Self-healing Concrete a New Growing Technology- a Review

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Abstract

Concrete is the most commonly used building material as well as one of the main construction material, the cracks in concrete create problems. Cracks in concrete occur due to various mechanisms such as shrinkage, freeze-thaw reactions and mechanical compressive and tensile forces. Concrete structures are often reinforced with steel. In order for the reinforcement to take over tensile forces, concrete has to crack. Through such cracks, water and compounds that are harmful to concrete can enter. Therefore a novel technique has been developed by using a selective microbial plugging process. One such thought has lead to the development of a very special concrete known as Bacterial Concrete where bacteria is induced in the mortars and concrete to heal up the faults. Self-healing approaches are promising techniques for the remediation of micro-cracks in concrete. The autogenous self-healing techniques show better results in healing of micro cracks on the surface of the concrete. Bacterial concrete refers to a new generation of concrete in which selective cementation by microbiologically-induced $CaCO_3$ precipitation has been introduced for remediation of micro cracks. In several follow up studies there is possibility is to use viable bacteria is sustainable and concrete embedded self-healing agent was explored..

Keywords: bio- chemical concrete, self- healing concrete, sustainable concrete production, green concrete.

Introduction

A typical durability-related phenomenon in many concrete constructions is crack formation. While larger cracks hamper structural integrity, also smaller sub-millimeter sized cracks may result in durability problems as particularly connected cracks increase matrix permeability. Ingress water and chemicals can cause premature matrix degradation and corrosion of embedded steel reinforcement. As regular manual maintenance and repair of concrete constructions is costly and in some cases not at all possible, inclusion of an autonomous self-healing repair mechanism would be highly beneficial as it could both reduce maintenance and increase material durability. The capability of concrete in resisting the chemical attacks, weathering action and abrasion by maintaining their engineering properties desired can be seen. Over last decade self-healing approach have been adopted in showing promising results in the concrete structures. The durability of the properties refers to trouble-free performance [1].

Several studies have been done in self-healing concrete subjects as follow. The crack healing capacity of bio-chemical additives, consisting of mixtures of viable but dormant bacteria and organic compounds packed in porous expanded clay particles, was investigated by C. Mohanasundharam et al [2]. In this study, Bacillus Sphaericus bacteria of concentration 1x106 cells/ml are used also the properties of control concrete and bacterial concrete are studied by conducting various tests such as compressive strength, split tensile strength, flexural test with varying grades of concrete M20, M25, M30. This study showed a significant increase in the strength was observed due to the addition of bacteria for a cell concentration of 106 cells per ml of mixing water and therefore calcium carbonate precipitation deposited in micro cracks. For this study, healing agent particles are coated with geopolymers following different mixture recipes. Metakaolin is used as an aluminosilicate source and sodium silicate as well as sodium aluminate is used as activator liquids were studied by de Koster et al [3]. The particles are coated by granulation in a low-shear granulator. In order to improve the coating process, the operating window and the granulation mechanism are determined for all activator liquids used. Leaching and strength tests are performed and coated particles are incorporated in cement paste in order to determine the feasibility of application of the particles in concrete [3].The particles are coated by granulation in a low-shear granulator. In order to improve the coating process, the operating window and the granulation mechanism are determined for all activator liquids used [3]. Leaching and strength tests are performed and coated particles are incorporated in cement paste in order to determine the feasibility of application of the particles in concrete. Within the Delft Centre for Materials at the Delft University of Technology, the functionality of various self-healing additives is investigated in order to develop a new generation of self-healing concretes. Microscopic Techniques in combination with permeability tests revealed