Schedule

Sunday, 22rd September
4.30 pm - 6 pm
Introduction of Participants

Monday, 23th September
8 am - 9.30 am
Mineralogical Basics
PD Dr. Katja Emmerich (CMM, KIT)

9.45 am - 11.15 am
Hydratation Properties of Clay Minerals
Dr. Eric Ferrage (Uni Poitiers, Frankreich)

Coffee break

11.45 am – 1.15 pm
Dielectric Properties of Water and Solutions
Dr. Udo Kaatze (Uni Göttingen)

Lunch break

2.15 pm - 3.45 pm
Models for the Permittivity of Soils
Dr. Norman Wagner (MFPA Weimar)

Coffee break

4.15 pm - 5.45 pm
Permittivity Measurement & Determination of Moisture Content in Soils
Dipl.-Ing. Franz Königer (IFG, KIT)

Maximum no. of participants: 15

Provisional registration via contact (email) until **31st May 2013** including short description on status and interest of research (abstract)

Final registration after confirmation via homepage www.cmm.kit.edu

Confirmation follows until **June 15th 2013**

Participation fee: 250 €
PhDs/students: 100 €

Venue
Bauhaus University Weimar
Room 001
Coudraystraße 11C
99423 Weimar

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June 2012

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Karlsruher Institut für Technologie

Center of Competence for Material Moisture

2. Autumn School

Moisture measurement in porous mineral materials

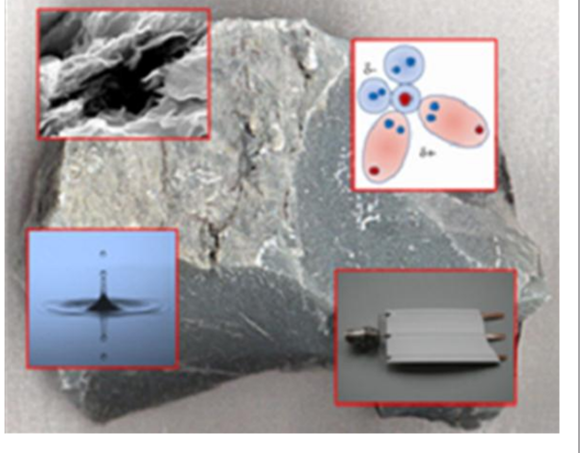
Basics, methods and techniques for characterization of materials and material moisture

September 22rd-23th, 2013*

Weimar

*) preceding CMM and ISEMA Conference, 24th-27th October 2013, Weimar

Competence Center for Material Moisture (CMM)



Introduction of Participants

Each participant gives a short overview on her/his research interests.
Discussion will be continued during joint dinner.

Mineralogical Basics

PD Dr. Katja Emmerich (CMM, KIT)

Clay minerals absorb water on the surface and in hydration shells of interlayer cations. Owing to this property, clay minerals are very important as raw materials to research and industry.
Knowledge of the water absorption in clays and soils are essential for the understanding of wetting and drying processes and for measuring of the moisture.
The structural similarities and differences between swellable and non-swellable clay minerals together with laboratory methods for identification and characterization of clay minerals will be presented.

Hydratation Properties of Clay Minerals

Dr. Eric Ferrage (Uni Poitiers, Frankreich)

Clay minerals contain water in different forms

- structural hydroxyl groups
- absorbed water on (upper) surfaces
- in hydrate envelopes of exchangeable interlayer cations - smectites
-

0W-, 1W- and 2W-textures develope in dependency of the environmental conditions and the hydration energy of the interlayer cations. These textures can be proved by means of x-ray analysis due to the basic distance of the smectites.
Due to the varying layer charge within a mineral and the heterogeneous occupancy of the interlayers by several cations (Na^+, Ca^{2+}, Mg^{2+}) 0W-, 1W- and 2W-textures can occur next to each other.
This phenomenon causes both, widening and shifting of the observed basis reflexion. An exact description of the hydration state is only possible by modeling of the diffractograms by using mixed layer components.
Furthermore the difference between inner crystalline and osmotic swelling will be highlighted.

Dielectric Properties of Water and Solutions

Dr. Udo Kaatze (Uni Göttingen)

The measuring of the moisture content by means of high frequency electromagnetic waves is based on the coupling of the waves to the electric charge distribution. The coupling to the dielectric properties of the matter and especially to the polarization process of water in an electric field plays an outstanding part due to water having a constant dipole because of its atomic texture.
After an introduction into the dielectric properties of water (relaxation processes in dependency of the frequency), dielectric spectra of aqueous solutions of nonpolar organic molecules, ion solutions and dipolar molecules will be discussed.

Models for the Permittivity of Soils

Dr. Norman Wagner (MFPA Weimar)

Porous mineral materials, e.g. soils, represent strongly simplified 3-phase systems (solid, aqueous pore-solution, air). The obvious differences in the real part of the relative permittivity of free water compared to other phases is used in applications by means of high-frequency electromagnetic measurement techniques to determine the volumetric water content of the soil with empirical or semi-empirical approaches from measured apparent permittivity.
However, relaxation effects due to interface processes disturb the quantification of the water content with these techniques.
In terms of modeling the effective complex permittivity of porous mineral materials, besides empirical and semi-empirical approaches, mixture equations as well as broadband relaxation models will be illustrated and their advantage and drawbacks will be discussed.

Permittivity Measurement & Determination of Moisture Content in Soils

Dipl.-Ing. Franz Königer (IFG, KIT)

Various dielectric moisture-measuring techniques are employed for the determination of the spatial distribution and temporary alteration of moisture content in soils and mineral mixtures. These dielectric methods are usually divided into capacitive methods and microwave methods.
The capacitive method uses the dependency of a condenser or the detuning of a resonant circuit due to material moisture. Methods using microwaves are based on interaction between material and high-frequency electromagnetic waves.
Conventional measuring methods (TDR, FD, SAR and GPR) and associated sensors will be presented. The advantages and limits of these methods will be shown on geotechnical and technical applications.
The illustrations will take the already worked out complexity of water binding on mineral surfaces, several relaxation processes and sample size and respectively sample geometry of heterogeneous materials into account.