The Impact of Waste Rubber Tire as Fine Aggregate on Mechanical and Durability Properties of Self-Compacting Concrete

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ABSTRACT. This research is an experiment study that provides a full investigation of the rubber influence on various self-compacting concrete characteristics in order to production self-compacting rubberized concrete, SCRC. This study aims to assess and investigate the durability and mechanical properties as well as rheological properties of fresh concrete of composite self-compacting rubberised concrete exposed to normal and severe salty environmental conditions. This study also encourage to employ crumb rubber in production of concrete in order to reduce the impact solid waste (tire waste) and its effect on environment. Experimentally, crumb rubber tire was partially replaced fine aggregate. These percentages of replacement ranged (0%, 4%, 8%, 12%, and 16%) by mass of fine aggregate. The results of this study designated to decrease in fresh properties indicators, slump flow- box, sieve segregation, with increasing crumb rubber tire content in SCC mixes. Also, the hardened properties of SCC, compressive strength, flexural strength and splitting test were investigated, the use of crumb rubber tire percentage in these mixes has a detrimental impact on these properties. While, the durability properties of SCRC, surface absorption, chloride migration and chloride penetration depth improved these properties with using the crumb rubber tire in SCC mixes.

INTRODUCTION

Tire production for vehicles is swelling exponentially given the speedily growing transportation development due to increase population in the world [1]. The vast amount of non-biodegradable waste occupies a large area and causes environmental hazards. Burning or using tire as fuel may be produced toxic gases that are harmful impact on environment and may be caused destructive pollution of natural air [2]. Chemically, tire rubber has a high content of styrene, a strongly toxic component that is highly damaging to health of humans [3]. Therefore, dumping of waste tires may be very dangerous to human health by recycling of this waste in any way is beneficial [4].In industrial construction, there are many application for sustainable and recycled materials that mixed with concrete. Several academics studies have examined the final disposal of waste rubber tires in recent years, due to the large amount produced globally and the difficulty in making disposal sites, which have become a severe environmental anxiety. Despite this, recycling looks to be the most cost-effective and environmentally friendly option for disposing of unwanted tires [5].

When waste tire rubber aggregates are mixed with SCC, a new combination entitled self-compacting rubberised concrete (SCRC) is created, which is more economically valuable and environmentally friendly [6]. Self-compacting concrete (SCC) is a type of concrete used in large or irregularly shaped structures. SCC is well-known for its superior deformability, great resistance to segregation, and effective use in crowded reinforced concrete buildings with demanding casting conditions that do not use vibration devices [7]. The first development of this type of concrete was in Japan in the late 1980s [8], to be primarily used in seismicity for heavily packed reinforced constructions. Because the longevity of concrete structures has become a major concern in Japan, proper compaction by competent labourers is essential to achieve long-lasting concrete structures [9]. Due to the lack of compaction, the craftsmanship has a significantly smaller impact on the final structural homogeneity when employing SCC than when using regular concrete. However, further experimental study needs to be done to confirm this issue [7]. Crumb rubber from scrap tires was employed as a partial replacement for sand, gravel and combined sand and gravel at different proportions to produce self-compacting rubberised concrete (SCRC) [10,11, 12]. Incorporating rubber aggregates generally has a detrimental impact on rheological properties of fresh concrete[10,13]and the mechanical strength, whereas, this material improved strain capacity resulting in important