Final Thesis (M.Sc./B.Sc.)

Sulphate transport in composite cements – Determining diffusion coefficients

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Background:

Sulphate attack is cause by the ingress of sulphate ions from phreatic and waste waters in concrete. Sulphate attack is a mainly diffusion based, chemical durability issue. High sulphate concentrations in the cement stone lead to irreversible changes in microstructure.

The chemically induced expansion of the hydrate phases leads to cracking and hence failure of the damaged concrete. While the SVA test and other standards are well suited to evaluated the general sulphate attack resistance of a binder or concrete mix design some questions remain. The biggest one is a proper description of the sulphate ingress velocity, to be more precise the determination of effective diffusion coefficients. A characterization of the sulphate transport properties is necessary for properly model sulphate attack, which is very interesting from the perspective of a civil engineer. In this thesis an existing experimental setup for chloride migration experiments has to be adapted for determining effective diffusion coefficients for sulphate. A comparison to non-accelerated diffusion experiments concludes the experimental part.
The work package is separated in literature research and a practical part, which includes the evaluation and discussion of the generated data. The project is closely realized in close collaboration with a PhD-student at RWTH University.

Your tasks:

- **Literature research including the topics.**
  - Basics of sulphate attack in Portland cements
  - Tests and Standards describing sulphate attack
  - Methods for determining sulphate in aqueous solutions
- **Experiments and Discussion**
  - Sample preparation in cement paste and mortar scale
  - Development of a method for determining the diffusion coefficient (based on an existing experimental setup) for:
    - Current assisted migration
    - Diffusion
  - Evaluation of Sulphate attack with SVA experiments and maybe other methods

Requirements:

- You are studying chemistry/ material science or a related engineering discipline
- Good knowledge of MS-Office or similar software
- Interest in analytical work and the material scientific aspects of the topic

Beneficial are:

- Practical experience in chemical or physical laboratories
- Basic knowledge of cement chemistry
- Good knowledge of the German language (C2)

The task is designed for 6 months a 40 hours per week.