

Failure and damage characterization of natural *Pinctada nacre* shells and translation to synthetic cementitious materials (Pinctada project)

PINCTADA research project presentation

PINCTADA intends to answer to new Energy and Environment challenges by increasing performance and reducing environmental cost of cementitious materials based on seashell incorporation with direct application in French Polynesia construction.

French Polynesia is well known for its production of Tahitian culture pearl from *Pinctada margaritifera* nacre. Careful management of the nacre stock and the environment in which it is raised, as well as a measured response to changing economic factors are necessary to maintain a sustainable industry. Particularly, natural farming of *Pinctada margaritifera* is submitted to the competition of the smaller natural specie *Pinctada maculate*, which exists in larger numbers than the margaritifera variety around the Polynesian islands and atolls.

This important nacre production generates an important amount of seashell under-product wastes for both *Pinctada margaritifera* and *Pinctada maculata* for which the re-use in industry has only few applications (cosmetic, jewellery, marquetry and local handicraft). In the same time, there is almost no production capacity of local quarries for construction aggregate supply especially in coral reef atolls and the exploitation of distant quarries increases the global environmental cost of the concrete used locally. Therefore a first objective of the PINCTADA project is to propose a new formulation of environmental-friendly concretes where the classical mineral granular skeleton is replaced by nacre seashell produced locally while ensuring similar durability and mechanical performances compared to classical and normalized concrete formulations.

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 PINCTADA project is hence to improve the performance of cementitious material by proposing new formulation of nacre-based fiber-reinforced concrete.

Partners

- *E2S Newpores project* (an international hub for the mechanics and physics of porous materials)
- *Direction des Ressources Marines de Polynésie Française* (local authorities for sea resource management)

Master candidate objectives

Within the PINCTADA project, the master candidate will be in charge of the characterization of the mechanical properties (elasticity and failure) of *Pinctada margaritifera* and *Pinctada maculata* pearl oyster shells by performing traction and 4 points bending test on a miniature loading machine. In addition, the master candidate will be in charge of optimizing a seashell-based granular skeleton to be incorporated in a concrete formulation for application in French Polynesia construction.

Laboratory and internship location

G2MP research team, LFCR lab (UMR5150 UPPA CNRS Total), Anglet, France.

Grant – 560 € / month.

Duration – From March to August 2021 (6 months)

PhD opportunity – This research effort will be pursued through a PhD position funded by the same PINCTADA project (envisioned starting date is October 1st, 2021).

Contact and supervision – Pr. David Grégoire – www.davidgregoire.fr