↑ Sporosarcina pasteurii bacteria

A LOOK INSIDE THE LAB

Bacteria-based green cement

An EPFL laboratory has developed a building material that harnesses the phenomenon of natural calcification. Dimitrios Terzis, the engineer who coordinated this research, explains the process... BY JULIE ZAUGG

The construction industry is one of the world's biggest polluters. The manufacture of cement alone, one of the components of concrete, generates 8% of anthropogenic CO_2 emissions. And this fact prompted the soil mechanics laboratory at the EPFL (École Polytechnique Fédérale de Lausanne) to develop a biological cement, under the leadership of Dimitrios Terzis, a civil engineer.

The material is produced by mixing Sporosarcina pasteurri bacteria with urea, a non-toxic synthetic molecule. These micro-organisms break down urea for food, generating calcium carbonate ($CaCO_3$) crystals. These are used as a binder for the aggregates (sand and gravel) that are one of the components of cement, rather than the more usual clinkers (lime, industrial resins and limestone).

"The process can be carried out at room temperature, whereas for the manufacture of conventional cement, the materials need to be heated to over 1000 degrees," explains Terzis. "And so it saves a lot of energy." By reproducing a calcification process that takes place in the natural environment, the process developed by the civil engineer also avoids the soil and groundwater contamination that clinkers can cause. Another advantage is that "this material does not affect soil permeability, unlike cement, which makes soil impermeable and encourages flooding", Terzis adds.

Along with Professor Lyesse Laloui, Terzis has founded a startup called MeduSoil to market this biocement. The firm, which has seven employees, has raised 2 million Swiss francs and has a plant in Tolochenaz (VD) capable of producing S. pasteurri bacteria on an industrial scale using processes borrowed from the food industry. "We can generate 100,000 litres of biocement each year, the equivalent of 100 kilometres of road," says Terzis. The first batch was produced in 2022.

At present, the main application envisaged is ground stabilisation. "In the event of heavy rains or prolonged heat waves, cracks may appear in soil, roads, dykes or dams, and these can be filled using our biocement," says Terzis. For example, it was used to stabilise sloping ground threatened by erosion near a station platform in the canton of Fribourg. In an urban environment, this cement could be used to help stabilise land that is currently unsuitable for construction.

Terzis hopes eventually to produce cement blocks that can be used in building construction. "For now, our processes are still too expensive," he explains. "First we will need to increase our volumes to achieve economies of scale."

Although the manufacturing process invented at EPFL is unique, other startups are also looking into this field. Biomason and Prometheus Materials in the US and Dutch company Basilisk all produce bacteria-based construction materials. In Singapore, meanwhile, Nanyang Technological University has developed a biocement that's able to slow beach erosion. ◢