Preliminary tests for application of carbon nanotubes and *Bacillus sphaericus* bacteria in self-healing cement mortars

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Abstract

Self-healing in concrete is a popular and developing topic, which utilizes both biotic and abiotic mechanisms to close micro-cracks. Nano additives such as carbon nanotubes (CNT) improve the cement material's resistance to cracks but could also influence the survivability of microorganisms in concrete. A combination of CNT and calcium carbonate precipitating bacteria might lead to both improvement of concrete's durability and provide self-healing properties, while increasing the survivability of the microorganisms in the environment of the cement-based material. The presented research focuses on preliminary tests of the influence of the *Bacillus sphaericus* bacteria and low addition of CNT on the cement mortar's strength and survivability of microorganisms in the environment of cement matrix. Strength tests and biotic control were performed to provide data to modify the mix for further tests concerning mechanical properties and survival of microorganisms.

Keywords: cement mortars; self-healing; carbon nanotubes; *Bacillus sphaericus*; cementitious composite.

1 Introduction

Concrete is the most popular construction material in the world and the questions of its durability, deterioration and sustainability are important considerations for advanced, modern materials. One of the important and developing strategies for increasing the durability of concrete structures is the usage of self-healing materials which utilize various techniques to counteract cracks and minor damage that can occur during the life cycle of a concrete structure. Damage of the concrete matrix is unavoidable on the micro level due to mechanical and non-mechanical factors including thermal effects, shrinkage and corrosion. These cracks, even if their influence on bearing capacity might not be substantial, reduce the durability of concrete by allowing the ingress of various corrosive media, reducing its longevity. Self-healing materials approach this problem by providing intrinsic or autogenous mechanisms that counteract micro-cracks appearing during the life cycle of a structure.

https://doi.org/10.2749/manchester.2024.0769
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