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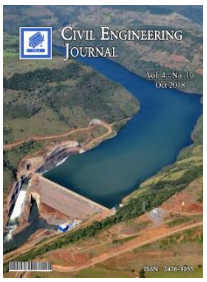

Effect of Activated Pozzolan with Ca(OH) $_2$ and nano-SiO_2 on Microstructure and Hydration of High-Volume Natural Pozzolan Paste

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Abstract

The main aim of this study is to investigate the effect of activated pozzolan on hydration and microstructure of high-volume natural pozzolan paste. Thermal activation of natural pozzolan with $Ca(OH)_2$ has been applied with nano-silica (NS) as activator at three different temperatures. X-ray diffraction (XRD), thermogravimetric analysis (TGA), laser particle analysis, scanning electron microscopy (SEM) with energy dispersive spectroscopy were employed. In order to analyze the test results, notions of "pre C-S-H" based on XRD and TGA results of activated pozzolan powders has been used. SEM images indicated microstructural improvements of the pastes with activated pozzolans compared to paste with natural pozzolan and natural pozzolan incorporating NS, showing the pore-filling effect of activated pozzolans. The microstructural improvements were proportion to the amount of pre C-S-H formed during the activation of pozzolan.

Keywords: Activated Pozzolan; Ca $(OH)_2$; Nano-Sio2 (NS); Pozzolanic Power; Pre C-S-H.

1. Introduction

Iran has a large number of natural pozzolan sources including Shahindej, Sahand, Sirjan, Rafsanjan, Taftan and etc. [1]. Natural pozzolans have volcanic origin [2] and are used in cement industry for production of pozzolana cement to reduce the effect of sulphate attack and hydration heat for giant constructions like dam construction. Natural pozzolans through a chemical reaction with $Ca(OH)_2$, in the presence of water in cement paste, show cementitious property but their chemical reactivity is too slow. The chemical reactions in hydration of Portland cement are as follows [3]:

$$2C_3S + 11H_2O \rightarrow C\text{-}S\text{-}H + 3CH \quad (1)$$

$$2C_2S + 9H_2O \rightarrow C\text{-}S\text{-}H + CH \quad (2)$$

Where C_3S is alite, C_2S is belite, CH is calcium hydroxide and C-S-H is calcium silicate hydrate which is responsible for concrete strength but calcium hydroxide reduces the compressive strength of the concrete due to its hexagonal crystalline structure and positioning in the interfacial transition zone (ITZ) which is harmful [4].

Natural pozzolans are low in CaO and high in SiO_2 and have high ignition loss [2] and due to less amount of CaO in

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