A 4-years Ph.D. position is opening in the Laboratoire Interdisciplinaire Carnot de Bourgogne (ICB UMR 6303 CNRS, Dijon), starting in Fall 2016, in close collaboration with the Institut des Sciences de la Terre (ISTerre UMR 5275 CNRS, Grenoble) and Empa (Zurich).

Project title:

Activities and nucleation processes in the SiO_2-CaO-H_2O-Organics system

Abstract:

Nowadays, organic additives are commonly used in the concrete industry to improve the mechanical properties of the final material. As a side effect the presence of organics affects the kinetics of cement hydration (simultaneous dissolution of cement grains and nucleation/growth of cement hydrates) that is generally strongly retarded. However, the physical and chemical mechanisms responsible for the change in cement reactivity in presence of such additives are poorly understood.

The PhD project aims at investigating the effect of small organic molecules on the nucleation and pre-nucleation processes of calcium silicate hydrate, C-S-H, the main cement hydrate. The work will involve the determination of ion activities and characterization of organic/ions complexes as well as the quantification of the kinetics and the determination of the reaction path of C-S-H nucleation with and without organics.

Details:

The determination of ion activities and characterization of ion complexes in presence of organic molecules is expected to be a decisive step to understand the role of the latter on the nucleation process of C-S-H. They will be determined and characterized based on a combination of experiments (solubility, potentiometric, FTIR, Si-NMR and C-NMR measurements) and simulations (Debye-Hückel modeling, Monte Carlo simulations/primitive model). The C-S-H pre-nucleation and nucleation stages will, on the other hand, be studied both in the homogeneous and heterogeneous case. This will involve measurements of the nucleation rates and induction times under controlled conditions and at various supersaturation degrees, by means of lab-based (titration set-up in combination with turbidity, conductimetry and DLS) and synchrotron-based experiments (SAXS and GISAXS in combination with a titration set-up).

Location/organisation:

The successful candidate will share her/his time between two CNRS institutes (ICB UMR 6303 Dijon, ISTerre UMR 5275 Grenoble) and the Swiss institute Empa (Zurich).

The present PhD project is part of Nanocem, a consortium of academic and industrial partners interested in fundamental research in cement and concrete http://www.nanocem.org/, and the student will be expected to actively participate in international workshops. On the other hand, ICB (Univ. Bourgogne Franche-Comté), Empa, ISTerre (Univ. Grenoble Alpes) are among the leading research institutes in cement chemistry and geochemsitry.

Expected skills of the candidate:

We are looking for a student with a master in Inorganic Chemistry, Materials Science, Earth Sciences, or related fields, with proficient spoken and written English level. A strong background in materials science and/or inorganic chemistry and excellent skills in the design and operation of experimental set-ups are an advantage. If you are motivated to perform scientific studies in well-equipped laboratories and enjoy working in an interdisciplinary environment, then you are the person we are looking for. The successful candidate will develop a characterization program to following the kinetics of cement hydration in the presence of simple organic molecules. The position is offered as a fixed term appointment of 4 years with a start date in the Fall of 2016.

Contacts:

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Please send your application by e-mail to: Dr. Christophe Labbez
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