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Effects of Scrap Rubber TYRE Aggregates as Partial Replacement of Natural Aggregates in High Strength Concrete

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***Abstract:** This research work mainly focus on feasibility of incorporating rubber tyre cubical chips as a partial replacement or natural aggregates in concrete. Little work is done using rubberized concrete for normal strength. Here an attempt is made to compare the strength of high strength concrete for different % of rubber aggregates. Experimental program consists of testing the different parameter of the materials used like cement, sand, and aggregate. In the present investigation the mechanical strength like compressive strength, flexural strength, split tensile strength are compared with the rubberized concrete using 20mm single size rubber pieces as replacement to natural aggregate. Replacing by 5%, 10%, 15% and 20%. And there results were checked with reference to conventional concrete and the amount of variation in the strength is studied.*

***Keywords:** High strength concrete, Rubber tyre, scrap rubber.*

I. INTRODUCTION

Approximately 37 million tires of vehicles are discarded yearly and tis number is keep on increasing in future and the traffic load will be grown to a value of 63% by 2021 presently 62% of tyre are recycled 11% are exported, 27% of tyre are used in landfills in illegal tires dumps.bt it causes serious threats to environment because it will not be biodegradable hence there will be intact with the soil here there are dumped. In this context we need to think too overcome this problem to have better outcomes.so this work not only gives the idea about using rubber in concrete as partial replacement of coarse aggregate but also helps in reducing the burden over environment when it is a matter of dumping the used waste

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II. OBJECTIVES

The objective of this research work is to find out the better optimum replacement of rubber aggregate inside concrete and to check the compatibility with concrete when replaced in concrete.. Little work is done using rubberized concrete for normal strength. Here an attempt is made to compare the strength of high strength concrete for different % of rubber aggregates.

The specific objectives of the project are as follows:

1. To evaluate the structural properties of concrete by using rubber aggregate replaced for high strength concrete.
2. To form a bunch of concrete mixes and check which will give a desired properties.
3. To establish the density and grading of the rubber crumb and chip aggregate.
4. To have economic analysis and investigate the market potential of rubber concrete products

III. MATERIAL CONSTITUENTS OF RUBBERIZED CONCRETE

This part reveals the different characteristics of the constituents of rubber replaced concrete. The constituents are mainly are rubber aggregate, mineral aggregates and cement.

Rubber aggregate

This type of aggregate are obtained by cutting waste discarded tyre rubber to a required shape and size which meet the requirement of natural aggregate. Using general processing technique, Mechanical grinding at room temperature or cryogenic grinding, The mechanical grinding is most commonly used methods which cuts the rubber to several centimeter to fraction of centimeter, then it is separated from sieve shakers. And this process has to be carried out at room temperature. This method uses variety of techniques to disintegrate rubber such as cracker mixes

Sl. No.	Specimen	M35 Mix – 28 days test result		
		Compressive strength N/mm^2	Split tensile strength N/mm^2	Flexural strength N/mm^2
1	R0	41.69	2.3	3.84
2	RC5	42.66	2.03	3.76
3	RC10	35.05	1.7	3.2
4	RC15	39.01	1.6	3.1
5	RC20	20	1.52	3.04

IV. PARAMETERS USED IN THE PRESENT INVESTIGATIONS

1) The plain high strength concrete used are M35 M55 and M65 grade concrete.
2) The main parameter which is compared to the plain concrete and with concrete with waste rubber aggregate cut into cubical type pieces with maximum size of 20mm by varying the percentage of rubber with 0%, 5%, 10%, 15% and 20%.
3) The super plasticizer used for mix of M55 and M65 is Conflast sp 430 by doing trial mix design.

V. CONCRETE MIX DESIGN

The conventional concrete was used as control concrete and serves as bench mark for the research work. Two different mixes were prepared in accordance with IS standard code (10262) with a target mean strength of 53 Mpa. Two different mixes shown different quantity of raw materials specifically W/c ratio and proportions of aggregate value, First the conventional concrete mix was prepared with coarse aggregate having a size of 20mm.Then in order to have rubberized concrete mix the coarse aggregate was replaced by the rubber aggregate. Four different batches were made in which the 20mm coarse aggregate replaced by rubber aggregate at different % of replaced95, 10, 15, and 20%)

The mixture proportions of the basic ingredients i.e. cement, water coarse aggregate and fine aggregate, were the same for the control concrete and rubberized concrete. For mixes M35, M55 and M65.

Table- I: Proportion by ratio: For M35 Concrete

Cement	Water	Sand	Coarse Aggregate
1	0.42	1.21	2.63

Mix proportion for M55

The mix design has been done using IS method. Trail experiment has conducted for fixing super plasticizer dosage of (0.9%) of the weight of Cement.

Table-II: Proportion by ratio: For M55 Concrete

Cement	Water	Sand	Coarse Aggregate
1	0.34	0.6	2.2

Mix proportion for M65

The mix design has been done using IS method. Trail experiment has conducted for fixing super plasticizer dosage of (1.2%) of the weight of Cement.

Table-III: Proportion by ratio: For M65 Concrete

Specimen	M55 Mix – 28 days test result (Table no 3)		
	Compressive strength N/mm^2	Split tensile strength N/mm^2	Flexural strength N/mm^2
R0	62.97	2.755	6
RC5	61.85	2.34	5.16
RC10	49.06	2.19	5.2
RC15	36	2.01	5.1
RC20	35.15	1.9	3.16

VI. EXPERIMENTAL PROCEDURE

Concrete cubes of 150x150x150mm were casted using 0%, 5%, 10%, 15% and 20% of rubber pieces replacement to natural aggregate. The total cubes casted were 15 in number. Similarly prism of 100X100X500 with rubber replacement total 15 in number are casted with also cylinders of 150mm diameter and 300mm height were casted 15 in numbers.. Thereby the total number of specimen casted and tested was 135 in number. One set of specimen consisting of 3 cubes, 3 prisms, 3 cylinders are casted in one set. The specimens were covered with wet gunny bags for 24 hours and were cured in portable water in 28 days.

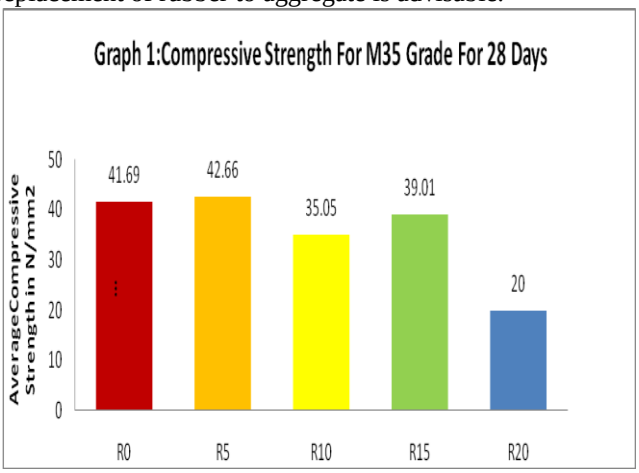
1. Compressive Strength
2. Split Tensile Strength
3. Flexural Strength

VII. EXPERIMENTAL RESLTS

Compressive strength:

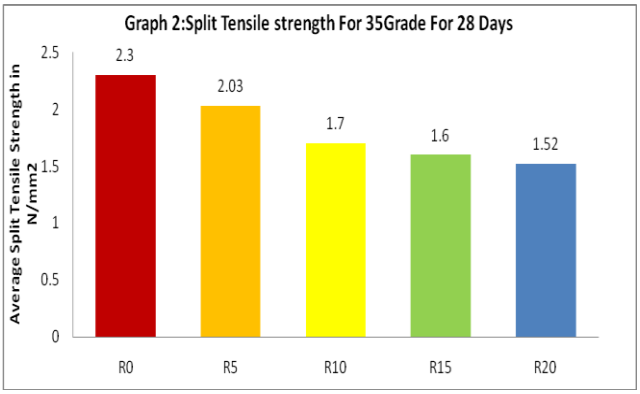
As it is most important characteristics of concrete and very easy to conduct on hardened concrete to know the compressive strength of the given sample the specimens were taken and tested under CTM machine having a capacity of 2000Kn.standard test procedure ere followed in accordance with IS516.

The Compressive strength test results for M35 grade concrete are shown in table 4 and graph No: 1, for M35 mix with and without rubber. The percentage variation in compressive strength is shown in table 8.4 and graph No: 10, for specimen with and without rubber, it is observed that with rubber replacement of 5%, 10%, 15% and 20%, the variations of strength are -2.03%, 16%, 6.3% and 52.05% respectively. It is observed that at 5% replacement there is increase in strength of 2.03%, which is almost negligible; hence 5% replacement of rubber to aggregate is advisable.



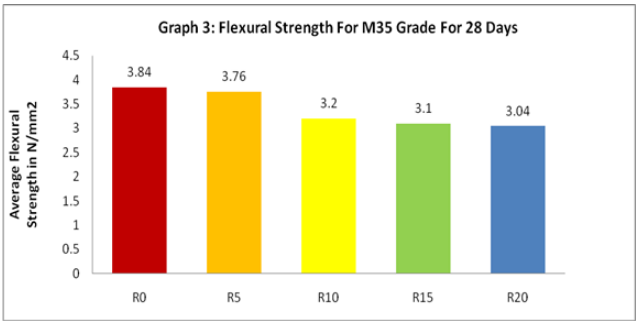
Grap.1 Compressive strength of M35 Concrete.

The split tensile strength test results for M35 grade concrete are shown in table 4 and graph No: 2, for M35 mix with and without rubber. The variations in split tensile strength are shown in table 8.4 and graph No: 2, for specimen with and without rubber. It is observed that with rubber replacement of 5%, 10%, 15% and 20%, the variation of strength is 11.73%, 26.08%, 30.43% and 34 % respectively.



Graph.2 Split Tensile strength of M35 Concrete.

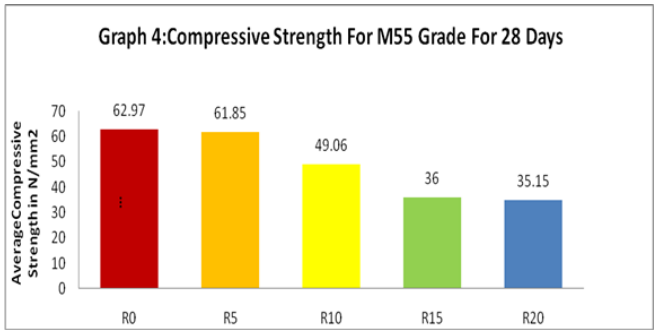
The flexural strength test results for M35 grade concrete are shown in table 4 and graph No:3, for M35 mix with and without rubber .The variations in flexural strength is shown in table 8.4 and graph No:3, for specimen with and without rubber. It is observed that with rubber replacement of 5%, 10%, 15% and 20%, the variation of strength is 8.5%, 21.95%, 24.4% and 26 % respectively. It is observed that with 5% replacement of rubber, the variation in strength is about 8.5% only. Hence 5% replacement of rubber is advisable.



Graph.3 Flexural strength of M35 Concrete

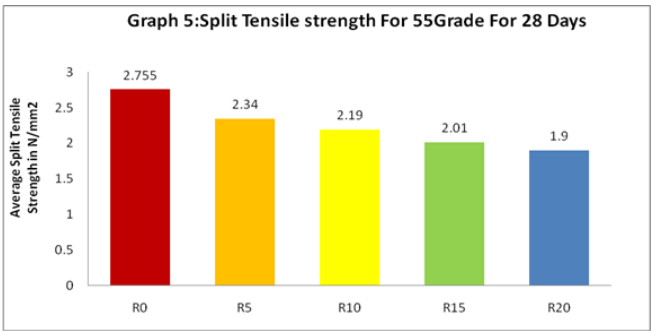
Table-IV: Strength Properties of M55 Concrete

The compressive strength test results for M55 grade concrete are shown in table 5 and graph No: 4, for M55 mix with and without rubber. The percentage variation in compressive strength is shown in table 5 and graph No:13, for specimen with and without rubber, it is observed that with rubber replacement of 5%,10%,15% and 20%, the variation of strength is 2.04%, 22.08%, 42.80% and 45% respectively. The decrease in strength of 2.04% is almost negligible; hence 5% replacement of rubber to aggregate is advisable.



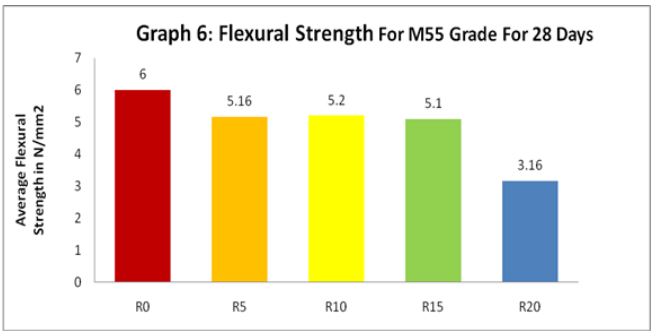
Grap.4 Compressive strength of M55 Concrete.

The split tensile strength test results for M55 grade concrete are shown in table 5 and graph No:5, for M55 mix with and without rubber .The variations in split tensile strength is shown in table 5 and graph No 5, for specimen with and without rubber. It is observed that with rubber replacement of 5%, 10%, 15% and 20%, the variation of strength is 14.9%, 20.36%, 26.9% and 30.9 % respectively.



Grap.5 split tensile strength of M55 Concrete

The flexural strength test results for M55 grade concrete are shown in table 5 and graph No 6, for M55 mix with and without rubber. The variations in flexural strength are shown in table 5 and graph No:6, for specimen with and without rubber. It is observed that with rubber replacement of 5%, 10%, 15% and 20%, the variation of strength is 14%, 13%, 15% and 47 % respectively.



Grap.6 Flexural strength of M55 Concrete

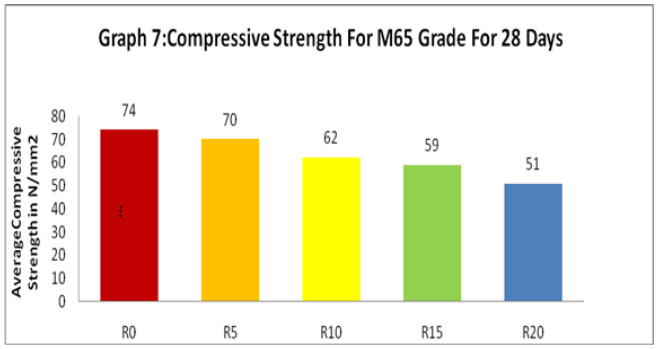
Sl. No.	Specimen	% Replacement of Rubber	% Variation M35 Mix – 28 days test result (table no 4)		
			Compressive strength N/mm^2	Split tensile strength N/mm^2	Flexural strength N/mm^2
1	RC5	5	-2.03	11.73	8.5
2	RC10	10	16	26.08	21.95
3	RC15	15	6.3	30.43	24.4
4	RC20	20	52.05	34	26

Sl. No.	Specimen	% Replacement of Rubber	% Variation M55 Mix – 28 days test result(table no 5)		
			Compressive strength N/mm^2	Split tensile strength N/mm^2	Flexural strength N/mm^2
1	RC5	5	2.04	14.9	14
2	RC10	10	22.08	20.36	13
3	RC15	15	42.82	26.9	15
4	RC20	20	45	30.09	47

Sl. No.	Specimen	% Rubber Replacement	% Variation M65 Mix – 28 days test result (table no 6)		
			Compressive strength N/mm^2	Split tensile strength N/mm^2	Flexural strength N/mm^2
1	RC5	5	5.4	13.3	1.6
2	RC10	10	16.21	14.01	15.72
3	RC15	15	20.02	24.5	23.2
4	RC20	20	31.08	38.3	33.07

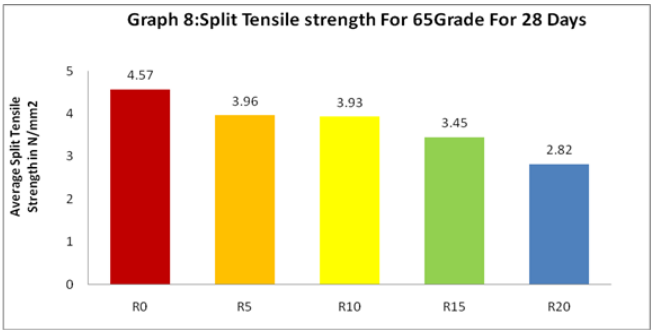
Sl. No.	Specimen	M65 Mix – 28 days test result (table no7)		
		Compressive strength N/mm^2	Split tensile strength N/mm^2	Flexural strength N/mm^2
1	R0	74	4.57	6.55
2	RC5	70	3.96	6.44
3	RC10	62	3.93	5.52
4	RC15	59	3.45	5.35
5	RC20	51	2.82	4.4

The compressive strength test results for M65 grade concrete are shown in table 7 and graph No: 7 for M65 mix with and without rubber. The Percentage variations in compressive strength are shown in table 6 and graph No: 7, for specimen with and without rubber, it is observed that with rubber replacement of 5%, 10%, 15% and 20%, the variation of strength is 5.4%, 16.21%, 20.02% and 31.08% respectively. The decrease in strength of 5.4% is almost negligible; hence 5% replacement of rubber to aggregate is advisable.



Grap.7 Compressive strength of M65 Concrete

The split tensile strength test results for M65 grade concrete are shown in table 8.3and graph No:8, for M65 mix with and without rubber .The variations in split tensile strength is shown in table and graph No8, for specimen with and without rubber. It is observed that with rubber replacement of 5%, 10%, 15% and 20%, the variation of strength is 13.3%, 14.01%, 24.5% and 38.3 % respectively. It is observed that with 10% replacement of rubber, the variation in strength is about 13% only. Hence 10% replacement of rubber is advisable.

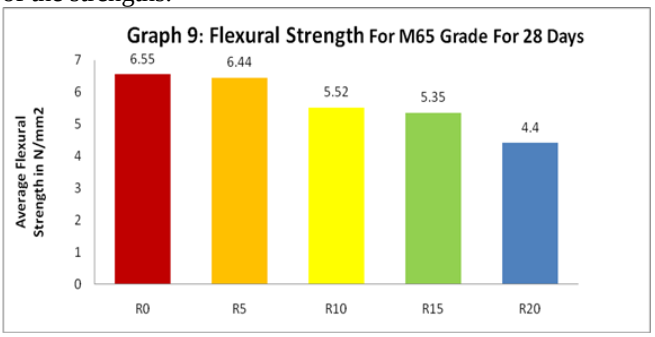


Grap. 8Flexural strength of M65 Concrete

The flexural strength test results for M65 grade concrete are shown in table and graph No: 9, for M65 mix with and without rubber. The variations in flexural strength are shown in table and graph No:9, for specimen with and without rubber. It is observed that with rubber replacement of 5%, 10%, 15% and 20%, the variation of strength is 1.6%, 15.72%, 23.2% and 33.07 % respectively.

It is observed that with 5% replacement of rubber, the variation in strength is about1.6% only. Hence 5% replacement of rubber is advisable.

But in present study it is interesting and encouraging to observe that there is marginal change in compressive strength, split tensile strength and flexural strength 5% to 10%. The reason may be due to the fact the rubber aggregate used are single size aggregate replacement of single size aggregate (20mm) giving less voids which is essential for improvement of the strengths.



VIII. CONCLUSION

From the tables and graphs shown in the chapters leads to the following conclusions.

1. The present investigations carried on plain and rubberized concrete have shown interesting and encouraging strength of rubberized concrete.
2. The literature survey indicates reduction in the compressive strength of rubberized concrete compared to plain concrete. Also reduction is observed in split tensile strength and flexural strength of rubberized concrete.
3. The results for split tensile strength almost remain same even with replacement of 5% of rubbers, thereby helping in utilizing the waste rubbers in concrete.
4. It is concluded that there is increase in the compressive strength with the replacement of up to 5% rubbers, may be due to the reduction of pores by replacing 20mm size rubber aggregates.
5. It is also seen that the flexural strength are marginally equal to plain concrete with reduction of 5% rubber.

6. It is concluded that with the higher replacement of rubber the strength falls considerably due to lumping of rubber in concrete .Which acts as weak bond between rubbers between rubber aggregates.
7. With the increase of strength of concrete of M35, M55 and M65 it is concluded that the variation in strength are not much effected on strength variation.
8. With the increase in the grade of concrete from M35 to M65, it is concluded that the variation of strength at higher grade of M65 is less compared to the variation of lesser grade.
9. It is concluded that the natural mineral aggregate can be replaced by the scrap and waste rubber by about 5% to 8% without compromising the strength of concrete there by helping the environment by utilizing the waste which is harmful to Mother Nature earth.

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