

## Summary of publication No. (1)

**Title: The effect of isolated *Bacillus ureolytic* bacteria in improving the bio-healing of concrete cracks**

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### Abstract

#### Background

Reinforcement corrosion and the concrete strength reduction are critical problems that resulted from crack creation in concrete. Very expensive and hazardous technologies based on chemical materials have been provided for repairing the cracks. Recently, crack repair using bio-catalysis precipitating bacteria has been developed as a viable and ecofriendly alternative technique. The main target of this study was to select and identify bacterial isolates with high urease activity to use in filling the cracks by the precipitation of  $\text{CaCO}_3$ .

#### Results

Two endospore-forming and alkali-resistant ureolytic bacteria were combined with concrete to tolerate the mechanical stresses generated by mixing. The two isolates designated as (B1 and B2) were selected and identified as *Bacillus wiedmannii* and *Bacillus paramycooides*, respectively, using 16S rRNA gene sequencing. Both bacterial species completely heal cracks in fully destructed concrete and significant enhancement in compressive strength was illustrated. The calcite filling of cracks and  $\text{CaCO}_3$  crystals that were screened using a scanning electron microscope may explain the crack healing and the enhancement in concrete strength.

#### Conclusions

*Bacillus wiedmannii* and *Bacillus paramycooides* can be inserted with the concrete to improve the compressive strength and the self-healing of cracks. The two ureolytic bacterial strains can be used to protect water buildings from exposure to frequent cracks.

#### Keywords:

Ureolytic activity, *Bacillus*, Bio-concrete, Compressive strength, Crack healing