Micro-capsules and bacteria to be used in self-healing concrete

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The research team at Bath will work to develop methods to keep bacteria alive in concrete.

A new research project involving researchers from Bath aims to develop novel self-healing concrete that uses an inbuilt immune system to close its own wounds and prevent deterioration.

The life of concrete structures is reduced when the material cracks and water is able to get at the steel reinforcement, causing rust and degradation.

The project is funded by a £2m EPSRC grant, matched by an additional industrial contribution of just over £1 million, and will involve our researchers in collaboration with Cardiff University (the lead partner) and the University of Cambridge.

Our team here at Bath aims to develop a concrete mix that contains bacteria within microcapsules, which will germinate when water enters a crack in the concrete to produce limestone (calcite), plugging the crack before water and oxygen has a chance to corrode the steel reinforcement.

Self-healing concrete could vastly increase the life of concrete structures, and would remove the need for repairs, reducing the lifetime cost of a structure by up to 50 per cent.

Over seven per cent of the world's CO2 emissions are caused by cement production, so reducing the amount required by extending the lifetime of structures and removing the need for repairs will have a significant environmental impact.

Dr Richard Cooper, from the Department of Biology & Biochemistry, said: "Cement is highly alkaline, making it a hostile environment for bacteria. We'll be assessing different species of bacteria to find one that is able to form abundant spores and which will survive and germinate in this environment. The work will involve finding alkaline-tolerant isolates and testing their biology and physiology."

Dr Kevin Paine, from the Department of Architecture & Civil Engineering, said: "Concrete densifies as it hardens, so the pore size decreases to a level where bacteria may be crushed. We're looking at enclosing the bacteria in micro-capsules, along with nutrients and calcium lactate which the bacteria will convert when water becomes present and use to fill cracks in the concrete."

Dr Andrew Heath, also from the Department of Architecture & Civil Engineering, said: "Self-healing materials are particularly suited to situations where safe access for maintenance is costly, so the outputs of this extended research programme could reduce the life-cycle costs of

infrastructure."

Dr Cooper added: "Including bacteria in concrete offers a double layer of protection in preventing steel corrosion. Not only do the bacteria work to plug cracks in the concrete, the process of doing so uses oxygen present which would otherwise be involved in the corrosion process of the steel bars."

The research team will assess the survival of different species of bacteria in the concrete over time. They'll allow the concrete to mature over certain time periods and then grind it down to create a suspension which can be assessed by biologists for surviving bacteria.

Provided by University of Bath