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EXPERIMENTAL STUDY OF REPLACEMENT OF COURSE AGGREGATE BY RUBBER CHIPS IN CONCRETE

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ABSTRACT

The discarding of waste tyres is serious concern all over the world as it causes environmental problems. Our main aim was to utilize the waste tyre rubber chips in concrete as a partial replacement instead of coarse aggregate. The use of waste tyre rubber chips in concrete makes it economical and moreover it becomes environmental friendly. The strength of concrete with partial replacement of waste tyre rubber chips at various percentages had been investigated. Compression and split tensile tests were carried out for three different percentages of rubber chips say, 0%, 4%, 8%% and 12% at 7 days curing period. The tests results indicate that as the percentage of rubber chips increases, lesser will be the strength of the concrete. But in case of 4% replacement of waste tyre rubber chips in concrete it shows the maximum strength compared to the other percentage replacement that is 8% and 12%. The observed strength of control specimens and 4% replacement of waste tyre rubber chips in concrete found to be almost identical.

Key words: Waste tyre rubber chips, Compressive and split tensile strength, 7 Days curing.

INTRODUCTION

Disposal of waste tyre rubber is one of the major concerns for all over the world. With the increase of automobiles in India from past few years the demand of tyres has gone up very high. As we know light weight concrete is widely used on various architectural works. In India more than 33 million vehicles use roads from 2007 to 2010, about 80 million tyres have hit the roads - these include two, three, four and six wheelers.

A typical tyre contains 24-28% of carbon black, 40-48% of natural rubber and 24-36% of synthetic rubber including styrene butadiene rubbers (SBR) and butyl rubber (BR), which all are ingredient used for tyre manufacturing. Worldwide more than 981 million tires are thrown away each and every year and even less than 7% are recycled, 11% are burned for fuel, and 5% are exported. The remaining 77% are sent to landfills, stockpiled, or

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illegally dumped. That's almost 765 million old tires are wasted every year across the world.

Investigations carried out so far reveal that waste tyre rubber chips in concrete is specially suggested for concrete structures located in areas of severe earthquake risk and also for applications submitted to severe forceful actions like railways sleepers. This material can also be used for non-load bearing purposes such as noise diminution barriers[1]. Over 5 billion tons of toxic solid waste materials are produced in US every year. Out of which more than 273 million scrap tyres (around 3.6 million tons) are produced every year. In accumulation to this, about 3 billion tires are stockpiled[2]. The retained automobile tires create fire and health problems.

As a solution to the problem of scrap tire disposal, an investigational study was conducted to examine the prospective of using tire chips and crumb rubber as an aggregate in Portland cement concrete[3]. It is assumed that cement acting as a binder mixed with crumb rubber make concrete blocks more flexible and thus, provides smoothness to the surface. At the same time it also provides sufficient strength or minimum required strength to the concrete[4].

The recycle prospective of tire chips as coarse aggregates in pavement concrete by investigating the effects of low and high-volume tire chips on fresh and hardened concrete properties indicated that tire chips can be used replacement of coarse aggregate in concrete pavement mixtures[5]. 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.

EXPERIMENTAL

Materials

Cement: Cement graded confirming to IS 1489 (Part 1): 1991. In this experimental analysis 53 grade of Portland Pozzolana Cement (PPC) is used for all Mixes.

Fine aggregate: As per IS 383:1970 zone III, the fine aggregate had been collected. Specific gravity for the sample is 2.61.

Coarse aggregate: As per IS 383:1970 the nominal size of coarse aggregate used for pavers is 10-12 mm size. Specific gravity for the sample is 2.71.

Rubber chips: The scrap tyre are collected and cut into small pieces. The rubber chips are sieved through 12 mm and retained in 10 mm for the replacement of coarse aggregate as shown in Fig. 1.

Fig. 1: Waste tyre rubber chips

Experimental work

Casting of control specimen

Cubes specimens of size 150 X 150 X 150 mm and cylinder specimens of diameter 150 mm & height 300 mm (as per IS 10086:1982) are used. Mix proportion for the control specimen was cast as per the ration given below.

Table 1: Mix proportion

Cement	Water	Fine aggregate	Coarse aggregate
1 Kg	0.44 l	1.7 Kg	1.64 Kg

Casting of rubber concrete

The casting of rubber concrete contains waste tyre rubber chips of 10 mm with partial replacement of coarse aggregate at various percentages like 4%, 8% & 12%. The mix identification is given in the Table 2.

Table 2 Identification of mix

Specimen ID	Mix
P 1	Control specimen
P 2	P1 + 4% replacement (rubber chips)
P 3	P1 + 8% replacement (rubber chips)
P 4	P1 + 12% replacement (rubber chips)

Compressive strength test

The compressive test as shown in Fig. 4.1 was carried out as per IS: 516-1959. The compressive load results of the control specimen and the rubber replaced concrete was calculated for 7 days and given in Table 4.1. It had been observed that the P2 shows the highest compressive strength among the replaced specimens compared with P3 & P4. The compressive strength of P1 is moderately lower than control specimen.

Fig. 3.1: Compression testing machine setup

Split tensile strength test

The test was carried out in CTM as shown in Fig. 4.2 as per IS: 5816-1999. The Split tensile strength had been calculated for 7days for the control specimen as well as for the rubber replaced concrete in Table 4.1. It had been observed that the P2 shows the highest split tensile strength among the replaced specimens compared with P3 & P4. The split tensile strength of P1 is to some extent lower than control specimen.

Fig.3.2 Split tensile test in CTM

Table 3.3 Compressive strength test & split tensile test for 7 days

Specimen ID	Compressive strength, N/mm^2	Split tensile Strength, N/mm^2
P1	23.869	2.869
P2	23.108	2.727
P3	18.021	2.036
P4	17.876	1.987

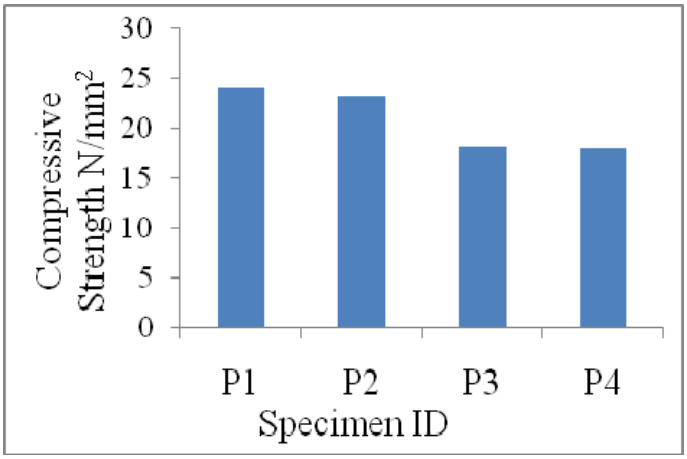

Fig.3.3 Compressive strength test of specimen – 7 days

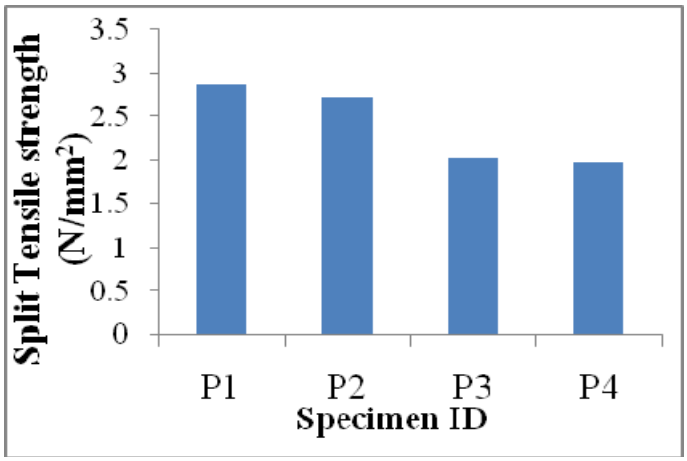

Fig.3.4 Split tensile strength test of specimen – 7 days

RESULTS AND DISCUSSION

The test result indicates that the Compressive and split tensile strength decreases with increase in percentage of rubber chips. Among diverse mixes of concrete P2 gives the highest strength for the replacement of coarse aggregate in comparison with control specimens. Slump value of the concrete increases as increase in waste rubber chips of scrap tyre i.e. workability increases with replacement. With the percentage of rubber increases, weight of the concrete decreases. So, light weight concrete can be used in architectural use. Environmental pollution can be controlled by the use of the scrap tyres. As decomposition of scrap tyre is a major problem in a developing nation like India.

CONCLUSION

- Rubber replacing concrete can be used in light weight concrete as it decreases the density of the concrete.
- Compressive strength of the concrete decreases as increase in replacement of rubber chips.
- From the literature review and experimental studies it is concluded that despite of decrease in strength of concrete there is a very high demand of concrete so it can be used as a partial replacement.
- In India there is a very few tyre recycle industries despite of 36 tyre manufacturers. So, there is need to increase in tyre recycle industry.
- Light weight rubber concrete can be used for the architectural use.

REFERENCES

1. Jr. T. U. Ganiron, Waste Tire as an Asphalt Cement Modifier for Road Pavement (2014).
2. T. R. Naik and R. Siddique, Properties of Concrete Containing Scrap Tire Rubber, Feb. (2002).
3. N. N. Eldin and A. B. Senouci, Rubber- Tire Particles as Concrete Aggregate (2015).
4. T.-C. Ling and H. Md. Nor, Granulated Waste Tyres in Concrete Paving Block Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference (APSEC 2006), 5-6 Sept. 2006, Kuala Lumpur, Malaysia (2006).

5. R. Lui, Recycled Tires as Coarse Aggregate in Concrete Pavement Mixtures, Ph.D., P. E. University of Colorado Denver Department of Civil Engineering College of Engineering and Applied Science, Denver (2013).

6. IS: 1489 (Part 1): Portland Pozzolana Cement Specification (1991).

7. IS: 10086: Specification for Moulds for use in Test of Cement and Concrete (1986).

8. IS: 516-1959, Method of Test for Strength of Concrete.

9. IS: 5816-1999, Method of Test for Splitting Tensile Strength of Concrete.

10. IS 383:1970, Specific Gravity of Coarse Aggregate and Fine Aggregate from Natural Sources for Concrete.

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