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"Experimental Study on Partial Replacement of Fine Aggregare by Crumbrubber in Concrete"

Amulya D[1], Ramyashree M P[2], Prajwal S[3], Shreyas L J[4], Sandeep S M[5]
[1234]*UG Student of VVIET, Department of civil engineering, Mysore, Karnataka.*
[5] *Assistant professor, Department of civil Engineering, VVIET, Mysore, Karnataka.*

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Abstract -In today's era, solid waste management is the thrust area.
Out of this various waste materials, plasticwaste, tire waste and municipal solid waste are of great concern. Aim of our present work is helping to solve Solid waste management of this tire waste and to investigate thealternate fine aggregate to reduce cost of structure and reduce environment pollution. Different combinations of crumb rubber with percentage of 5, 10, 15, 20 traditional fine aggregate were evaluated based on compression strength, split tensile strength and flexural strength tests were conducted according to Indian Standards. Tests were also carried out to determine workability of concrete. The study pointed out that the increased in percentage of Crumb Rubber in Concrete reduces the effective Compressive strength and Flexural strength but increases workability of concrete. Increases of Crumb rubber percentage in concrete it makes more economical if we consider it to point of environment protection.
***Key Words*:** sand, aggregate, crumb rubber

I. INTRODUCTION

Hazardous waste materials are being generated and accumulated in huge quantities causing an increasing hazard to the environment. Hazardous materials can be classified as chemical, toxic or non-decaying material accumulating with time. The growth of rubber and plastic can be considered nondecaying materials that disturb the surrounding environment. [1]. These tires are among the largest and most tricky sources of waste, due to the large amount produced, their durability, and the fact they contain a number of components that are ecologically problematic. It is estimated that 259 million tires are discarded annually [2]. Crumb rubber is a material produced by shredding and commutating used tires. Thereis no doubt that the increasing piles of tires create environmental concerns. The long term objective is to find a means to dispose of the crumb rubber in Portland cement concrete and still supply a final product with good engineering properties

1.1 Objectives

1. To introduce Crumb Rubber in varied proportions, which is substituted for fine aggregate material, in orderto increase compressive strength % and decrease building material production.

2. This experimental work's major objective is to investigate the strength and toughness characteristics of rubberized cement concrete.
3. Utilisingtyre rubber particles could result in a novel variety of concrete with distinct mechanical and fracture properties, in addition to environmental advantages.

4. Through laboratory research, better understand the properties of crumb rubber used in concrete.

5. The primary objective of this research is to discover ways to dispose of the crumb rubber by incorporating it into a concrete mix with Portland cement while still producing an end product with good engineering qualities.

6. Although recycled tire rubber has been widely employed in highway asphalt, there are few studies on its applications in cement concrete.

7. Some experimental studies to assess the strength and toughness qualities of rubberized concrete made of Portland cement.

8. Utilisingtyre rubber particles could result in a novel type of concrete with distinct mechanical and fracture properties, in addition to environmental advantages.

9. Making use of trash.

10. Concrete with rubber added for design strength.

11. Reducing the natural resource production costs of building materials.

1.2 Literature review

1.P. Rohit, S.K. Alisha, P.V.S.S.P. Ganesh Varma

In their study the aim was to study of waste tire as partial replacement of fine aggregate to produce rubberizes concrete in M25 grade of mix. Different partial replacement of crumb rubber i.e., 0%, 3%, 6%, 9% and 12% by volume of fine aggregate are casted and tested for flexural strength and split tensile strength. The result shows that there is a reduction in all type of strength for crumb rubber mixture, but crumb rubber content concrete become more lean due to increase in partial replacement of crumb rubber as fine aggregate i.e. 3%, 6%, 9% and 12%. Flexural strength of concrete decreases with 3% replacement of sand and further decrease in strength with the increase in percentage of crumb rubber. For split tensile strength decreases with 3% replacement of sand and further decrease in strength with the increase in percentage of crumb rubber. This is mainly due to lower bond strength between cement paste and rubber tire aggregate.

2. Aravind S M Tech student, Civil Department Ilahia College of Engineering & Technology Kerala ,India

In this study they did partial replacement of fine aggregate as crumb rubber as 0.5%, 1%, 1.5% and 2% in M25 grade of concrete and its effects on concrete properties like compressive strength, flexural strength were investigated. Addition to this combination of glass fiber at ratio 0.4% and 0.5% addition to the weight of cement are used to regain the reduced strength due to use of waste tire crumb rubber particle. Results indicate that replacement of wastetire crumb rubber particle to the fine aggregate in concrete at ratio 0.5% and 1% there is no effect on the concrete properties would occur, but there was a considerable change for 1.5% and 2% replacement ratio.

3. Rudrapratap Singh Kaurav1,Sandeep Gupta2,Shailendra Prasad Tiwari3,

In this investigation he did casting and testing of cubes, cylinders, and prisms for M20 grade of concrete and added 5% and 10% of rubber fiber by volume of concrete. There the specimens are tested for compression, split tensile and flexural strength. The test results were done and noted that due to addition of rubber fiber, strength of concrete decreases, but as observing ductility is improving. Hence it is used for medium grade of concrete.

1.3 Materials

A. Ordinary Portland cement

Ordinary Hydraulic cement is Portland cement. It is used to create concrete that has the ability to set and harden when its chemical qualities interact with water. OPC sets and hardens in water to produce the appropriate setting properties, yet it does not disintegrate in water. In order to create the finished cement powder, a little amount of gypsum is mixed with the clinker before it is finely crushed. This project makes use of OPC grade 53.

B. Fine aggregate

Sand that is close to riverbed quality and readily available locally is used as fine aggregate. The sand particles pack to provide a minimum void ratio; a higher void content necessitates more water mixing. Assessing properties such voids ratio, gradation specific surface, and bulk density optimal cement concentration and minimal water for mixing.

C. Course aggregate

Concrete's coarse aggregate is a chemically stable component. The drying shrinkage and other dimensional changes brought on by moisture transport are lessened by the presence of coarse aggregate. Regular concrete contains coarse aggregate, which increases the cement concrete's variability. In typical concrete, the cement mix's interaction with the aggregate surface is weak. By limiting the maximum size of the aggregate, the cement becomes more uniform, and the strength and durability properties of the concrete are significantly improved.

D. Crumb rubber

The term "crumb rubber" refers to the little fragments of rubber extracted from car tyres. This kind of rubberis made using a procedure known as ambient grinding. This kind of grinding involves several steps and makes use of truck or vehicle tyres in the form of treads, sidewalls, or shred. By adhering to the steps, The metals, textiles, and rubbers are divided in that order. Following processing, the tyres are fed through

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a shredder to be reduced to smaller bits. The little chips are then fed into a granulator, which breaks them down even more into even smaller pieces while also eliminating the steel and fibre.

CRUMB RUBBER

It involves using mechanical or cryogenic methods to turn the tyre into tiny granular or powdered particles. During this procedure, the steel and fabric parts of the tyres are also taken out. Particles in crumb rubber range in size from 4.75mm to less than 0.075mm. typically three Tyre waste is processed into crumb rubber using several techniques.

1.4 Material Mix Design

SLNO	RUBBER REPLACEMENT(%)	CEMENT(kgs)	Fine aggregate (kgs)	Course aggregate(kgs)	Crum b rubber(kgs)
1	0%	410	850	1118.5	0
2	5%	410	819	1118.5	30.24
3	10%	410	789	1118.5	60.48
4	15%	410	759	1118.5	90.24
5	20%	410	729	1118.5	120.9

1.5 Specimen and preparation

- A total of 30 specimens were prepared with M45mix for the study.

- In order to prepare the recycled crumb rubber specimens, fine aggregate were replaced by wastematerials of crumb rubber in several percentages like 5 ,10,15,20% in separate concrete mixtures.

- The crumb rubber is passed through 2.36mm sieve and retained to 1.17mm sieve is taken forthe study.
- Using these mix proportion specimens were casted .

- After 24 hours of casting, cubes were taken outfrom the mould and then submerged in water tank for curing.

- All specimens were fabricated and then cured inwater for 28 days.

- And then after curing specimens were tested forcompressive strength, tensile strength and modules of elasticity test.

1.6 Test On Cubes

A total of 30 specimens were prepared with M45 mix for the study.In order to prepare the recycled crumb rubber specimens, fine aggregate were replaced by waste materials of crumb rubber in several percentages like 5,10,15,20% in separate concrete mixtures.The crumb rubber is passed through 2.36mm sieve and retained to 1.17mm sieve is taken for the study.Using these mix proportion specimens were casted .After 24 hours of casting, cubes were taken out from the mould and then submerged in water tank for curing.All specimens were fabricated and then cured in water for 28 days.And then after curing specimens were tested for compressive strength, tensile strength and modules of elasticity test.

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Table 1: Compression Test Result

SL NO	% OF CRUMB RUBBER	COMPRESSIVE STRENGTH(N/mm2)
1	0%	26.75
2	5%	28.73
3	10%	27.46
4	15%	25.63
5	20%	24.42

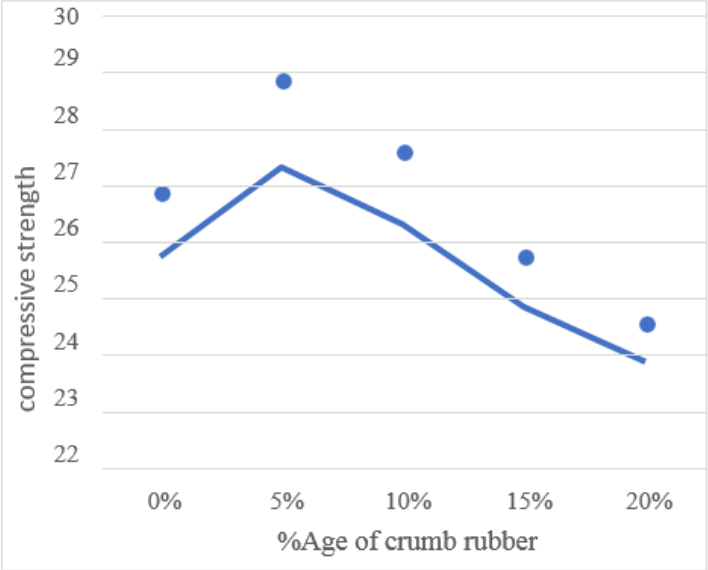
Table 2: Split Tensile Test Result

SL NO	% OF CRUMB RUBBER	SPLIT TENSILE STRENGTH (N/mm2)
1	0%	2.869
2	5%	2.727
3	10%	2.036
4	15%	1.987
5	20%	1.890

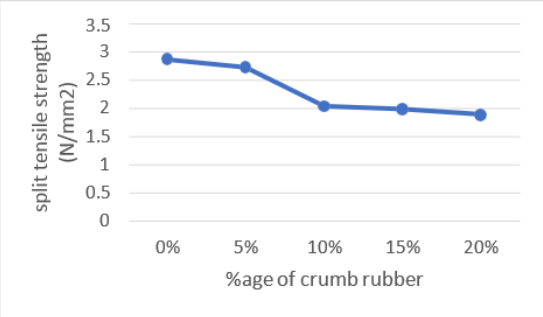
Table 3: Flexural Strength Test Result

SL NO	% OF CRUMB RUBBER	FLEXURAL STRENGTH(N/mm2)
1	0%	3.42
2	5%	3.38
3	10%	3.32
4	15%	3.28
5	20%	3.22

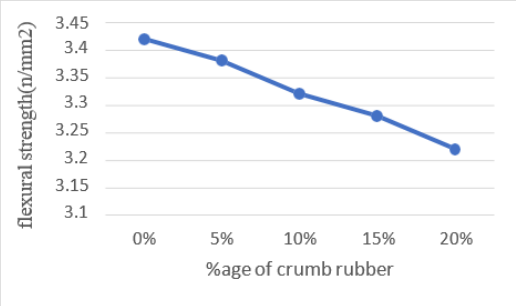
Graph 1: Compression Test



Graph 2 :Split tensile



Graph 3: flexural strength



1.7 Conclusion

1. Concrete that has a higher percentage of crumbed rubber has a lower workability; thatis, as the amount of crumbed rubber increases, so does the workability of the concrete.
2. The strength data from the 7-day and 28-day compressive strength specimens differ bysubstitute for crumbly rubber.
3. For concrete of the M20 grade, the addition of5% crumb rubber increases strength compared to standard concrete.
4. For concrete of the M20 grade, a 10% crumb rubber additive results in less strength than normal concrete.
5. Additionally, it was discovered that using 5% crumb rubber as a fine aggregate by volume results in somewhat higher strength compared to using 10%, 15%, and 20%.Therefore, concrete with 5% crumb rubberadded as a fine aggregate can be used in applications requiring low concrete strength.
6. There are no differences between the use of 0.5% and 1% crumb rubber as a fine aggregate in concrete for M20 grade. For concrete of the M20 grade, the strength value decreased as the fraction of crumb rubber used to replace fine aggregate increased.
7. The main cause of the strength loss was a weaker connection between the rubber tyre aggregate and cement paste.

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