

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

## TIME TABLE

<b>1st day</b>	
10:00 - 12:00	Welcome / 1st lecture
12:00 - 13:00	Lunch
13:00 - 14:30	2nd lecture
15:00 - 16:30	3rd lecture
<b>2nd day</b>	
08:00 - 10:00	1st exercise
10:30 - 12:00	4th lecture
12:00 - 13:00	Lunch
13:00 - 14:30	5th lecture
15:00 - 16:30	6th lecture
19:00	Dinner
<b>3rd day</b>	
08:30 - 10:00	2nd exercise
10:30 - 12:00	7th lecture
12:00 - 13:00	Lunch
13:00 - 14:30	8th lecture
15:00 - 16:30	3rd exercise
<b>4th day</b>	
08:30 - 10:00	9th lecture
10:30 - 12:00	10th lecture
12:00 - 13:00	Lunch
13:00 - 15:00	4rd exercise / final discussion

## NOTES

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

## REGISTRATION VIA POST, FAX, MAIL



### IBZ - Salzchemie GmbH & Co. KG

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## TRAINING COURSE

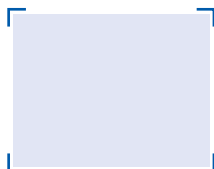
### The solid - liquid equilibriums of the quinary system of oceanic salts

An introduction of the fundamentals of the  
system, its graphical presentation and the  
quantitative description of the equilibriums



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The solid - liquid equilibriums in the quinary system  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Mg}^{2+}$  /  $\text{Cl}^-$ ,  $\text{SO}_4^{2-}$  //  $\text{H}_2\text{O}$  and the subsystems have immense economic and scientific relevance. They are the basic for potash and salt production. The formation of salt deposits can only be explained when the stable and metastable phase equilibriums are understood. Although the system has already been investigated for more than 100 years, the solid-liquid equilibriums of the so called quinary system of oceanic salts are still the subject of many researches. The quinary system consists of 6 binary, 9 ternary and 5 quaternary subsystems. There are hundreds of publications summarizing the solubility of these substances. In many cases it is difficult to assess the given data. The phase equilibriums are often very complex and understanding them requires the graphical presentation of stable and metastable crystallization fields. This is one of the main subjects in the course as well as the presentation of phase relations in the quinary system.

Based on his experience in teaching salt chemistry at university levels for many years, the lecturer Prof. Dr. Ziegenbalg gives an overview on fundamental and applied aspects of the quinary system. Starting with the subsystems all relevant minerals and equilibriums will be reviewed. The phase equilibriums are discussed and also the properties of selected double salts. Possibilities of their production are summarized as well. In special seminars the construction and usage 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.



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

## PROGRAM

- 1** **Fundamentals**
  - 1.1 Thermodynamics
  - 1.2 Stable / metastable equilibriums
  - 1.3 The phase rule
  - 1.4 Concentration units
- 2** **Historical development of the graphical representation of salt water systems**
- 3** **Binary systems**
  - 3.1 Possibilities of graphical representation
  - 3.2 The system  $\text{NaCl} - \text{H}_2\text{O}$
  - 3.3 The system  $\text{KCl} - \text{H}_2\text{O}$
  - 3.4 The system  $\text{Na}_2\text{SO}_4 - \text{H}_2\text{O}$
  - 3.5 The system  $\text{MgSO}_4 - \text{H}_2\text{O}$
  - 3.6 The system  $\text{K}_2\text{SO}_4 - \text{H}_2\text{O}$
  - 3.7 The system  $\text{MgCl}_2 - \text{H}_2\text{O}$
  - 3.8 Quantitative calculations
- 4** **Ternary systems**
  - 4.1 Possibilities of graphical representation
  - 4.2 The system  $\text{NaCl} - \text{KCl} - \text{H}_2\text{O}$
  - 4.3 The system  $\text{NaCl} - \text{MgCl}_2 - \text{H}_2\text{O}$
  - 4.4 The system  $\text{KCl} - \text{MgCl}_2 - \text{H}_2\text{O}$
  - 4.5 The system  $\text{NaCl} - \text{Na}_2\text{SO}_4 - \text{H}_2\text{O}$
  - 4.6 The system  $\text{MgCl}_2 - \text{MgSO}_4 - \text{H}_2\text{O}$
  - 4.7 The system  $\text{K}_2\text{SO}_4 - \text{KCl} - \text{H}_2\text{O}$
  - 4.8 The system  $\text{Na}_2\text{SO}_4 - \text{K}_2\text{SO}_4 - \text{H}_2\text{O}$
  - 4.9 The system  $\text{Na}_2\text{SO}_4 - \text{MgSO}_4 - \text{H}_2\text{O}$
  - 4.10 The system  $\text{K}_2\text{SO}_4 - \text{MgSO}_4 - \text{H}_2\text{O}$
  - 4.11 Quantitative calculations
- 5** **Quaternary systems**
  - 5.1 Systems with one common ion
    - 5.1.1 Possibilities of graphical presentation
    - 5.1.2 The system  $\text{NaCl} - \text{KCl} - \text{MgCl}_2 - \text{H}_2\text{O}$
    - 5.1.3 The system  $\text{Na}_2\text{SO}_4 - \text{K}_2\text{SO}_4 - \text{MgSO}_4 - \text{H}_2\text{O}$
  - 5.2 Reciprocal salt pairs
    - 5.2.1 Possibilities graphical presentation
    - 5.2.2 The system  $2 \text{NaCl} / \text{K}_2\text{SO}_4 - \text{H}_2\text{O}$
    - 5.2.3 The system  $2 \text{NaCl} / \text{MgSO}_4 - \text{H}_2\text{O}$
    - 5.2.4 The system  $2 \text{KCl} / \text{MgSO}_4 - \text{H}_2\text{O}$
- 6** **The quinary system**
  - 6.1 Possibilities of graphical presentation
  - 6.2 The isotherms at 25 °C, 50 °C, 75 °C, 90 °C
  - 6.3 Polythermal presentation
- 7** **Outlook**



## REGISTRATION

### Training course

### The solid - liquid equilibriums of the quinary system of oceanic salts

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

### Wanted Date of Course

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### Event participant/s

Mr.  Mrs.

Title / Profession  
.....

Surname  
.....

First name  
.....

Company  
.....

Address  
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Phone / Fax  
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Mail  
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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.

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Date, Sign, Company stamp