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PARTIAL REPLACEMENT OF COARSE AGGREGATES BY RUBBER TIRES IN CEMENT CONCRETE

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ABSTRACT

Concrete is one in all the foremost wide used construction materials within the world.Cement and aggregate, that area unit the foremost necessary constituents employed in concrete production, are the vital materials required for the development trade. This inevitably diode to an eternal and increasing demand of natural materials used for his or her production. Parallel to the necessity for the utilization of the natural resources emerges a growing concern for safeguarding the surroundings and a necessity to preserve natural resources (such as aggregate) by exploitation various material which area unit recycled or waste materials during this analysis, a study was applied on the employment of recycled rubber tires as a partial replacement for coarse aggregates in concrete construction using regionally obtainable waste tires. In the initial a part of this thesis, the background of the study and also the extent of the matter were discussed. A review of relevant literatures was done to review previous works within the subject matter. The analysis was applied by conducting tests on the raw materials to see their properties and suitableness for the experiment. Concrete combine styles area unit ready consisting of 3 concrete grades (M15, M20 and M25). The specimens were created with proportion replacements of the coarse mixture by ten, twenty five and fifty exploit rubber mixture. Moreover, a bearing combine with no replacement of the coarse mixture was created to create a comparative analysis. The ready samples incorporates concrete cubes, cylinders and beams. Laboratory tests were applied on the ready concrete samples. The lists of tests conducted are; slump, unit weight, compressive strength, lastingness, impact resistance and flexural strength tests. The info assortment was chiefly supported the tests conducted on the ready specimens within the laboratory. The check results were compared with the several typical concrete properties and show that there's a discount in compressive strength of the concrete because of the inclusion of rubber aggregates. Albeit this could limit its use in some structural applications, it has few desirable characteristics like lower density, higher impact resistance, increased plasticity, and a small increase in flexural strength within the lower compressive strength concrete categories. the results show that it's potential to use recycled rubber tyres in concrete construction as a partial replacement for coarse aggregates. all the same, the proportion of replacement ought to be restricted to a mere quantity and also the application brought to be restricted to explicit cases wherever the improved properties because of the rubber aggregates area unit fascinating and once the corresponding demerits of the rubber aggregates don't have an effect on the employment of the structure.

INTRODUCTION

Cement and aggregate, which are the most important constituents used in concrete production, are the vital materials needed for the construction industry. Concrete strength is greatly affected by the properties of its constituents and the mix design parameters. Because aggregates represent the major constituent of the bulk of a concrete mixture, its properties affect the properties of the final product. An aggregate has been customarily treated as an inert filler in concrete. Aggregate is cheaper than cement and it is, therefore, economical to put into the mix. Nevertheless, economy is not the only reason for using aggregate: it confers considerable technical advantages on concrete, which has a higher volume stability and better durability than hydrated cement paste alone. Among the many threats that affect the environment are the wastes which are generated in the production process or discarded after a specific material ends its life time or the intended use. The wastages are divided as solid waste, liquid waste and gaseous wastes. There are many disposal ways for liquid and gaseous waste materials. Some solid waste materials such as plastic bottles, papers, steel, etc can be recycled without affecting the environment. However, studies on how to dispose some solid wastes such as waste tyres is the most beneficial ways are not yet fully exhausted.

Tire is a thermoset material that contains cross-linked molecules of sulphur and other chemicals. The process of mixing rubber with other chemicals to form this thermoset material is commonly known as vulcanization. On the other hand, disposal of the waste tires all around the world is becoming higher and higher through time. This keeps on increasing every year with the number of vehicles, as do the future problems relating to the crucial environmental issues. This is considered as one of the major environmental challenges the World is facing because waste rubber is not easily biodegradable even after a long period of landfill treatment. One of the solutions suggested was the use of tire rubber as partial replacement of coarse aggregate in cement-based materials

OBJECTIVES OF THE STUDY

Objectives of the study

General Objective

Most of the time, used tire rubber is not noticed to be applied in a useful way. It is rather becoming a potential waste and pollutant to the environment. Moreover, the collecting process of waste tires is not very costly as compared to the extraction or production of mineral aggregates used in normal concrete. Hence, this study is intended to show the feasibility of using crumb rubber concrete as a partial replacement for coarse aggregate in concrete. The general objective of this research is to evaluate the fresh and hardened properties of the concrete produced by replacing part of the natural coarse aggregate with an aggregate produced from locally available recycled tire rubber.

Specific Objectives

The specific objectives of the research are listed as follows:

1) With the increase in urbanization, the number of cars and consequently the amount of used tire is going to increase significantly in the near future. Hence, the non environmental nature of these wastes is going to be a potential threat. This study can show an alternative way of recycling tires by using them into concrete construction. Therefore, it is the aim of this study to introduce an environmental friendly technology, which can benefit the society and the nation.

2) Application of used tires in concrete construction is a new technology and a well developed mix design for material proportioning is not available. Through this study, it is intended to arrive at a suitable mix proportion and percent replacement using locally available materials by partial replacement of the natural coarse aggregates with recycled coarse rubber aggregates. Hence the possibility of using waste tires as an alternative construction material will be investigated.

3) By conducting different laboratory tests on prepared specimens, it is intended to analyze the results. Moreover, from the properties of the concrete the advantages and disadvantages of using it will be figured out.

STATEMENT OF THE PROBLEM

Concrete has been a major construction material for centuries. Moreover, it would even be of high application with the increase in industrialization and the development of urbanization. Yet concrete construction so far is mainly based on the use of virgin natural resources. Meanwhile the conservation concepts of natural resources are worth remembering and it is very essential to have a look at the different alternatives. Among them lies the recycling mechanism. This is a twofold advantage. One is that it can prevent the depletion of the scarce natural resources and the other will be the prevention of different used materials from their severe threats to the environment.

It has been well reported that about 1 billion of used automobile tires are generated each year globally. Specifically, 275 million of used rubber tires accumulate in the United States and about 180 million in European Union. In addition to that, the traditional ways of recycling tires in our country like as a shoe making material and other tools is decreasing nowadays. This is considered as one of the major environmental challenges facing municipalities around the world because waste rubber is not easily biodegradable even after a long period of landfill treatment. The best management strategy for scrap tires that are worn out beyond hope for reuse is recycling. Utilization of scrap tires should minimize environmental impact and maximize conservation of natural resources. One possible solution for this problem is to incorporate rubber particles into cement-based materials. Scrap tires can be shredded into raw materials for use in hundreds of crumb rubber products.

The other part of the problem is that aggregate production for construction purpose is continuously leading to the depletion of natural resources. Moreover, some countries are depending on imported aggregate and it is definitely very expensive. For example, the Netherlands does not possess its own aggregate and has to import. This concern leads to a highly growing interest for the use of alternative materials that can replace the natural aggregates. Therefore, the use of recycled waste tires as an aggregate can provide the solution for two major problems: the environmental problem created by waste tires and the depletion of natural resources by aggregate production consequently the shortage of natural aggregates in some countries.

LITERATURE REVIEW

Several researchers have used different materials like rubber, steel wires, carbon black, recycled concrete as partial replacement of coarse aggregate in concrete. In this study, many literatures have been reviewed, which are as under:

Eldin and Senouci (1993) reported that Rubberized concrete showed good aesthetic qualities. The appearance of the finished surfaces was similar to that of ordinary concrete and surface finishing was not problematic. However, the authors reported that mixes containing a high percentage of larger sized rubber aggregate required more work to smooth the finished surface. They also found that the colour of rubberized concrete did not differ noticeably from that of ordinary concrete.

Khatib and Bayomy (1999) investigated the workability of Rubberized concrete. They observed a decrease in slump with increased rubber aggregate content by total aggregate volume. Their results show that for rubber aggregate contents of 40% by total aggregate volume, the slump was close to zero and the concrete was not workable by hand. Such mixtures had to be compacted using a mechanical vibrator. Mixtures containing fine crumb rubber were, however, more workable than mixtures containing either coarse rubber aggregate or a combination of crumb rubber and tire chips.

Siddique and Naik (2004) and Senthil Kumaran et al (2008) presented an overview of some of the research published regarding the use of scrap tires in the manufacture of concrete. Studies indicate that good workable concrete mixtures can be made with scrap-tire rubber.

Eldin and Senouci (1992) reported that, in general the Rubberized concrete batches showed acceptable performance in terms of ease of handling, placement and finishing. However, they found that increasing the size or percentage of rubber aggregate decreased the workability of the mix and subsequently caused a reduction in the slump values obtained. They also observed that the size of the rubber aggregate and its shape (mechanical grinding produces long angular particles) affected the measured slump. The slump values of mixes containing long, angular rubber aggregate were lower than those for mixes containing round rubber aggregate. Round rubber aggregate has a lower surface/volume ratio. Therefore less mortar will be needed to coat the aggregates, leaving more to provide workability. They suggested that the angular rubber aggregates form an interlocking structure resisting the normal flow of concrete under its own weight; hence these mixes show less fluidity. It is also possible that the presence of the steel wires protruding from the tire chips also contributed to the reduction in the workability of the mix.

Topcu (1995) included low volumes of rubber aggregate during the preparation of the concrete, while Rostami et al (1993) appeared to use larger volumes of rubber aggregate. Their results indicated that concrete densities were reduced to 87% and 77% of their original values, respectively, when the maximum amounts of rubber aggregate were used in the investigations.

Eldin and Senouci (1993) reported a reduction in density of, up to 25% when ordinary aggregate was replaced by coarse rubber aggregate. Li et al (1998) found that the density of Rubberized concrete was reduced by around 10% when sand was replaced by crumb rubber to the amount of 33% by volume.

Ali et al. (1993) reported that when rubber aggregate was added to the concrete, the air content increased considerably (up to 14%).

Fedroff et al (1996) and Khatib and Bayomy (1999) observed that the air content increased in Rubberized concrete mixtures with increasing amounts of rubber aggregate. Although no air-entraining agent (AEA) was used in the Rubberized concrete mixtures, higher air contents were measured as compared to control mixtures made with an AEA (Fedroff et al 1996). The higher air content of Rubberized concrete mixtures may be due to the nonpolar nature of rubber aggregates and their ability to entrap air in their jagged surface texture. This increase in air voids content would certainly produce a reduction in concrete strength, as does the presence of air voids in plain concrete (Benazzouk et al 2007). Since rubber has a specific gravity of 1.14, it can be expected to sink rather than float in the fresh concrete mix. However, if air gets trapped in the jagged surface of the rubber aggregates, it could cause them to float (Nagdi 1993). This segregation of rubber aggregate particles has been observed in practice.

Goulias et al (1998) conducted an experimental study incorporating crumb rubber, as fine aggregate with Portland cement. Test results showed modifications in the brittle failure of concrete, which indicates that rubber concrete specimens exhibited higher ductility performance than normal concrete. Results showed large deformation without full disintegration of concrete.

Chou et al (2007) investigated Rubber replaced concrete for various applications and has shown promising results. The addition of rubber particles leads to the degradation of physical properties, particularly, the compressive strength of the concrete.

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