

## Target Group

The course is aimed at scientists, engineers and technicians dealing with crystallization and precipitation processes.

## Schedule:

The course consists of two days of 5 lectures and 2 exercises with a length 90 minutes each. At demand, special subjects can be included.

## Required knowledge

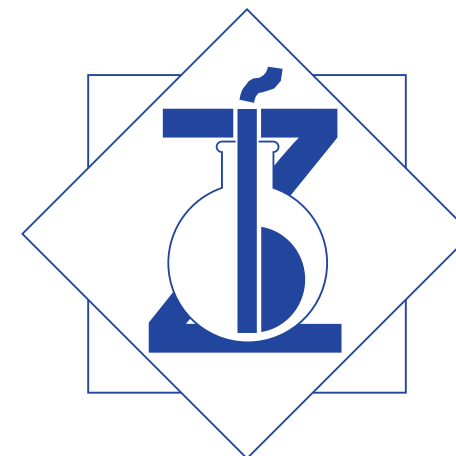
Basic knowledge in Physical Chemistry and/or Chemical Engineering.

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## Training Course

The use of phase diagrams to describe crystallization and dissolution processes during Sylvinit and Carnallite processing

*- An introduction to the fundamentals of the system NaCl-KCl-MgCl<sub>2</sub>-H<sub>2</sub>O -*

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## Aims

The equilibriums in the system NaCl-KCl-MgCl<sub>2</sub>-H<sub>2</sub>O are the basis for the processing of Sylvinit and Carnallite. Knowledge of the phase relations as well as equilibrium conditions allows the deduction of conditions favorable for raw salt processing or in-situ leaching technologies. Due to its incongruent solubility, the behavior of Carnallite differs from other salt minerals. The use of phase diagrams is the most favorable way to visualize the complex relations in the system NaCl-KCl-MgCl<sub>2</sub>-H<sub>2</sub>O. Saturation concentrations as well as crystallization paths can be deduced easily.

Based on his experiences in teaching salt chemistry at university level for many years, the lecturer Dr. G. Ziegenbalg gives an overview on fundamental and applied aspects of the system NaCl-KCl-MgCl<sub>2</sub>-H<sub>2</sub>O. Starting with the binary systems all relevant equilibriums will be reviewed. Different types of graphical representation are presented and discussed. The benefits of phase diagrams for quantitative calculations will be explained in detail. In special seminars, construction and the use of phase diagrams will be trained both for qualitative and quantitative calculations.

## Program

1. **Fundamentals**
  - 1.1 Solubility diagrams
  - 1.2 Driving forces of crystallization
  - 1.3 Fundamentals of crystallization kinetics
  - 1.4 Concentration units
2. **The binary subsystems**
  - 2.1 The system NaCl-H<sub>2</sub>O
  - 2.2 The system NaCl-KCl-H<sub>2</sub>O
  - 2.3 The system MgCl<sub>2</sub>- H<sub>2</sub>O
3. **The system NaCl-KCl-H<sub>2</sub>O**
  - 3.1 Graphical representation in rectangular co-ordinate systems
  - 3.2 Graphical representation in the Gibbs triangle
  - 3.3 Saturated / unsaturated systems
  - 3.4 Crystallization paths during isothermal evaporation
  - 3.5 Crystallization under polythermal conditions
  - 3.6 Quantitative calculations
4. **The system KCl-MgCl<sub>2</sub>-H<sub>2</sub>O**
  - 4.1 Graphical representation
  - 4.2 Characteristics of Carnallite
  - 4.3 Congruent /Incongruent solubility

5. **The system NaCl-KCl-MgCl<sub>2</sub>-H<sub>2</sub>O**
  - 5.1 Characteristics of Carnallite
  - 5.2 Graphical representation in rectangular co-ordinate systems
  - 5.3 Graphical representation in the Gibbs triangle
  - 5.4 Crystallization paths
  - 5.5. Quantitative calculations
6. **Conclusions**