

**Use of sea-shells for environmental-friendly concretes
and high-performance cement-based grouts
(BECCoH project)**

BECCoH research project presentation

BECCoH intends to answer to new Energy and Environment challenges by increasing performance and reducing environmental cost of concrete and cement-grout materials based on seashell incorporation.

France is the first oyster producer country in Europe and oyster seashells are prominent in the Aquitaine region, especially in the Arcachon bay area whose economic activities are based on two pillars: oyster farming and tourism. This important oyster production generates an important amount of seashell under-product wastes, which are usually dumped in local harbors or directly stored on the littoral, with high negative impacts on both natural eco-systems and tourism. In the same time, there is currently a decrease in the production capacity of local quarries for construction aggregate supply and the exploitation of distant quarries increases the global environmental cost of the concrete used locally. Therefore a first objective of the BECCoH project is to propose a new formulation of environmental-friendly concretes where an important part of the granular skeleton is replaced by oyster seashells produced locally while ensuring similar durability and mechanical performances compared to classical and normalized concrete formulations. A unique pilot construction site will be installed and instrumented during the project in collaboration with the Arcachon bay area authorities to test the performance of these new bio-hybrid concrete under real life conditions.

In addition, nacre – the iridescent material in seashells – is one of many natural materials employing hierarchical structures to achieve high mechanical performance from relatively weak constituents. Nacre has bio-inspired and motivated many researchers in the last ten years to understand, mimic and transfer to synthetic materials its unique mechanical performance. The second objective of the BECCoH project is hence to improve performance of cement-grout material used for geothermal well cementation by incorporating nacre-based under-product in their formulation. Well cementation is used to mechanically link tubing to the geological formation and it has a crucial role to avoid mass transfer between the different geological layers during production. In geothermal context, an ideal cement-grout should present in the same time very antithetical performances (e.g. low density, high strength, high ductility), which cannot be achieved by classical synthetic materials but are usually achieved by natural ones because of their unique hierarchical design. Incorporating nacre-based seashell under-products in cement-grout formulation may help in reaching such an ideal material. A direct partnership with BOPS Company, specialist of well cementation and production, will allow direct and fine comparison with classical cement-grout formulation actually used on-field and will allow the study of the new formulations proposed in the context of real industrial conditions.

Partners

- Région Nouvelle Aquitaine (first European agricultural region, first French touristic region)
- Arcachon bay area authorities (first French oyster birth farming area)
- Oyster farming union of the Arcachon bay area
- BOPS (well cementation and exploitation company)
- CERIB (industrial technical center for research and innovation in concrete and concrete-like materials)
- Ovive (company specialized in collect and valorization of seashells)
- Creahd (regional center for eco-construction in Aquitaine)

PhD candidate objectives

Within the BECCoH project, the PhD candidate will be in charge of the material formulation and the performance validation of new environmental-friendly cement-based materials incorporating seashell under-products for application in urban furniture and geothermal well cementation. The PhD candidate will be involved at each step of the project, starting from the seashell-based granular skeleton optimization, the global environmental cost estimation, to the material performance characterization both in laboratory and on-site. He/she will exchange directly with all the industrials and local authorities involved within the project.

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Candidate's profile

The candidate should hold a master degree in civil or mechanical engineering, physics, materials science or a similar field. Previous experience with the characterization of porous media (transport, elasticity, failure) or the development of custom-made experimental set-ups is an asset. The candidate should have a strong interest in performing experimental work in a multi-disciplinary team. Proficiency in English is mandatory.

Job details

The successful candidate will be hosted at ISABTP Civil Engineering School by LFCR (UMR5150, UPPA-CNRS-Total SA) and SIAME (EA UPPA) laboratories. The project will be co-directed by Prof. David Grégoire and Dr. Céline Bascoulets. The envisioned starting date is December 1st, 2018, and the maximum duration is 3 years. The position includes full social security coverage and a gross salary of approx. 1685 € per month. Depending on the candidate profile and the candidate career plans, teaching course at ISABTP may be additionally proposed with an additional salary.

Evaluation procedure

Candidates will be ranked in a first phase based on their submitted application.

In a second phase, an interview will be organized with the selected candidates (possibly via Skype). Applications should include a cover letter, CV, transcripts of diplomas and lists of courses attended (with grades obtained), recommendation letters, and names and contact details of at least two references.

Applications should be submitted **before November 1st, 2018** by email at [david.gregoire\[at\]univ-pau.fr](mailto:david.gregoire[at]univ-pau.fr).

The interview will take place during the second half of November.