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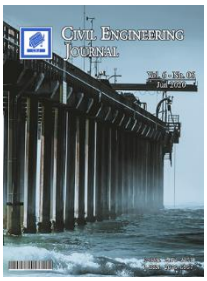

Mechanical Behaviour and Microstructure Characteristic of Concrete by Using Freshwater and Seawater

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Abstract

The development of infrastructure in archipelago countries often faces difficulties and challenges due to the lack of fresh water. Hence, in some cases, the usage of seawater is favourable, in particular for concrete making. Little studies have been conducted on comparing the seawater, and freshwater concretes, especially on microstructure analysis. The objective of this study was to reveal the compressive strength, elasticity, and microstructure of concrete using seawater and freshwater as the mixing water. The methodology of this study was mix design, making test specimens, curing test specimens, and microstructure analysis. The tests of concretes were conducted for each sample with variations of 1, 3, 7, and 28 days and the mechanical behavior were tested using compressive strength and elasticity as parameters. At the same time, the microstructure was examined using an X-Ray Diffraction (XRD). The results showed an increase in compressive strength and elasticity of seawater and freshwater concretes at all variations with insignificant differences observed between the two types of concretes. It was also discovered that the formation of Friedel's salt ($3CaO.Al_2O_3.CaCl_2.10H_2O$) in the seawater concrete was not in the freshwater concrete. In conclusion, the differentiation of microstructure did not significantly affect the compressive strength and elasticity between seawater and freshwater in mixing concrete.

Keywords: Compressive Strength; Concrete; Elasticity; Freshwater; Microstructure; Seawater.

1. Introduction

There is currently a very rapid development in concrete technology and several innovative research works have been conducted to improve the quality of concrete, especially with a bid to finding solutions to many problems observed in the materials used for mixing and overcoming the problems arising from the use of these concretes in the field. The significant challenges faced by engineers is the lack of clean water to be used in mixing, workability, work processes, especially structures with complex reinforcement, high structure, and negligence in the maintenance.

A shortage of freshwater supplies raised global consideration to use seawater as an option for concrete mixing [1]. Recently, seawater and sand containing chloride are used as mixing materials in some parts of the world. In some developed countries, civil engineers have thought about the future challenges of reducing the use of clean water for this process, considering the increase in infrastructural development [2]. Freshwater and seawater might contain impurities that affect the quality of mixing water for concrete. Fortunately, the presence of impurities has shown a favourable effect on strength development at early ages and strength reduction in a long duration of time [3]. The utilization of seawater and sea-sand in concrete construction has been reviewed previously. Studies have shown the benefit of sea-sand and seawater to produce faster early strength of concrete as compared to ordinary concrete. Instead,

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