interruption
- Grain size range 0,2 – 1,0 mm

Improvement of Crystals Quality

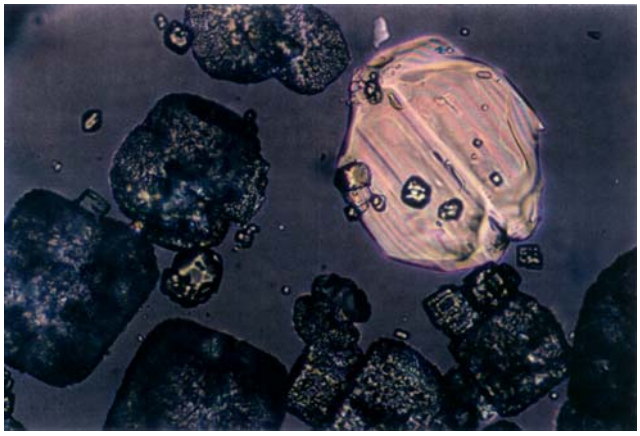
- Increasing of average grain size is possible
- Narrow grain size distribution is possible
- Rounded particles can be produced
- Low amount or none dust forming fine particles
- High purity of crystalline crop is possible

Improvement of Process Control

- Continuously running process in all process steps
- Flexible process management, interruptions of dosing do not require an emptying of apparatuses
- Safe and sure process control
- High process yield, because the reaction crystallisation process is running near the theoretical steady-state conditions
- Long periods of operation possible, because the occurrence of incrustations is low
- High process reliability caused by long residence times of crystals in the apparatuses



a)



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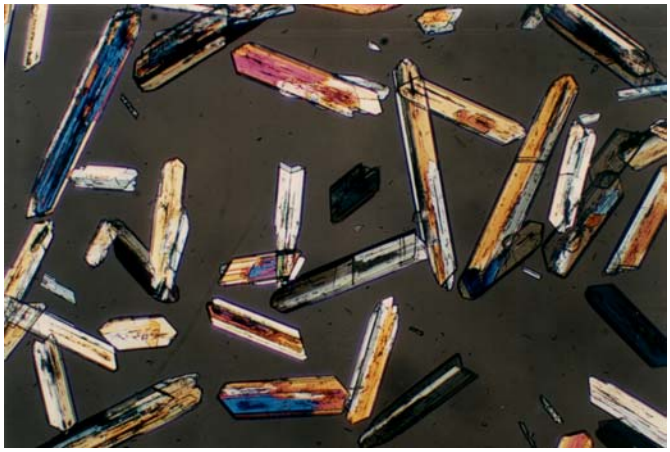
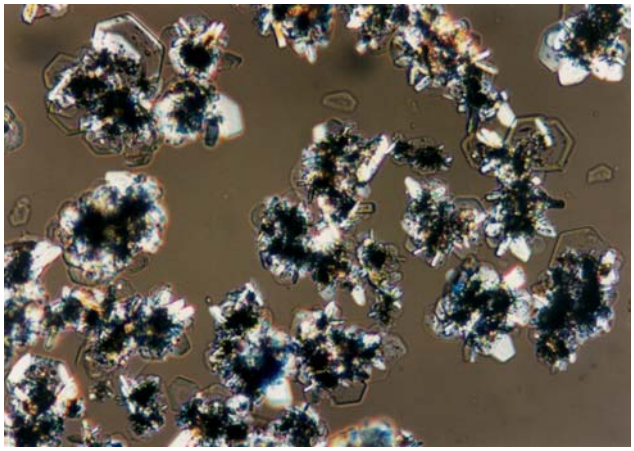


c)



d)

Crystals produced according **K-UTEC** technology:

a) Carnallite ($KCl \cdot MgCl_2 \cdot 6H_2O$)

b) Potassium chloride from carnallite (KCl)

c) Gipsum ($Ca_2SO_4 \cdot 2H_2O$)

d) Rare earth ($NaLa(SO_4)_2$)

The **K-UTEC** crystalliser is he main part of the **K-UTEC** crystallisation procedure. Depending on the system it is possible to manufacture crystals with grain size distributions up to an upper grain size of 1.5 mm.

The **K-UTEC** crystalliser consists of a cylindrical vessel (1) with a flat bottom (2) and overflow launder (4). The vessel is sectionalised by a circular metal sheet (5) into a central part with high solid content and an outer clarification zone with low solid content.

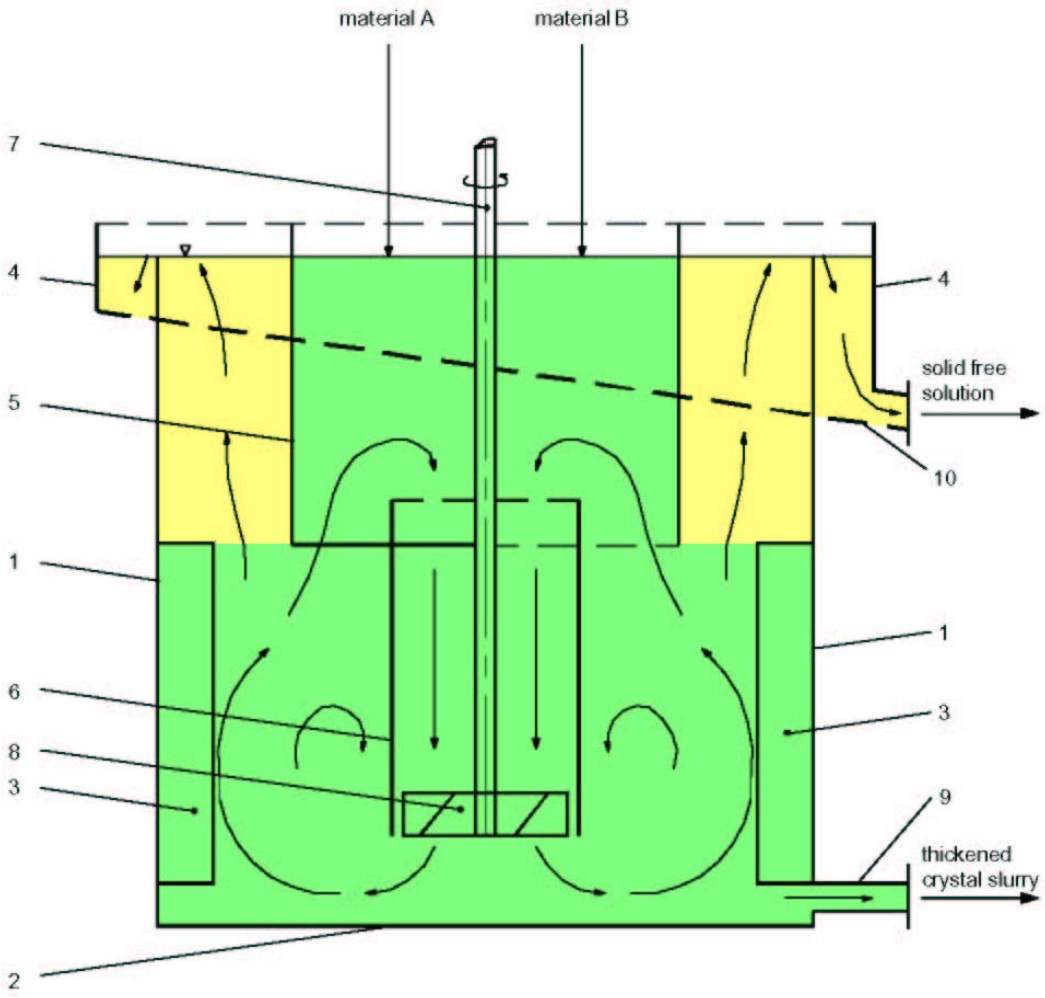
The crystalliser is fitted with an axial stirrer, composed of a vertical stirrer shaft (7) and a pitched blade stirrer (8). The stirrer produces a material flow, directed to the bottom of the vessel, which comes out at the lower end of the draught tube (6) and is sucked in again at the upper end. Wall baffles (3) and if needed additional flow baffling equipment produce a well defined loop streaming inside the apparatus.

Material feed to the apparatus takes place mainly as flow by gravity. The produced crystalline crop is withdrawn from the reactor via the discharge socket (9), whereas the pre-clearified solution flows out through the overflow launder (4).

For heat exchange the crystalliser is fitted with a double-walled jacket.

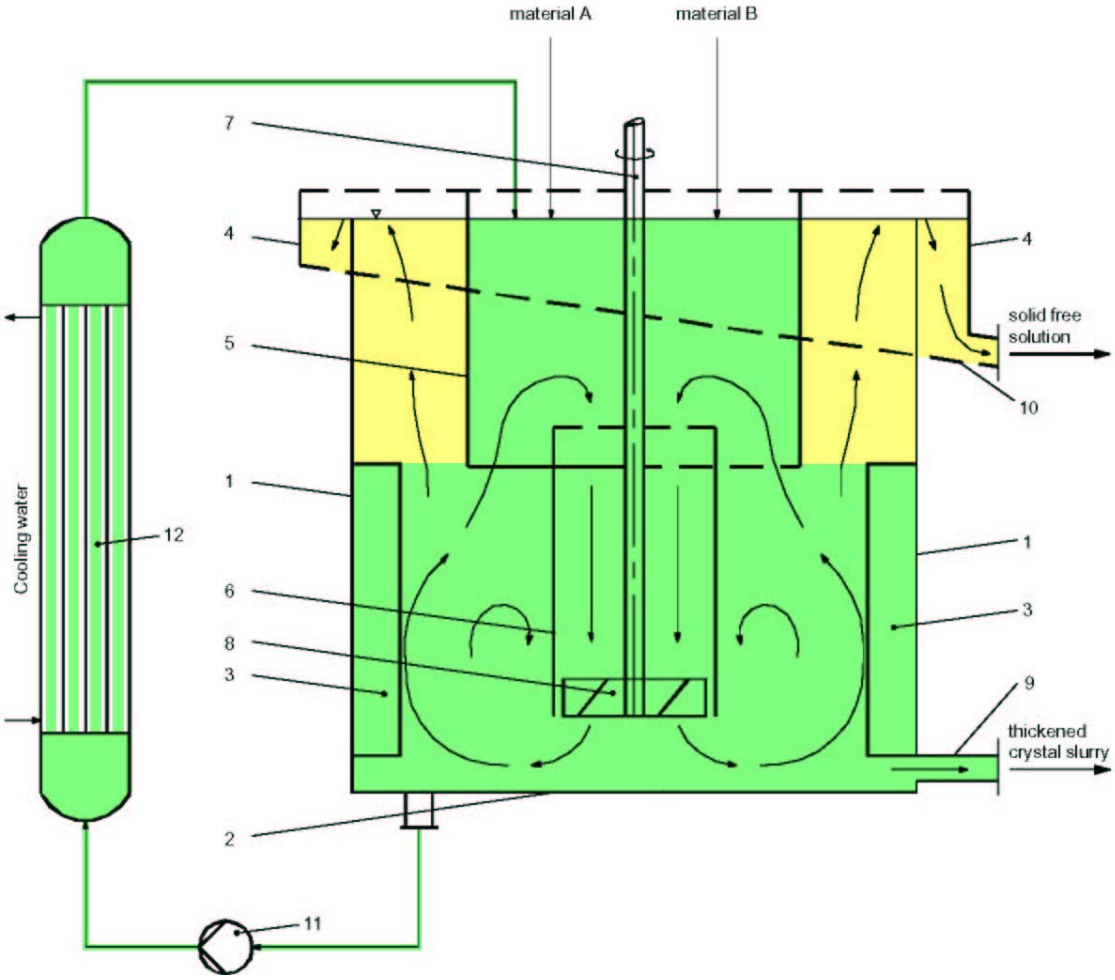
The **K-UTEC** crystalliser is applicable for cooling crystallisation as well as for reaction crystallisation. It is possible to built the crystalliser up to a apparatus capacity of 350 m³. For heat exchange in cooling crystallisation processes it is possible to fit the crystalliser with a forced circulation through an outer heat exchanger.

TYPICAL CONSTRUCTION OF CRYSTALLISER



1	cylindrical vessel
2	flat or conical bottom
3	wall baffles
4	overflow launder
5	circular separation sheet
6	draft tube
7	vertical stirrer shaft
8	pitched blade stirrer
9	crystal discharge
10	solution discharge

Typical Construction Principle of the Crystalliser with outer Suspension Circulation



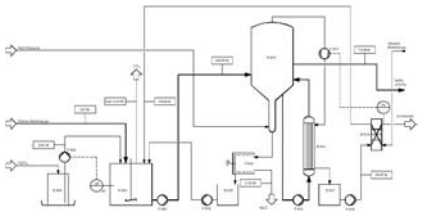
1	cylindrical vessel
2	flat or conical bottom
3	wall baffles
4	overflow launder
5	circular separation sheet
6	draft tube
7	vertical stirrer shaft
8	pitched blade stirrer
9	crystal discharge
10	solution discharge
11	circulation pump
12	heat exchanger

Process development, process field tests, Process Design and Basic Engineering for any application.

We develop “tailored” solutions for every application, proceeding from original raw materials by the following steps:

- Crystallisation test work in our test field with apparatuses with capacities of 20 litres, 100 litres and 400 litres with the materials provided by our clients

- Crystallisation test work in the production facilities of our client as by-pass plant to the running process



a) process flow sheet development

b) process development in **K-UTEC**-test field

c) process development at site (bypass plant)

- Preparation of product samples

- Recovering of all required process data from continuously running test work

- Process and technology development for any specific application

- Process design

- Basic engineering

- Commissioning of industrial plants by experienced engineers and technicians

Our Performances

Process Development, Process Testing

Process Design and Basic Engineering

For any Field of Application

We develop “tailored” solutions for any case of application proceeding from original raw materials by the following course of processing:

- Bench scale crystallisation test work in our test field with different sizes of apparatuses (20 l, 100 l, 400 l,) with raw materials, provided by the client·
- Crystallisation test work at the client’s facilities in bypass operation to the process with materials taken directly from the running plant. Apparatus capacities of 100 l, 400 l and 1000 l are possible (rental apparatuses).
- Evaluation and assessment of product samples.
- Recovery of all necessary process data from continuously running test work.
- Process development for any specific application.
- Process Design
- Basic Engineering
- Commissioning of industrial plants, carried out by experienced **K-UTEC** employees.

Examples for Material Systems

➢ Cooling Crystallisation

Crystallisation of single salts like:

- KCl
- $(NH_4)_2SO_4$
- K_2SO_4
- $Na_2SO_4 \cdot 10H_2O$
- $MgSO_4 \cdot 7H_2O$
- $CuSO_4 \cdot 5H_2O$
- KNO_3
- NH_4Cl

Crystallisation of double salts like:

- $K_2SO_4 \cdot MgSO_4 \cdot 6H_2O$ (schönite)
- $3K_2SO_4 \cdot Na_2SO_4$ (glaserite)
- $KCl \cdot MgCl_2 \cdot 6H_2O$
- $KAl(SO_4)_2 \cdot 12H_2O$

➢ Reaction Crystallisation

- KCl
- K_2SO_4
- Na_2SO_4
- $K(NH_4)SO_4$
- $KAl(SO_4)_2 \cdot 12H_2O$
- $NH_4Al(SO_4)_2 \cdot 12H_2O$
- $Na_2SO_4 \cdot La_2(SO_4)_3 \cdot nH_2O$
- K-Aluminate
- $(NH_4)_2SO_4 \cdot NiSO_4 \cdot 6H_2O$