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A Review Of Using Cement Concrete With Shredded Rubber

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Abstract:

The construction industry is always increases its uses and applications. Therefore, it is required to find alternative materials to reduce the cost of concrete. On the other hand, Non-biodegradable waste i.e. water bottles, cool drink bottles and disposable glasses, shredded or crumbed rubber etc., is creating a lot of problems in the environment and its disposal becoming a great difficulty. The objective of this paper is to investigate the use of rubber pieces as coarse aggregate in the concrete.

Keywords: Rubberized concrete, Waste tyres, Shredded tyres.

Introduction

The production of tyres has increased proportionally to the production of automobiles, in Turkey. In the year 2000, total sales of tyres was around 126,000 tons of which 86,000 tons were sold directly to vehicle owners; hence, the assumption that approximately 90,000 tons of rubber tyres are replaced annually. In addition to locally manufactured tyres, imported tyres are also sold in the domestic market. Thus, based on these figures, it is estimated that the total volume of waste tyres needing disposal is approximately 120,000 tons annually.

Scrap tire chips and their granular counterpart, crumb rubber, can be successfully used in a number of civil engineering applications. Tire chips consist of tire pieces that are roughly shredded into 2.5 to 30 cm lengths. They often contain fabric and steel belts that are exposed at the cut edge of the tire chip. Tire chips have been researched extensively as lightweight fill for embankments and retaining walls. Crumb rubber is a finely ground tire rubber from which the fabric and steel belts have been removed. It has a granular texture and ranges in size from very fine powder to sand-sized particles. Crumb rubber has been successfully used as an alternative aggregate source in both asphalt concrete and PCC.

Table: Typical materials used in manufacturing tire

1. Synthetic rubber
2. Natural rubber
3. Sulfur and sulfur compounds
4. Phenolic resin
5. Oil
(i) Aromatic
(ii) Naphthenic
(iii) Paraffinic
6. Fabric
(i) Polyester
(ii) Nylon
7. Petroleum waxes
8. Pigments
(i) Zinc oxide
(ii) Titanium dioxide
9. Carbon black
10. Fatty acids
11. Inert materials
12. Steel wires

Review of literature

(Dogan & Çelebi, 2008) studied "Properties of Concrete with Shredded Waste Tyres" and found that the ever-increasing volume of discarded tyres poses a serious problem from the point of view of solid-waste disposal as well as its derogatory environmental impact. Research is being carried out to solve this problem by reusing or recycling material from such tyres. One such study was undertaken to determine the effects of incorporating shredded rubber tyres into Portland cement concrete mixes. Tests were carried out on experimental blocks prepared with concrete mixes in which predetermined portions of coarse aggregates were replaced by two lengths of rubber fibres from shredded tyres, separately, to the order of 10, 15, 30 and 45%. A total of 9 mixes, including the control mix, were prepared and 17 samples of each were tested for their unit weight, slump, flow, air content, density, water absorption, porosity, water permeability, durability after freeze-thaw cycles, compressive and flexural strengths. This paper presents the findings of experiments related to the physical and mechanical properties of concrete with varying ratios of the rubber fibres from waste tyres.

(M. Venu, 2010) studied "Study of Rubber Aggregates in Concrete" and found that the use of scrap tyre rubber in the preparation of concrete has been thought as an alternative disposal of such waste to protect the environment. In this study an attempt has been made to identify the various properties necessary for the design of concrete mix with the coarse tyre rubber chips as aggregate in a systematic manner. In the present experimental investigation, the M20 grade concrete has been chosen as the reference concrete specimen. Scrap tyre rubber chips, has been used as coarse aggregate with the replacement of conventional coarse aggregate Concrete is one of the most popular building materials. The construction industry is always increases its uses and applications.

(Al-fadhli, 2017) studied "Advantages of Concrete Mixing with Tyre Rubber" and found that strong waste administration is one of the major natural concerns everywhere throughout the world. Tire-rubber particles made out of tire chips, piece elastic, and a mix of tire chips and scrap elastic, where utilized to supplant mineral totals in cement. These particles were utilized to supplant 10% , 15% , 20%, and 25% of the aggregate mineral totals volume in cement.Using rubber aggregates in such applications can help to prevent pollution and overcome the problem of storing used tyres. Advantages if using rubber aggregates to replace and coarse aggregates is that waste rubber that is expensive to store and is a hazard, can be reused.

(Valente & Sibai, 2019) studied "Rubber/crete: Mechanical properties of scrap to reuse tire-derived rubber in concrete" and found that the recycling of waste tires is of paramount importance for environmental protection and for economic reasons. The number of scrapped tires in the United States has reached 550 million per year and is still rising. Even higher numbers are estimated in the European Union, reaching 1 billion tires per year. Disused tires create waste with a highly negative environmental impact. Tire disposal mainly involves highly polluting treatments (e.g. combustion processes to produce fuel oil), with only a small percentage of waste (3% to 15%) destined for less-invasive treatments such as powdering. In this article we will look at previous studies in which different amounts of waste tire powder are combined with cement concrete mixtures to provide a final product with mechanical properties suitable for engineering applications. Previous work has shown that a good compressive strength can be achieved through

replacing 30% of powdered tire with crushed sand. First, as the percentage of aggregation between crumb rubber and crushed sand increases, compressive strength decreases.

(Retama & Ayala, 2017) studied "Influence of Crumb-Rubber in the Mechanical Response of Modified Portland Cement Concrete" and found that the influence of crumb-rubber on the mechanical properties of Portland cement concrete (PCC) is studied by experimental tests and numerical simulations. The main hypothesis of the study is that replacing part of the stone aggregate with crumb-rubber in the mix modifies the energy dissipation during the cracking process and affects the concrete behaviour under monotonically increasing loads. The experimental research program characterizes the mechanical properties of PCC for three different types of concrete with a variable content of crumb-rubber. The experimental results showed that fracture energy and other properties are directly related to the rubber fineness used in the mixture. The material properties derived for these laboratory tests are used to study, by numerical models, its response through its damage evolution.

(Khatib & Bayomy, 1999) studied "Rubberized Portland cement concrete" and found that the use of recycled tire rubber in a portland cement concrete (PCC) mixture is investigated as a possible alternative for nonconventional PCC mixtures. This study is focused on the determination of the practicality of producing such mixes and evaluating their engineering properties. An experimental program was developed to use two types of tire rubber (fine crumb rubber and coarse tire chips) in PCC mixtures. A control PCC mix is designed using American Concrete Institute mix design methods, and three groups of rubberized PCC mixes were developed by partially replacing the aggregate with rubber. Eight tire rubber contents were used in each group. Mixes were tested in compressive and flexural strength in accordance to ASTM standards. Results show that rubberized PCC mixes can be made and are workable to a certain degree with the tire rubber content being as much as 57% of the total aggregate volume. However, strength results show that large reductions in strength would prohibit the use of such a high rubber content.

Uses of Rubber

1. Where vibration damping is needed, such as in foundation pad for rotating machinery and in railway stations,

2. For trench filling and pipe bedding, pile heads, and paving slabs, and

3. For resistance to impact or blast is required such as in railway buffers, jersey barriers (a protective concrete barrier used as a highway divider and a means of preventing access to a prohibited area) and bunkers. Rubcrete, because of its light unit weight (density ranges from 900 to 1600 kg/m3) may also be suitable for architectural applications such as:

(1) Nailing concrete,

(2) False facades,

(3) Stone backing and

(4) Interior construction.

Rubber-concrete may be used in highway construction as:

(1) Shock absorber in sound barriers,

(2) Sound boaster (which controls the sound effectively), and

(3) in buildings as an earthquake shock-wave absorber. However, research is needed before definite recommendations can be made.

Tire shreds can be used to construct embankments on weak, compressible foundation soils. Tire shreds are viable in this application due to their light weight. For most projects, using tire shreds as a lightweight fill material is significantly a cheaper alternative.

Conclusion

The use of scrap tyre rubber in the preparation of concrete has been thought as an alternative disposal of such waste to protect the environment. In this study an attempt has been made to identify the various properties necessary for the design of concrete mix with the coarse tyre rubber chips as aggregate in a systematic manner. Scrap tyre rubber chips, can be used as coarse aggregate with the replacement of conventional coarse aggregate Concrete is one of the most popular building materials.

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