



**IBZ - Salzchemie**  
GmbH & Co. KG

## 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  $\text{NaCl} - \text{KCl} - \text{MgCl}_2 - \text{H}_2\text{O}$



## TIME TABLE

<b>1st day</b>	
08:30 - 09:00	Welcome + Introduction
09:00 - 10:30	1st lecture
11:00 - 12:30	2nd lecture
12:30 - 13:30	Lunch
13:30 - 15:00	1st exercise
15:30 - 16:00	Visit of our laboratories
19:00	Dinner
<b>2nd day</b>	
08:30 - 10:00	3rd lecture
10:30 - 12:00	2nd exercise
12:00 - 13:00	Lunch
13:00 - 14:30	4th lecture
15:00 - 17:00	Visit of "terra mineralia" ( <a href="http://www.terra-mineralia.de">www.terra-mineralia.de</a> )
<b>3rd day</b>	
08:30 - 10:00	5th lecture
10:30 - 12:00	3rd exercise
12:00 - 13:00	Lunch
13:00 - 15:00	Final lecture, summary and discussions

## NOTES

Additional information for registration, request for hotel reservation, etc.

## REGISTRATION VIA POST, FAX, MAIL



**IBZ - Salzchemie GmbH & Co. KG**

Gewerbepark „Schwarze Kiefern“  
09633 Halsbruecke, Germany  
Tel.: +49 3731 200-155  
Fax: +49 3731 200-156  
Mail: [info@ibz-freiberg.de](mailto:info@ibz-freiberg.de)  
[www.ibz-freiberg.de](http://www.ibz-freiberg.de)

**IBZ - Salzchemie GmbH & Co. KG**

Gewerbepark „Schwarze Kiefern“  
09633 Halsbruecke, Germany





The equilibriums in the system NaCl - KCl - MgCl<sub>2</sub> - H<sub>2</sub>O are the basic for the processing of Sylvinite 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 easily deduced.

Based on his experiences in teaching salt chemistry at university level for many years, the lecturer Prof. Dr. 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 presentation will be shown and discussed.

The benefits of phase diagrams for quantitative calculations will be explained in detail. In special seminars, the construction and use of phase diagrams will be trained both for qualitative and quantitative calculations.

## ACCOMODATION

We have pre-booked rooms, please inform us as soon as possible when you are interested. Seminar dates and course fees (including course materials, lunch and evening event) are given in the attached information. The course can also be given as In-House Seminar. Please contact us for details.

## TARGET GROUP & KNOWLEDGE

The course is aimed at scientists, engineers and technicians dealing with crystallization and precipitation processes. Basic knowledge in physical chemistry and chemical engineering are required.

## TOPICS OF THE EXERCISES WILL BE

- ▶ Conversion of concentration units
- ▶ Calculation of crystallization paths
- ▶ Calculation of crystallization processes
- ▶ Calculation of evaporation heats
- ▶ Development of mass balances



Minimum participants **5**, maximum participants **15**

## PROGRAM

### 1 The fundamentals of salt-solution equilibriums

- 1.1 Solubility diagrams
- 1.2 Concentration units
- 1.3 The phase rule
- 1.4 Temperature and pressure dependence of solid-liquid equilibriums

### 2 Crystallization - Fundamentals

- 2.1 Crystallization kinetics
- 2.2 Nucleation and crystal growth
- 2.3 Possibilities to influence crystal growth

### 3 The binary subsystems

- 3.1 The system NaCl - H<sub>2</sub>O
- 3.2 The system KCl - H<sub>2</sub>O
- 3.3 The system MgCl<sub>2</sub> - H<sub>2</sub>O

### 4 Ternary systems

- 4.1 The system NaCl - MgCl<sub>2</sub> - H<sub>2</sub>O
  - 4.1.1 Characteristics of the MgCl<sub>2</sub> - hydrates
  - 4.1.2 Crystallization as result of mixing of more solutions
  - 4.1.3 Calculations
- 4.2 The system NaCl - KCl - H<sub>2</sub>O
  - 4.2.1 Graphical representation in different coordinate systems
  - 4.2.2 Crystallization paths
  - 4.2.3 Calculations

### 5 The system NaCl - KCl - MgCl<sub>2</sub> - H<sub>2</sub>O

- 5.1 Graphical presentation in different coordinate systems
- 5.2 Graphical presentation in the Gibbs triangle
- 5.3 Crystallization paths
- 5.4 Quantitative calculations

### 6 Carnallite Processing

- 6.1 Cold decomposition
- 6.2 Hot decomposition
- 6.3 Carnallite crystallization

### 7 Scale Formation

- 7.1 Characteristics of Gypsum / anhydrite
- 7.2 The system NaCl - CaSO<sub>4</sub> - H<sub>2</sub>O
- 7.3 The system NaCl - KCl - CaSO<sub>4</sub> - H<sub>2</sub>O

### 8 Heat and material balances

- 8.1 Basic principles
- 8.2 Material balances
- 8.3 Heat balances / calculation of evaporation enthalpies

## REGISTRATION

### Training course

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

Registration deadline is 7 days before the course starts. Applications will be considered according to the order of receipt.

### Wanted Date of Course

### Event participant/s

Mr.  Mrs.

Title / Profession

Surname

First name

Company

Address

Phone / Fax

Mail

You can get information about dates of seminars and course fees from the flyer included. If the application will be canceled one week before the seminar starts, you will get money back minus 10% of the course fee for administrative reason. If you cancel later than one week before the course starts there will be no refund.

Date, Sign, Company stamp