

Self-healing fungi concrete could provide sustainable solution to crumbling infrastructure

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A new self-healing fungi concrete, co-developed by researchers at Binghamton University, State University of New York, could help repair cracks in aging concrete permanently, and help save America's crumbling infrastructure.

Congrui Jin, assistant professor of mechanical engineering at Binghamton University, has researched concrete and found that the problem stems from the smallest of [cracks](#).

"Without proper treatment, cracks tend to progress further and eventually require costly repair," said Jin. "If micro-cracks expand and reach the steel reinforcement, not only the concrete will be attacked, but also the reinforcement will be corroded, as it is exposed to water, oxygen, possibly CO₂ and chlorides, leading to structural failure."

These cracks can cause huge and sometimes unseen problems for infrastructure. One potentially critical example is the case of [nuclear power plants](#) that may use concrete for radiation shielding. While remaking a structure would replace the aging concrete, this would only be a short-term fix until more cracks again spring up. Jin wanted to see if there was a way to fix the concrete permanently.

"This idea was originally inspired by the miraculous ability of the human body to heal itself of cuts, bruises and broken bones," said Jin. "For the damaged skins and tissues, the host will take in nutrients that can produce new substitutes to heal the damaged parts."

Jin worked with professor Guangwen Zhou and associate professor David Davies, both from Binghamton University, and associate professor Ning Zhang from Rutgers University. Together, the team set out to find a way to heal concrete and found an unusual answer: a fungus called *Trichoderma reesei*. When this fungus is mixed with concrete, it originally lies dormant—until the first crack appears.

"The fungal spores, together with nutrients, will be placed into the concrete matrix during the mixing process. When cracking occurs, water and oxygen will find their way in. With enough water and oxygen, the dormant [fungal spores](#) will germinate, grow and precipitate calcium

carbonate to heal the cracks," explained Jin.

"When the cracks are completely filled and ultimately no more water or oxygen can enter inside, the fungi will again form spores. As the environmental conditions become favorable in later stages, the spores could be awakened again."

The research is still in the fairly early stages, with the biggest issue being the survivability of the fungus within the harsh environment of concrete. However, Jin is hopeful that with further adjustments the *Trichoderma reesei* will be able to effectively fill the cracks.

"There are still significant challenges to bring an efficient self-healing product to the concrete market. In my opinion, further investigation in alternative microorganisms such as fungi and yeasts for the application of self-healing concrete becomes of great potential importance," said Jin.

The paper, "Interactions of fungi with concrete: Significant importance for bio-based self-healing concrete," was published in *Construction and Building Materials*.

More information: Jing Luo et al, Interactions of fungi with concrete: Significant importance for bio-based self-healing concrete, *Construction and Building Materials* (2018). [DOI: 10.1016/j.conbuildmat.2017.12.233](https://doi.org/10.1016/j.conbuildmat.2017.12.233)

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