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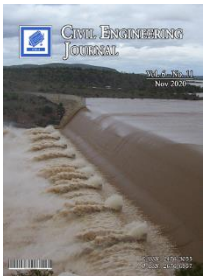

Effect of Admixtures on Mechanical Properties of Cementitious Mortar

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Abstract

In the current study, the primary focus is to investigate the effect of Styrene Butadiene Rubber (SBR), silica fume and fly ash on compressive and flexure strengths of cementitious mortar. Three types of specimens are prepared; the first series comprises of control specimen; the second one consists of the mortar's specimen modified with SBR and the third one consists of the mortar's specimen modified with SBR in a combination of fly ash and silica fumes. Mortar samples are cast in the weight ratio of 1:2.75 (cement: sand). The SBR is added at a rate of 20% of the mass of cement. The water to cement ratio (W/C) is kept at 0.5 for control specimens and the quantity of mixing water in SBR-containing samples is reduced by the same amount as the SBR is added: The adjustment is meant to obtain same consistency for all the specimens. 20% fly ash and 2.5% silica fume are added to the mortar as replacement of cement. Compressive and flexure tests are carried out according to ASTM standards. Moreover, SEM is also performed on samples at the age of 28 days. Studies reveal that SBR and SCMs reduce the mechanical strength of the mortars. SEM and EDS studies show that SBR hinders the formation of albite, whereas silica content from silica fumes and fly ash converts CaCO3 to Wollastonite (a white loose powder), which is responsible for the reduction of mechanical strength. The study also confirms that the addition of SBR in place of water hinders the formation of primary and secondary hydration products.

Keywords: Cementitious Composites; Mortar; Styrene Butadiene Rubber; Silica Fumes; Fly Ash; Mechanical Properties; SEM.

1. Introduction

A material that imparts plasticity, consistency, and bonding properties when mixed with water with or without aggregate is designated as cementitious material [1]. Supplementary cementitious materials are used as a partial or complete substitution of ordinary Portland cement in concrete mixtures. The resultant mix improves the workability of fresh concrete by reducing the thermal or differential cracking in mass concretes by decreasing heat of hydration [2, 3]. Ground Granulated Blast Furnace Slag (GGBS) is a useful by-product obtained from the blast furnace and can be used both as coarse aggregates (un-ground) and supplementary cementitious mater (Ground form) [4]. Fly ash is also waste materials produced from electric arc furnace, and coal-fired power stations resemble pozzolanic characteristics and therefore can be constructively used [5-7]. Using of industrial by-products like GGBS, silica fumes, fly ash and combination of them in concrete, reduces the problem of CO2 which is higher during cement production and eliminates the usage of natural resources like clay, limestone and sand [8-10]. Besides, they also increase the strength by secondary hydration reactions.

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