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Fresh, Mechanical and Absorption Characteristics of Self-Consolidating Concretes Including Low Volume Waste PET Granules

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Abstract

This study evaluates the effect of waste polyethylene terephthalate (PET) granules on the fresh, mechanical and absorption characteristics of self-consolidating concretes (SCCs). Fine aggregates were replaced with different percentages (from 0% to 8%) of PET granules obtained by crushing waste PET bottles. The fresh properties of SCC containing PET granules were determined using slump flow and V-funnel flow time tests. Mechanical properties (compressive strength and splitting tensile strength tests) and absorption properties (sorptivity and water absorption tests) were evaluated. The results indicated that utilization of waste PET granules in production of SCC could be an effective way for recycling purpose. The maximum amount of PET replacement should be limited to 5%. Exceeding 5% of PET content may result in an increase of V-funnel flow time to overpass the limiting value, decrease in compressive strength, reduction in sorptivity and increase in the water absorption. The production of high performance SCC containing 5% PET granules satisfies all the requirements for SCC with satisfactory outputs.

Keywords: Self-Consolidating Concrete; Polyethylene Terephthalate; Hardened Properties; Mechanical Properties; Aggregate.

1. Introduction

Self-consolidating concretes (SCCs) are known as a greatly coherent and flowable concretes that are capable to consolidate under their own weight without compaction and vibration. SCCs were developed firstly in Japan in 1980s to increase stability and durability of concrete structures [1-5]. SCC decreases the risk of poor workmanship during casting and compaction of concrete. Moreover, economic efficiency, less human work, more freedom to designers and lowering noise level on the construction site are other advantages of using SCC [6].

PET is a kind of polyesters made of the composition of ethylene glycol and terephtalic acid and it's called as "polyethylene terephthalate". PET is one of the mostly utilized plastics in the package industry because of high stability, high pressure tolerance, non-reactivity with substances and great quality of gas trapping which can preserve the gas in the gaseous drinks. The manufacturing of PET bottles increased especially in USA, Canada, Asia and Western Europe due to the increase in the beverage consumption [7-9]. The overall amount of recyclable PET bottles in the United States was about 23.4×10^8 kg in 1 year, whereas the recycled quantity was just about 6.53×10^8 kg which is 28% of the existing amount [10]. There are different methods for disposing PET bottles such as burial, incinerate and recycling [11]. It can be useful to profit from the generated heat during incineration, but the combustion of PET bottles may produce poisonous

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