


IMT Mines Alès
École Mines-Télécom


SCIENCE & TO INVENT A WORLD

CREATIVITY SUSTAINABLE

PhD Position in Civil Engineering

Institution	IMT Mines Alès (Ecole Nationale Supérieure des Mines d'Alès)
Administrative residence	Alès (Département du Gard – Région Occitanie)

1. Presentation of our institution and C2MA

1.1 Mines Telecom Institute

The Mines-Télécom Institute (IMT), a large establishment within the meaning of the education code, is a public scientific, cultural and professional establishment (EPSCP) placed under the main supervision of the ministers of industry and digital technology. Leading group of engineering schools in France, it gathers 11 public engineering schools spread across the national territory, which train 13,500 engineers and doctors. IMT employs 4,500 people and has an annual budget of €400 million, 40% of which is its own resources. The IMT has 2 Carnot institutes, 35 industrial chairs, produces 2,100 A-rank publications annually, 60 patents and carries out €110 million in contractual research.

1.2 IMT Mines Alès

Created in 1843, IMT Mines Alès currently has 1,400 students (including 250 foreigners) and 380 staff. The school has 3 research and teaching centers of high scientific and technological level, which work in the fields of materials and civil engineering (C2MA), environment and risks (CREER), artificial intelligence and industrial and digital engineering (CERIS). It has 12 technological platforms and has 1,600 partner companies.

1.3 Centre des Matériaux des Mines d'Alès

The **Mines Alès Materials Center** (C2MA) has three research teams: the PCH "Composite and Hybrid Polymers" own research unit (UPR), the DMS "Sustainability of Eco-Materials and Structures" team of UMR CNRS n°5508 LMGC and the RIME "Research on the Interactions of Materials with their Environment" team from UMR CNRS n°5254 IPREM.

The C2MA Center also has 2 teaching departments (GCBD "Civil Engineering and Sustainable Building" and ECOMAP "Ecomaterials and Processes") and 4 technological platforms (ALCOVES in Pau, MOCABIO, MICRAL and EDMOS in Alès – see figure).

1.4 DMS team part of UMR LMGC

The research activity of the Durability of Eco-Materials and Structures (DMS) team aims to offer a comprehensive view of the development of eco-materials and their interaction with their service environment. The development of these materials and structures must combine notions of mechanical resistance and durability, whether it concerns civil engineering structures or high-performance composites for other industries. These works should contribute to the development of eco-materials, whether bio-sourced or recyclable, for a more sustainable construction and ecological transformation of industrial sectors.

In the context of the institution's scientific strategy, the DMS team constitutes a new team associated with the Laboratory of Mechanics and Civil Engineering (LMGC - UMR5508 currently under the co-supervision of CNRS and the University of Montpellier). This associated team comprises 15 members from IMT Mines Alès, including 4 professors, as well as 2 technicians. It hosts a dozen doctoral students and 1 to 2 post-docs. Its average annual scientific output is 3.2 international publications per full-time research equivalent.

2. Research project : BIOSEACRETE

The latest report from the Intergovernmental Science Policy Platform on Biodiversity (IPBES), published in 2019, highlights the devastating effects of human activities on marine biodiversity. Faced with this alarming situation, the construction of marine structures must evolve towards a more environmentally-friendly approach, with efforts to minimise the ecological impact of these infrastructures. To achieve this, eco-design is favoured. This approach involves not only limiting the negative effects of construction, but also designing structures in such a way as to encourage local biodiversity while avoiding the proliferation of invasive species.

The sustainability of marine structures and eco-design have thus become central concerns for decision-makers and project owners. In this context, the project aims to design marine concretes by integrating precise environmental criteria. The project has three major objectives: to reduce the carbon footprint of concrete, to save natural resources, and to use marine structures which support the local ecosystem, in line with environmental ambitions 2 and 6 of the Green Pact for Europe.

The project BIOSEACRETE, therefore, proposes to design innovative and sustainable concretes, adapted to the marine ecosystem and capable of playing an active role in preserving marine biodiversity. To do this, it is looking at the interaction between biocolonisation (the growth of marine micro-organisms on structures) and the durability of concrete. This project is unique in that it is testing

the same materials on two distinct marine sites: the Baltic Sea and the Mediterranean Sea. The aim of this approach is to assess the evolution of biodiversity on these materials according to the specific conditions of each site, namely differences in climate and salt concentrations. The studies also include analysis of the microstructure of the concrete and the effect of biological and chemical attack on its long-term durability.

One of the innovations of this project lies in the comparison between traditional concrete, commonly used in maritime structures in the two partner countries (Denmark and France), and an eco-designed concrete incorporating aggregates from the circular economy and a binder with low greenhouse gas emissions. This comparison will determine whether these new concretes can compete in terms of durability while offering significant ecological advantages, which can be quantified using a life cycle analysis.

In addition, comparison of the kinetics and diversity of biocolonisation on the surface of concrete at two exposure sites will make it possible to investigate the environmental factors that play a key role in the establishment of marine life in the vicinity of civil engineering structures.

In conclusion, this project responds to current environmental concerns by adapting the design of marine infrastructures to reduce their impact on biodiversity and promote the sustainable use of resources. Thanks to tailored concrete compositions and a better understanding of the effects of biocolonisation on their durability, marine structures could in future play a positive role in preserving marine ecosystems.

Keywords: marine infrastructure, biodiversity, nature inclusive design

3. Team supervision and PhD registration

The project is attached to the C2MA centre and the DMS team attached to the I2S graduate school. It will be supervised on the IMT Mines Alès (France) side by Jean-Claude Souche, Gwenn Le Saout and Marie Salgues and is associated in Denmark with Wolfgang Kunther and the Technical University of Denmark (DTU). DTU Sustain is one of the largest university departments in Europe specializing in Environmental and Resource technology. The work will be supported by the section on Materials and Durability which is specialized in concrete but works also with other construction materials.

4. Candidate profile

The candidate will have a background in civil engineering or solid materials chemistry or similar, enabling him/her to be competent in concrete chemistry. Knowledge of or an interest in environmental impact assessment methods such as life cycle analysis and/or microbiology would be considered an advantage.

You must show initiative in carrying out the projects assigned to you and in producing the deliverables (bibliographic report, writing articles, oral presentations, drafting the manuscript, etc.).

This position is especially interesting for you for you are:

- Cooperative, you have a real aptitude for teamwork.
- Curious, you enjoy acquiring new multi-disciplinary skills, particularly in cross-disciplinary areas of civil engineering.
- Astute, you know how to conceptualise and develop methodologies for the experimental research program.
- Communication, you are not afraid to express your thoughts in person at international conferences, or by publishing in international journals
- Your level of English has enabled you to communicate in the two host laboratories.

5. Contacts

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