IMT Lille Douai
École Mines-Télécom
IMT-Université de Lille

Laboratoire
Génie Civil
et géo-Environnement
Lille Nord de France

PhD position in cement science

CASSIS project

***C**ement **A**rcheometry and **S**ynthesi**S**: **I**nsight**S** from the 19th century binders and their durability*

The center for teaching, research and innovation (CERI) "Materials and Processes", of IMT Lille-Douai, born in 2019 from the merging of previous civil engineering dpt. and the composites dpt., focuses on various topics related to those domains.

Within the framework of the CASSIS (Cement Archeometry and SynthesiS: InsightS from the 19th century binders and their durability) project, the CERI will hire a PhD student in the domain of cement science.

Abstract of CASSIS

Concrete nowadays fully makes part of cultural heritage's materials as evidences the exponential increase of historical monuments listed in France. As cement is a key component of concrete, its identification, its characterization, the determination of its origins and the evaluation of its properties are essential in the study of an historical concrete, either in terms of archeometry but also to establish restoration protocols and to enhance its durability.

The development of the cement industry during the 19th century all over the French territory led to the production of numerous types of cements. Fast or very fast setting, semi-slow or slow setting, natural or artificial, the majority of those cements are not produced anymore, which increases the complexity of their identification.

Most of those cements were produced at low temperatures compared to nowadays Portland cements, and they were based on local geological resources, encountered close to the production plants, which naturally did reduce the CO_2 emissions. Beyond the patrimonial issues, a better knowledge of these cements, their durability and their properties, constitutes an interesting basis in the research for building materials more in adequacy with the challenges of the sustainable development.

The north of France is the cradle of this industry in France. It is first with the pebbles of the beach of Boulogne-sur-Mer that the first cement was produced in 1803. It was a natural cement, very fast setting so-called "gypsum-cement". In 1846, again in Boulogne-sur-Mer, the first artificial Portland cement, slow-setting was manufactured. Nevertheless these historical cements of the North of France were not much studied.

The first aim of the proposed study will be to characterize the first cements of Boulogne's Region. In that purpose a panel of mortars and concrete will be sampled on historic constructions and will be characterized in terms of composition, residual anhydrous grains, and hydrated phases. The analytical protocol will include optical and SEM observations, X-Ray diffraction and Raman spectroscopy. Isotopic studies and solid NMR analysis, unexplored and innovative for such application to ancient mortars and concrete will supplement this protocol.

The second objective will be to study the transition between fast-setting natural cement and slow-setting Portland cement, by producing microscopy and crystallographic references, to allow an easier differentiation of these cements on historical buildings.

Quarries historically used for the productions of fast-setting natural cements and Portland of the North of France will be looked for, and sampling of raw stone will be performed. From those fragments of raw material, cements will be synthetized in the laboratory, exploring a panel of burning temperatures. Cements so obtained will be characterized and compared with historic mortars and concretes previously studied, by using the same analytical protocol. Their properties during and after the setting, will also be evaluated.

Research team

PhD director : Vincent Thiery (IMT)

Scientific committee: Catherine Davy (Ecole Centrale de Lille), Myriam Bouichou and Elisabeth Marie-Victoire (LRMH), Laurent Izoret (ATILH), Cyrille Albert-Mercier (Université Polytechnique des Hauts de France), Isabelle de Waele and Myriam Moreau (LASIR)

Host laboratories

Main host laboratory : CERI Matériaux & Procédés – Laboratoire de Génie Civil et de géo-Environnement (LGCgE) - 764, Boulevard Lahure – 59500 DOUAI - FRANCE

LRMH (Laboratoire de Recherche des Monuments historiques)- Pôle Béton29, rue de Paris77420 Champs-sur-Marne- FRANCE

Ecole Centrale de Lille - Cité Scientifique - CS 20048- F-59651 Villeneuve d'Ascq Cedex - FRANCE

Application

The candidate will hold a MSc or an engineering degree in materials science, geology or chemistry. The candidate should show an interest in experimentation, field work and interdisciplinary research (analyses and synthesis in laboratory, history of techniques, study of historical monuments). He/She should be mobile, organized, show good writing and communication skills in French and in English. Knowledge of cement chemistry and microscopy would be appreciated.
Scheduled to start in Autumn 2019 .

Please send your application (resume, cover letter, contact references, document size smaller than 2Mo) to the following e-mail addresses: vincent.thiery@imt-lille-douai.fr, myriam.bouichou@culture.gouv.fr