Use of Waste Tire Rubber Chips As A Partial Replacement To The Coarse Aggregates In Concrete

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Abstract- *The use of scrap tire 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 tire rubber chips as aggregate in a systematic manner. In the present experimental investigation, the M25 grade concrete has been chosen as the reference concrete specimen. Scrap tire 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. 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. Concrete tested with varying percentages of rubber from 0 to 20% of normal aggregates. Compressive strength, of concrete is measured and comparative analysis is made.*

Keywords- Tire Rubber, Rubber chiefs, Steel Fibre, Chipped Rubber.

I. INTRODUCTION

During the last three decades, there have been dramatic changes in the way of thinking about industrial processes and the approach and evaluation of new and innovative materials. Concrete, in its most basic form, is one of the world's oldest building materials. Concrete is a substance composed of only a few simple and commonly available ingredients that when properly mixed and cured, may last for centuries. Concrete is an evolving material as well. New techniques and methods for selecting the right quantities of those simple components are continually being presented to the design community. New ingredients to include in concrete mixes are also constantly being researched and developed. In general, concrete has low tensile strength, low ductility, and low energy absorption. Concrete also tends to shrink and crack during the hardening and curing process. These limitations are constantly being tested with hopes of improvement by the introduction of new admixtures and aggregates used in the mix. One such method may be the introduction of rubber to the concrete mix. Shredded or crumbed rubber is waste being of non-biodegradable and poses severe fire, environmental and health risks.

II. RESEARCH OBJECTIVES

The objective of this study is to test the properties of concrete when shredded or crumbed rubber used as aggregate by partial replacement of natural aggregates. The parameters of this investigation include the compressive strength of concrete specimens. Cubes of 150 X 150 X 150mm size for compressive strength, Cylinders of size 150 mm diameter and 300 mm height for flexural strength and Beam of size 100 X 100 X 500 mm for split tensile strength are casted for the testing of concrete. The concrete having compressive strength of 25N/mm2 (M25) is used and percentages of rubber aggregates are 0, 5, 10, 15 and 20% of normal aggregates. The natural aggregates are replaced by rubber aggregates on volume basis. The strength performance of modified concrete specimens was compared with the conventional concrete.

III.CHIPPED RUBBER (CR)

Chipped rubber made by cutting process of used waste automobile tires after removing wires from it. Chipped rubber also generated in tire remoulding plants.

WasteTire

Rubber Chips

IV. EXPERIMENTAL STUDY

A) Material

- CEMENT – OPC 53 grade
- FINE AGGREGATE – Natural river sand
- COARSE AGGREGATE – 20 mm
- WASTE TIRE RUBBER CHIPS – *20 mm*
- WATER – Normal potable water

B) NaoH Treatment

The waste tire rubber particle are immersed into NaoH solution for 20 min and then dried before using in the concrete mix. NaoH treatment to the surface of rubber particle enhances the adhesion between the rubber particle and cement paste.

C) Concrete mix design

The mix design for M25 grade of concrete with target strength 31.6 mpa used for this study.
The proportions of material are given below in table.All substitutions of waste tire chipped rubber with coarse aggregate is done by volume basis.

TABLE 1. CONCRETE MIX DESIGN

Item in mix	Specific gravity (g/cc)	weight(kg/m3)
Cement	3.15	450
Natural sand	2.68	682.33
Coarse Aggregate	2.71	1125.73
Water	1	186 lit.

TABLE 2.PERCENTAGE OF RUBBER CHIPS REPLACING COARSE AGGREGATE IN CONCRETE.

Percentage of rubber chips	Rubber chips (kg/m3)	Coarse aggregate (kg/m3)
5%	1.8	4.39
10%	3.62	8.78
15%	5.42	13.17
20%	7.23	17.57

TABLE 3.PERCENTAGE OF STEEL FIBER ADDITION TO THE WEIGHT OF CEMENT IN CONCRETE.

% of steel fiber	Wt. of the steel fiber added
0.5%	175 gm
1.0%	350 gm
1.5%	525 gm
2.0%	700 gm

V. RESULTS AND DISCUSSION

A) workability

The w/c ratio 0.42 is taken for this study and the recorded slump values are as follows ,

W/C Ratio= 0.42 slump (mm)

00% replacement	78
05 % replacement	84
10 % replacement	87
15 % replacement	92
20 % replacement	98

It observed from the above result, for higher rubber content workability ofconcrete increases
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B) Compressive strength

From the result it was observed that higher content of waste tirerubber chips decreases the compressive strength of concrete.

This decreased compressive strength can be increase by adding steel fiber to the weight of cement in different percentage.

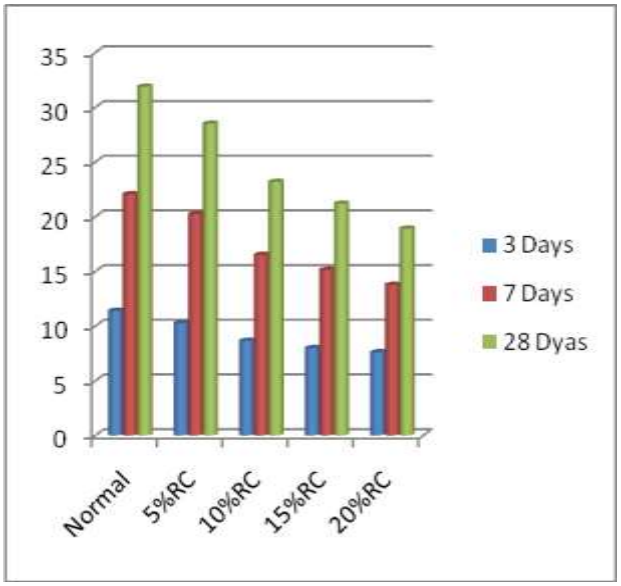
The following values are based on the testing of concrete block made by adding rubber chips in it. Each value

is taken from the average of 3 specimens of each % of rubber replaced with coarse aggregate.

Value are in KN.

TABLE 4.COMPRESSIVE STRENGTH OF CONCRETE AFTER ADDING RUBBER CHIPS.

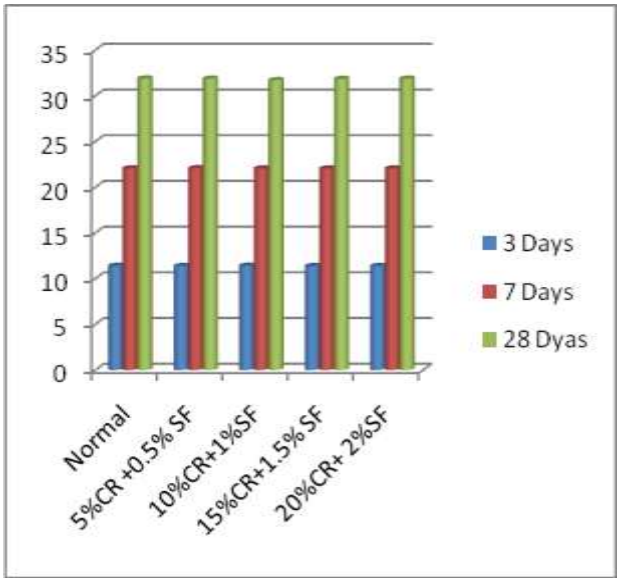
% Replaced	3 days	7 days	28 days	% decreased
Normal	11.38	22.05	31.87	0 %
05 %	10.26	20.23	28.50	11 %
10 %	8.64	16.50	23.18	27 %
15 %	7.98	15.13	21.18	33 %
20 %	7.6	13.76	18.90	41 %



As we can see the compressive strength of concrete is get decreased by the replacing the rubber chips with the coarse aggregate.

To recover the compressive strength of concrete, we add the steel fiber in it and repeat the procedure.
The following table shows the value of compressive strength after adding steel fiber in it.

% of steel fiber	3 days	7 days	28 days
Normal	11.38	22.05	31.87
0.5 %	11.36	22.06	31.86
1.0 %	11.4	22.04	31.70
1.5 %	11.35	22.03	31.83
2.0 %	11.36	22.04	31.86



VI. CONCLUSION

A) By partially replacing the rubber chips at different proportions in the concrete it results in decreasing the workability of concrete with the increasing the percentage of rubber chips.

B) It is also observed that the increasing percentage of the rubber chips decreases the compressive strength of the concrete. It reduced the compressive strength of concrete at the rate of 8.5% to 10% per increasing 5% of rubber chips.

C) From the obtained test results it is observed that the weight of the block specimens has been reduced due the increasing percentage of rubber chips in the concrete. The rubberized concrete is used to produce light weight concrete.

D) It is also observed that the reduced compressive strength is enhanced by the steel fiber upto the certain limit.

E) The crack pattern of the block observed during the test on the rubberized concrete which doesn't shows typical compression failure behaviour.

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