

EXPERIMENTAL STUDY ON THE PROPERTIES OF CRUSHED WASTE TYRE CONCRETE

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ABSTRACT - The widely used building material in the construction was Concrete, as well as the major user of natural resources with yearly ingesting of 20 billion tons. Basically, it consists of aggregates which are bonded together by cement and water. The major part of concrete besides the cement is the aggregate. Aggregate include Coarse and Fine. Use of these conventional materials in concrete is likely to diminish the resources unless there is a suitable substitute. Rubber which is generated in large quantities as waste does not have useful disposal till now. But rubber is found to possess properties that are required for viable replacement of fine aggregate in concrete. Hence, we in this project have aimed to study the efficiency of rubber as substitute for fine aggregate and utilize the Crushed Waste Tyre in concrete, to minimize global warming. Aggregate properties such as specific gravity, water absorption, acid resistance was to be conducted to ascertain the properties concrete specimens were to be casted and tested for concrete mix with various percentage of replacement (5%,10% &15%) and its viability for replacement are discussed in this project.

Key Words: Crushed Waste Tyre rubber, Compressive strength, Splitting tensile strength, Flexural Strength.

1.INTRODUCTION

The use of rubber product is increasing every year in worldwide. India is also one the largest country in population exceeds 100cr. So, the use of vehicles also increased, according to that the tyres for the vehicles also very much used and the amount of waste of tyre rubber is increasing. This creates a major problem for the earth and their livings. For this issue, the easiest and cheapest way of decomposing of the rubber is by burning it. This creates smoke pollution and other toxic emission and it create global warming. Currently 75-80% of scrap tyres are buried in landfills. Only 25% or fewer are utilized as a fuel substitute or as raw material for the manufacture of a number of miscellaneous rubber goods. Burying scrap tyres in landfills is not only wasteful, but also costly. Disposal of whole tyre has been banned in the majority of landfill operations because of the bulkiness of the fires and their tendency to float to the surface with time. Thus, tyres must be shredded before they are accepted in most landfills. So

many recycling methods for the rubber tyre are carried according to the need. From this one of the processes is to making the tyre rubber in to crumb rubber. It is used in many works such as Road construction, Mould making etc

2. EXPERIMENTAL INVESTIGATION

Materials

Cement

Ordinary Portland cement of 53 grade confirming was used in the present study. The properties of cement are shown in Table 1.

Table -1 Properties of Cement

Sl. No.	Property	Result
1.	Initial Setting time	35min
2.	Specific Gravity	3.148
3.	Fineness Modulus	1.5%

Fine Aggregate

Natural sand as per IS: 383-1987 was used. Locally available river sand having bulk density 1860kg/m³ was used. The properties of the fine aggregate are shown in Table 2.

Table -2 Properties of Fine Aggregate

Sl. No.	Property	Result
1	Specific Gravity	2.6
2	Fineness Modulus	2.4%
3	Water Absorption	0.50%

Coarse Aggregate

Crushed aggregate confirming to IS: 383-1987 was used. Aggregate of size 20mm of specific gravity 2.66 and fineness modulus are shown in Table 3.

Table -3 Properties of Coarse Aggregate

Sl. No.	Property	Result
1	Specific Gravity	2.66
2	Fineness Modulus	6.7%
3	Water Absorption	2.4%

Crushed Waste Tyre Rubber

The properties of Crushed Waste Tyre are shown in Table 4.

Sl. No.	Property	Result
1	Specific Gravity	1.7
2	Fineness Modulus	4.5%
3	Water Absorption	2%

Rubber

Table -4 Properties of Crushed Waste Tyre

Specimen Details

From the study of the past literatures, the conventional concrete grade was chosen as M30 for replace the Crushed Waste Tyre in the fine aggregate. Tests for physical properties of the materials have done and the mix ratio for the concrete was calculated by the materials properties as 1:1.82:3.07 and the water to cement ratio of 0.42 had been chosen.

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Mix Proportioning

Concrete mix design in this experiment was designed as per the guidelines in IS 10262-2009. All the samples were prepared using design mix. M30 grade of concrete was used for the present investigation. Mix design was done based on I.S 10262-2009. The table 5 shows mix proportion of concrete (Kg/m³)

Table -5 Mix proportioning

Water	Cement	Fine Aggregate	Coarse Aggregate
161 litres	380.95 Kg/m ³	696.71 Kg/m ³	1169.72 Kg/m ³
0.42	1	1.80	3.1

EXPERIMENTAL PROCEDURE

The specimen of standard cube of (15x15x15) cm and standard cylinders of (30x15) cm and prisms of (100x100x500) cm were used to determine the compressive strength, split tensile strength and flexural strength of concrete. Three specimens were tested for 7 & 28 days with proportion of Crushed Waste Tyre replacement. Totally 24 cubes, 24 cylinders and 24 prisms were cast the strength parameters and 12 cubes for acid attack test. The constituents were weighed and the materials were mixed by hand mixing. The water cement ratio was 0.42.

Experiments Conducted

The following experiments are conducted on the specimen cast.

- Compression test
- Splitting tensile test
- Flexural test

Results and Discussion

The normal and Crushed Waste Tyre concrete are tested for their performance by determining their compressive strength, splitting tensile strength and flexure strength development at different ages of 7th and 28th days. The results obtained are discussed in detail in the following sections.

Compressive Strength

The limit of compressive strength of the cement concrete depends on both, the strength of the matrix and the particle tensile strength of the aggregate. The strength of the concrete is usually related to the cement content and water to cement ratio. However, in this study the Crushed Waste Tyre is partially replaced with fine aggregate and test the strength under compression. The compression strength of the concrete at 7th and 28th day were conducted is given in Table 6.

Table -6 Compressive strength of normal and Crushed Waste Tyre concrete.

Replacement of Fine Aggregate by crushed waste tyre	7 days(N/mm ²)	28 days(N/mm ²)
0%	24.32	37.2
5%	27.10	37.76
10%	24.52	35.32
15%	19.52	29.02

Splitting tensile strength

The splitting tensile strength of the Crushed Waste Tyre concrete with the different percentage replacement of Crushed Waste Tyre fine aggregate in normal concrete at the 7th and 28th day results were to be tabulated in Table 7.

Table -7 Splitting tensile strength of normal and Crushed Waste Tyre concrete.

Replacement of Fine Aggregate by crushed waste tyre	7 days(N/mm ²)	28 days(N/mm ²)
0%	3.05	4.08
5%	2.75	3.50
10%	2.3	2.96
15%	2.0	2.59

Flexural Strength

The flexural strength of the normal and Crushed Waste Tyre concrete for the different proportions of Crushed Waste Tyre in fine aggregate at 7th and 28th day results were given in the Table 8.

Table -8 Flexural strength of normal and Crushed Waste Tyre concrete.

Replacement of Fine Aggregate by crushed waste tyre	7 days(N/mm ²)	28 days(N/mm ²)
0%	6.02	7.91
5%	5.75	6.95
10%	5.00	5.78
15%	4.96	5.46

3. CONCLUSIONS

From this study the effective utilization of rubber tyre waste has been developed and it made to use in the concrete mixture as fine aggregate. At present the Crushed Waste Tyre production in the south India is very less than north. So, the material availability was less, because of less knowledge about that. Based on the test results the following conclusions were made. These can also include non-primary structural applications of medium to low strength requirements, benefiting from other features of this type of concrete.

Even if rubber tyre aggregate was used at relatively low percentages in concrete, the amount of

waste tyre rubber could be greatly reduced due to the very large market for concrete products worldwide. Therefore, the use of waste tyre rubber aggregates in concrete shows promise for developing an additional direction for used tyres.

- The compressive strength of Crushed Waste Tyre concrete with 5% replacement is 37.76 N/mm²; it is higher than the strength of normal concrete (37.20N/mm²) on 28th day.
- The compressive strength of Crushed Waste Tyre concrete with 10% replacement, it gives acceptable strength of 35.32 N/mm²
- In splitting tensile strength, the strength of Crushed Waste Tyre concrete is lower than the strength of normal concrete.
- In the flexural strength test conducted on Crushed Waste Tyre concrete it shows a decrease in strength when compared to the strength of normal concrete.

From the test results, it is found that the Crushed Waste Tyre possesses less bonding ability which has affected on the strength of the concrete.

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