



## Self-Healing Ability of High-Strength Fibre-Reinforced Concrete with Fly Ash and Crystalline Admixture

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### Abstract

The aim of this study is to analyse the self-healing capability of high-strength fibre-reinforced concrete (M70) with fly ash and crystalline admixture (CA) in four types of environmental exposures i.e. Water Immersion (WI), Wet-Dry Cycles (WD), Water contact (WC) and Air Exposure (AE). Specimens for four mixes are cast, one mix containing 1.1% of CA and three mixes with 10%, 20% and 30% partial replacement of cement with fly ash and additions of 1.1% CA. The specimens were pre-cracked at 28 days, in the range of 0.10-0.40 mm and the time set for healing was 42 days. The result shows that all the mixes have considerable amount of closing ability and strength-regaining capability for all exposure conditions. The concrete with 20% fly ash and 1.1% CA has complete crack closing ability and 100% strength-regaining capability for WI and WD cycle conditions. From SEM analysis, it is confirmed that self-healing products are CaCO<sub>3</sub> and C-S-H gel.

*Keywords:* Self-Healing; Fly Ash; Crystalline Admixture; SEM; FTIR.

### 1. Introduction

In recent years, with the development of economy and growth of urban population, more and more buildings have been constructed and this has led to the vast concentration of people and goods. Currently, construction material such as concrete is highly used because it has high compressive strength, notable fire resistance, better casting and lower expense than other construction materials. However, a major problem with the concrete is that it is vulnerable to cracking due to its relatively low tensile strength [1-2]. The cracks will reduce the capabilities of anti-permeability, anti-chloride-corrosion and anti-carbonisation greatly, which can make the corrosion of interior reinforcements much easier and can lower the carrying capacity and durability of the structure. If the repair of concrete cracks is not completed in time, it will affect the normal use of concrete structure, resulting in total destruction and even collapse.

High-strength concrete with self-healing system based on the combined action of fly ash and CA has been developed in order to seal developing cracks, which improves durability of concrete. Self-healing admixtures are those which have the capability of repairing small damages or cracks. The main reason for investigating the properties of self-healing admixtures is that constructions built with them will have increased service-life; likewise, structures with difficult or expensive repairs will benefit from self-healing their own damages. Thus, self-healing concrete will lead to an increase in the sustainability of the structures. In concrete, microcracks cannot be avoided completely and responsible for their failure in strength. This is even more important when it comes to infrastructure, as this type of construction requires high level of user performance, high durability and minimum ecological impact possible. Many works for the public

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