

Concrete / Construction Chemistry Laboratory

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Introduction

We perform both fundamental research and application-oriented research (R&D) on cement-based building materials. With our work we aim at improving the sustainability of building materials. By studying alternative binder systems and concrete of improved durability, we aim at reducing their energy consumption and CO₂-emission.

At the Concrete / Construction Chemistry Laboratory, we use our competence in the fields of concrete technology (e.g., self-compacting concrete, recycled aggregate concrete) and construction chemistry in national and international research project.

We act as consultants in all our scientific and technical fields and we offer investigations and measurements on a service basis. For our partners, we research and bring to being sound solutions in demanding areas. In all our activities, we remain independent and impartial.

Cement hydration and microstructure

A main research focus is modelling of cement hydration. The composition of the solid and liquid phases during hydration is examined with a series of experimental methods and compared to the results of thermodynamic modelling (Figure 1).

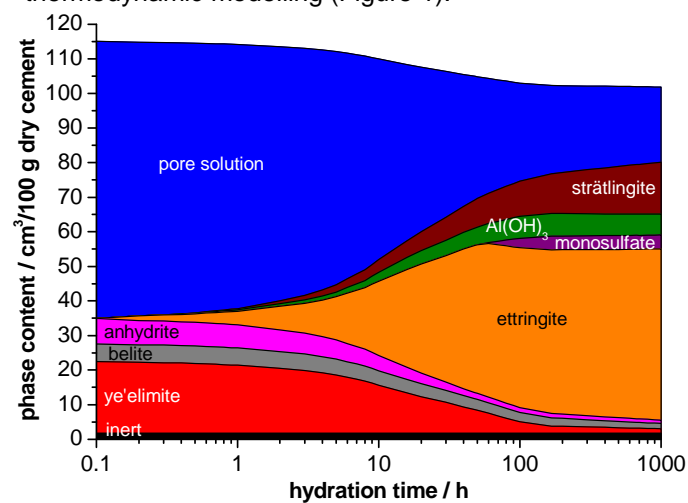


Figure 1: Thermodynamic modeling of hydration of a calcium sulfoaluminate cement

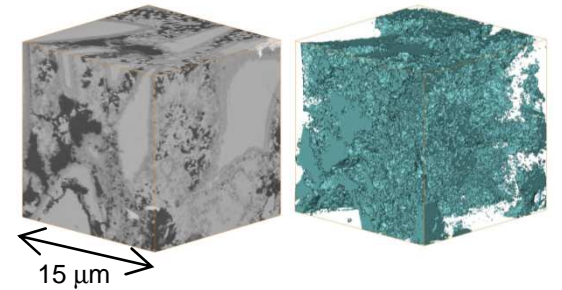


Figure 2: Focussed-ion beam nanotomography of a blast-furnace slag cement paste (left) and its pore structure (right)

Cement pastes and mortars are multiple phase composites which undergo a complex structural and chemical metamorphosis during their hardening process. In particular the porosity and the pore network are paramount for material properties like strength, permeability and durability. Quantitative morphological and topological characterization of pore structures is fundamental for the physical modeling of such properties.

Durability and sustainability

One of our main activities deals with the interaction between cement-based materials and the environment leading to concrete damages. The ingress or loss of ions critically influences the stability and the durability of concrete. The mechanisms are examined based on the microstructure and on the transport processes. Solutions for the development of more resistant concrete are investigated.

Additionally, we investigate the causes of shrinkage-induced cracks in concrete, which may lead to a reduction of the durability. The goal is to develop concrete mixtures with reduced shrinkage-induced cracking and improved durability.



Figure 3: Ganter bridge, Switzerland

Figure 4: Sulfate attack on concrete with formation of thaumasite. Thin section, transmitted light (Belchen tunnel, Switzerland)

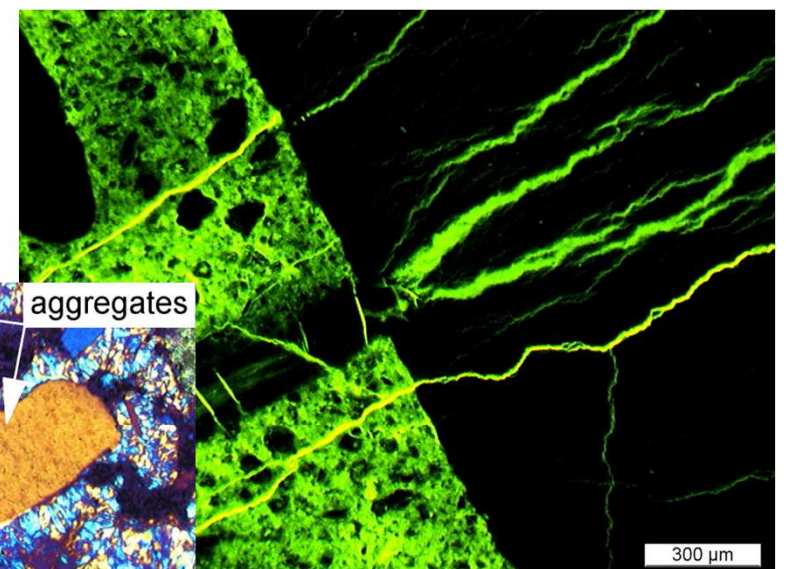
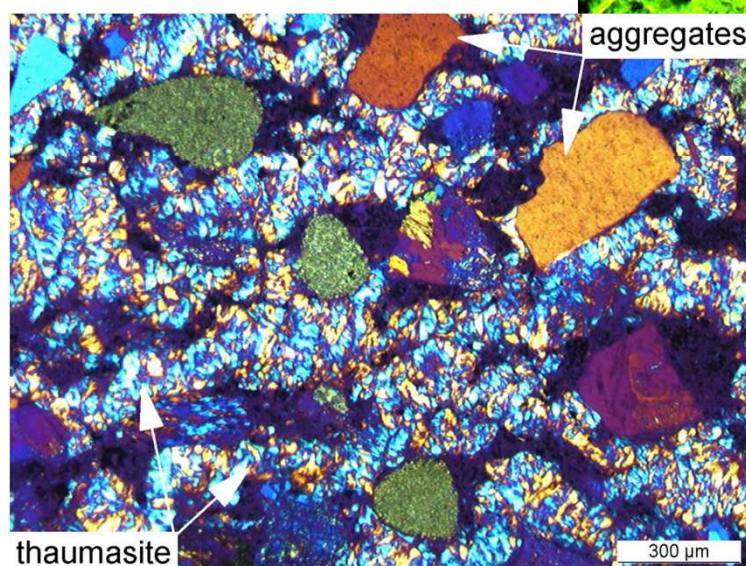


Figure 5: AAR induced cracks in aggregate with gel formation in paste. Thin section, fluorescent light (motorway bridge, Mels, Switzerland)

Our laboratory

Qualified staff and an outstanding infrastructure support the scientists in research and development projects as well as in challenging services.

Our laboratory offers a large range of tests on fresh and hardened concrete, cement, admixtures, additives, and aggregates. Tests for water conductivity, freeze-thaw, chloride resistance, shrinkage, creep, etc.

We perform both standard and non-standard tests and provide different types of measurements and analyses.

Our test laboratory meets the highest quality standards and is accredited in a number of STS scopes.



Figure 6: Creep stands for loads up to 600 kN

Our services

Thanks to our world-class laboratory infrastructure and the expertise of our researchers, we provide advice and information about different aspects of cement and concrete:

- research into the relationship between raw materials, methods of production and utilization in view of the practical application of new cementitious materials;
- transfer of knowledge by publications, courses organization and talks in national and international conferences;
- in our large laboratory we can perform both standard tests and specially tailored ones;
- the most modern chemical analysis methods and efficient microscopy investigations;
- consulting about problems with concrete, mortar, cement and admixtures;
- cooperation in the elaboration of norms and guidelines within national and international professional organizations and standards committees.