A Case Study on the Performance Based Enhancement of Cementitious Systems through Sustainable Nanomaterials

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Abstract

This study concerns the application of a water-saving cement additive that can appreciably better the hardened properties of a cured product of a cementitious composition over a long time period. This advanced cement additive is a Nanotechnology based advanced material also known as Nano Materials at varying dosages by weight of ordinary Portland cement (1 part by weight) in a dry mix with river sand constituting 3 parts by weight of cement. Nanomaterials are insoluble in water so it's dissolved in a polymeric compound of Polycarboxylate Ether through ultrasonication.7.07cm cubes are cast with this mixture with water adjoined as per IS:4031 Standards under the fixed water/cement(w/c) at 0.4. After casting the cubes are cured at room temperature and they are tested for 3 Days, 7 Days, 28 Days, & 365 Days for compressive strength. Not only the results when compared are found to be superior to that of the ordinary cement composite cubes but also were found to be much more economical when compared to Silica Fumed cement compositions.

Keywords: Cement; Composite; Nano; Water

1 Introduction

Nanomaterials are possessors of unique nanostructures within the 1 to 100 nanometers range and were recognized as early as the late 1800s. Doping of these nanomaterials within a cementitious composite matrix can provide advantageous properties to the cement composites which could not be achieved hitherto using the corresponding bulk materials. In light of the recent advances in Nanosciences, the use of nano additives has unlocked new vistas in the civil products industry. Moreover, the cementitious products industry is at present facing a tremendous challenge from a sustainability perspective due to the huge amount of carbon dioxide(CO_2) emitted from cement plants[1].To reduce the amount of CO_2, modern approaches prescribe the use of SCMs as has been advocated by Indian Standards like IS:456 & IS:10262. The most commonly used SCMs in concrete mixtures are fly ash (Type C, Type F), slag cement, and, to a lesser extent, silica fume though in a broader sense natural pozzolans & LC3 systems are also included [2]. These materials are by-products of various industries: Fly ash-burning coal in power plants; Slag cement-smelting iron ore; Silica fume-alloying silicon or ferrosilicon.

The better performance of SCMs is attributed due to their high specific areas & fineness leading to researchers' search for more ultra-fine materials. Nanomaterials have their dimensions in the 1 to

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