Control of ettringite morphology by the use of admixtures

Duration of the internship: 6/7 months

Location: Université Gustave Eiffel, Laboratoire Comportement physico-chimique et durabilité des matériaux (CPDM), Bâtiment Bienvenüe 14-20 Bd Newton 77447 Champs sur Marne

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Requested profile: Master's degree student in materials science or civil/chemical engineering. Taste for experimental work and a good level in English is required.

Description:

The adjustment of the cement sector to the new socio-economic challenges (increasing demand for the reduction of the CO_2 footprint, adaptation to new technologies, etc.) has led to an increasing deviation of cement and concrete formulations from traditional compositions. This is particularly important when it comes to the design of low-CO_2 cements, in which it is common to reduce the cement content in concrete by substituting it with other materials with low carbon footprint and high availability (such as limestone or clays). Such substitution involves significant changes in the fresh properties of those concretes, affecting their applicability, which are typically solved by the use of admixtures like superplasticisers. Another relevant example is the design of concrete for 3D printing, characterised by its high cement content and an extensive use of admixtures, including superplasticisers. As a consequence of the variation of cement content and the addition of admixtures, there is a greater complexity in the chemical environment, in which the hydration reactions of cement take place, and a greater lack of understanding of how this affects the material early-age properties.

The objective of this internship is to study the effect of superplasticisers on the morphology of the main hydration product of cement in its early stages of reaction: ettringite. Ettringite is a crystalline compound characterised by its needle-like shape, whose dimensions are known to be strongly affected by the adsorption of admixtures (see Figure 1). Due to its particular shape, it has the potential to significantly modify the packing of the particles that compose the cement pastes, and therefore their rheological behaviour and their possible applications. However, although this is a key aspect for the development of greener and more innovative concretes, the understanding of the role of superplasticizers in ettringite formation remains underexplored to date.

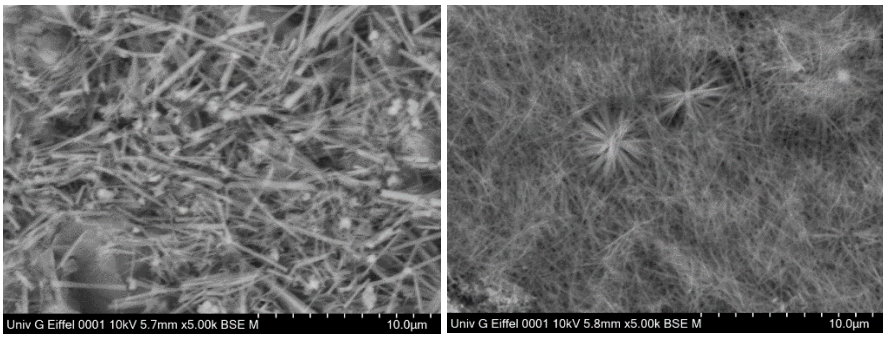

Figure 1. Ettringite synthesized in the absence (left) and presence (right) of a superplasticizer.

During this internship, ettringite will be synthesized in the presence of different types and concentrations of superplasticisers. The study will be focused then on the analysis of the morphology of the obtained crystals by means of optical and electronic microscopic techniques, and its subsequent characterization by image analysis. Potentially, the study could be extended to the assessment of the role of ettringite morphology on superplasticiser adsorption by Total Organic Carbon analysis.