

**Use of Common slipper shells for environmental-friendly
and high-performance cement-based grouts
(MIG project)**

MIG (Multifunctional Innovative Grout) research project presentation

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

The common slipper shell – *Crepidula fornicata* – is a medium-sized sea snail, a marine gastropod mollusk in the family Calyptraeidae. If the species is native to the western Atlantic Ocean, specifically the Eastern coast of North America, it is considered as an invasive species in Denmark, France, Italy, the Netherlands, Spain, and the United Kingdom, and has also spread to Norway and Sweden. The common slipper shell has few to no predators in Europe, and can thrive on several types of hard bottoms and shellfish banks. The species is a sequential hermaphrodite with a very efficient reproduction process. The largest and oldest animals, at the base of a pile are female, the younger and smaller animals at the top are male. If the females in the stack die, the largest of the males will become a female. The common slipper shell is well known to have a negative impact on human activities (e.g. it damages oyster fisheries) but it starts to be considered positively by the food industry. The cleaning of oyster fisheries or the direct use in the food industry will generate an important amount of Common slipper shell under-product wastes, which cannot be dumped in local harbors or directly stored on the littoral, with high negative impacts on both natural eco-systems and tourism.

Otherwise, 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 objective of the MIG project is hence to improve performance of cement-grout material used for geothermal well cementation by incorporating 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 I4CS 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

- *E2S Newpores project* (an international hub for the mechanics and physics of porous materials)
- *I4CS an independent service company focused on well construction engineering for oil & gas, geothermal, subterranean gas sequestration markets*

Master candidate objectives

Within the MIG project, the master candidate will be in charge of the material formulation and the performance validation of new environmental-friendly cement-based grouts incorporating seashell under-products for different applications such as geothermal well cementation. He will be involved at each step of the project, starting from the cement-based grout formulation and casting, to the material performance characterization both with laboratory and industrial equipment (mechanical and transfer properties).

Laboratory and internship location

- G2MP research team, LFCR lab (UMR5150 UPPA CNRS Total), Anglet, France (50%).
- I4CS company R&D lab, Paris suburbs, France (50%).

Grant – 560 € / month.

Duration – From March to August 2021 (6 months)

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