THE DURABILITY PERFORMANCE OF RUBBERIZED-ULTRA HIGH PERFORMANCE CONCRETE EXPOSED IN MAGNESIUM SULPHATE AND HYDROCHLORIC ACID

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I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at University Malaysia Pahang or any other institutions.

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ABSTRAK

Sisa buangan tayar adalah salah satu perkara penting perlu diambil perhatian kerana bilangan kenderaan semakin meningkat. Selain itu, peningkatan sisa tayar buangan akan memberi kesan buruk kepada alam sekitar.Sebelum ini, penggunaan tayar kedalam kandungan konkrit dan penggunaan konkrit getah telah diterokai.Terdapat banyak kajian telah dilakukan terhadap penggunaan tayar dalam konkrit. Dalam kajian ini, penggunaan konkrit tayar dalam UHPC.Konkrit berprestasi tinggi(UHPC) ialah salah satu bahan binaan yang mempunyai sifat mekanikal yang baik dan ketahanan yang baik berbanding konkrit konvesional.Selain itu, Konkrit berprestasi tinggi jugak mempunyai jangka hayat yang lama dan kecekapan ekonomi struktur. UHPC adalah satu bahan yang kukuh dan kuat.Ianya dihasilkan daripada batu-batuan kasar, pasir dan pasir halus, jumlah air yang sangat rendah, silika dan jumlah simen yang tinggi.UHPC mempunyai limit daripada segi kos dan bahan mentah. UHPC memerlukan sejumlah besar pasir, batu-batu dan simen. Bagi menghasilkan UHPC dengan menggunakan banyak pasir dan batu-batu,ianya telah menyebabkan kekurangan sumber semula jadi.Oleh itu, ia memberi idea untuk menggantikan tayar 5% sebagai batu dari jumlah berat batu yang sebenar.

ABSTRACT

Tyre rubber waste is one of significant waste that should be more concerned due to the increasing in the number of vehicles. Moreover, the increasing volume of tyre rubber waste will give bad impact to environment. Previously, utilization of tyre rubber waste on properties of concrete and applications of rubberized concrete had been explored. In this study, the application of rubberized concrete in UHPC. Ultra-High-performance concrete (UHPC) is a construction material with excellent mechanical properties and good durability as compared to conventional concrete. It can contribute to the longer life and economic efficiency of structures. UHPC is high strength material created by using coarse, fine and ultrafine aggregates, very low amounts of water, silica fume and high amounts of cement. Besides, UHPC has some limit Tyre rubber waste is one of significant waste that should be more concerned due to the increasing in the number of vehicles. Moreover, the increasing volume of tyre rubber waste will give bad impact to environment. Previously, utilization of tyre rubber waste on properties of concrete and applications of rubberized concrete had been explored. In this study, the application of rubberized concrete in UHPC. Ultra-High-performance concrete (UHPC) is a construction material with excellent mechanical properties and good durability as compared to conventional concrete. It can contribute to the longer life and economic efficiency of structures. UHPC is high strength material created by using coarse, fine and ultrafine aggregates, very low amounts of water, silica fume and high amounts of cement. Besides, UHPC has some limitations in terms of cost and availability of raw constituent materials. The UHPC is required the large amount of sand, aggregates and cement. Therefore, it is has led to depletion of natural sources, so it is give idea to replace 5% crumb tyre as aggregates from total weight aggregates

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LIST OF SYMBOLS

MPa	Megapascal
d	Diameter
l	Length
mm	Millimetre
kg/m^3	Kilogram per cubic meter
%	Percentage

LIST OF ABBREVIATIONS

WCT	Waste crumb tyre
UHPC	Ultra-High-Performance Concrete
NC	Normal concrete
SF	Silica fume
SP	Superplasticizer
w/c	Water-cement ratio
OPC	Ordinary Portland Cement
BS	British Standard
Agg	Aggregate

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Ultra-High-Performance Concrete (UHPC) is the most favourite research field of concrete because it is a new generation concrete which has a wonderful combination of high compressive strength and excellent ductility. It can contribute to the longer life and economic efficiency of structures. (Park, 2015)found that UHPC have improve the quality of high performance and high strength concrete. The UHPC have some mechanical properties such as sustained post cracking tensile strength greater than 5 MPa and compressive strength greater than 150 MPa. Although, UHPC have a good mechanical properties in term of compressive and tensile strength, toughness and ductility. UHPC also need to strict quality control to make sure the target standard for that products (Park, 2015). Graybeal (2003) reported that when properly reinforced with steel, the UHPC can achieve the compressive strength and tensile strength as high as 242 MPa and 14 MPa respectively.

In general, UHPC is constitute from a water-to-cementitious materials ratio less than 0.25, optimized gradation of granular constituents and a high percentage of discontinuous internal fibre reinforcement. UHPC also reduce liquid entry because it is not had pore of water, improve durability as compared to conventional concrete and high-performance concrete (Graybeal, 2011). UHPC is high strength material created by using coarse, fine and ultrafine aggregates, very low amounts of water, silica fume and high amounts of cement (Arafa, 2010). Besides, UHPC has some limitations in terms of cost and availability of raw constituent materials. UHPC is required the large amount of sand, aggregates and cement. Therefore, it is has led to depletion of natural

sources, which is one of the greatest challenge in concrete industry nowadays. Based on the material constituent in UHPC, the sand can be seen as the most dominant material use to produce UHPC. Usually, quartz sand is usually used in UHPC mixtures as fine aggregates because it is excellent aggregates interface. But due the cost of quartz sand is very high, it is give idea to search for other substitution for natural sources.

On the other viewpoint, the disposal of waste material such as glass, fly ash, roof tiles and tyre are one of the most important environmental issues all the world. The waste tyre production increases every year in Malaysia (Sandra, 2006). The amount of waste tires produced in this country every year is estimated at 8.2 million or about 57,391 tons. Waste tyre cause serious environment problem all around the world. In positive view, tyre rubber waste is known for its light weight, elasticity, energy absorption, sound and heat insulating properties. Therefore, to reduce the quantity of waste tires, it can be used in civil engineering construction.

Several studies have been reported by previous researchers on possibility of the use of tyre rubber waste as replacement materials in concrete construction field. The results obtained from this research is the concrete increase in workability and increase in compressive strength of concrete (Utkarsh, 2015). Hence, for this research has been using UHPC as experimental material. UHPC is the same as normal concrete but have different material. In addition, it is the same method used to replace aggregate with waste tire. Therefore, this present study was about the waste tyre crumb particles as a aggregate replacement in UHPC.

1.2 Problem Statement

Ultra-high-performance concrete (UHPC) is a construction material with excellent compressive strength and good durability. Normally, the conventional UHPC include the steel fibres to improve compressive and durability of UHPC (Sherif, 2016). UHPC contains materials such as Portland cement, silica fume, fine sand, earth quartz, superplasticizer and water. UHPC has a very high cost

which makes it a less attractive alternative as a building material. The raw materials forming UHPC are the major contributors to price increases. The most expensive material in UHPC is quartz. Therefore, to reduce the cost of making UHPC by replacing quartz with waste material. Besides that, it is also can save the environment and can reduce the amount of waste material.

Nowadays disposal of waste material like bottle, glass, roof tiles and tyre waste become a major problem. (George, 2013) reported that the amount of waste tyre collected at landfills each year in this world is 275 million tonnes. The quantity of waste tires cannot be accommodated by landfill due every year the amount of waste tire increase. Therefore, this is the opportunity to the researcher to apply waste tyre in concrete as aggregates replacement. Several studies had been conducted that the compressive strength and durability of rubberized concrete decrease. This is because the (Ankit,2016) noted that the bonding between the rubber particles in concrete was very weak to increase the bonding between the rubber particles with the cement matrix, the surface treatment of rubber particles should be treated. This is because the surface treatment use chemical NaOH solution is perfect as cleaning agent to remove the dirt and also clear the surface. Furthermore, from the previous researcher mentioned that there are different in duration of immersed waste tyre into NaOH solution. Therefore, the further investigation on the duration of immersion was carried out.

Besides, durability is an ability of the concrete to resist weathering action, chemical attack and abrasion while maintaining its desired engineering properties. Durability of concrete depends on the mixed design proportions, workmanship of the work, placing, compaction of concrete and mechanical properties of concrete. Chemical resistance of concrete depends on the selection of materials, weathering action and it can be improved further by introducing air bubbles into the concrete Hence, all the rubberized-UHPC specimens were exposed into acid attack to investigate the durability resistance performance.

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