ENHANCING STRENGTH OF CONCRETE WITH CRUSHED RUBBER TYRES

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ABSTRACT

Concrete is a composite material composed of coarse aggregate bonded together with fluid cement that hardens over time. Cement, sand and stone are the main constituents of concrete. Nowadays need of natural resources for various development works is emerging as a growing threat to the environment, which also led to continuous and increasing demand of resources. The crushed rubber tyre is significantly increased in future due to increase in urbanization in India. Hence, the no environmental nature of these used is going to be a potential threat .This project was being carried out on crushed rubber tyre as a partial replacement for coarse aggregate in concrete construction using locally available crushed rubber tyres. Therefore, it is the aim of this study to introduce an environmental friendly technology, which can benefit the society and the nation.

Key words:- *Used rubber tyres, Silica Fumes, coarse aggregate*

1. INTRODUCTION

[1] In last few years in India, the demand for used rubber tyre has gone up to a very high level because of increase in automobiles. In earthquake risk area, the used rubber tyre is mainly used for concrete structures. The balanced automobiles may create health problem is near future. [2] In concrete cement and aggregate are most important constituents the need of resource for concrete is increasingly very rapidly aggregate are mainly from natural resources. For the problem, we need alternative replacement for aggregates. Here, we use crushed rubber tyres as a replacement for coarse aggregate used rubber tyres are recycled only in small amount. So, we partially replace crushed rubber tyres in aggregate. [3] The recycled tyres mostly used as a partial aggregate in concrete because of recent research shows changes in mechanical properties of concrete when the rubber is introduced to mix with concrete. Rubber is the main constituent of the tyre. Natural and synthetic rubbers are mainly used in concrete. The rubber particle decreases the compressive strength of concrete. [4] Disposal of waste tyres by dumping method Affect the environment very badly. It pollutes the land, air and water resources. so we use it used rubber tyres as replacement for aggregate and check properties, compressive strength and split tensile strength of concrete. [5] Effects of fire wastes on the mechanical properties of concrete. In a changing technology we used waste components as a modern creation. In order that tire waste because used in the concrete design for replacement of coarse aggregate. Different other materials was added in the mix such as silica fume, emulsified asphalt, PET, fibres far improving properties and creating new using possibilities of rubber concrete. [6] Prevention of waste is considered as the most considerable treatment process in European union waste treatment hierarchy recovery and recycling process takes the second place after prevention of waste treatment process. In the span of period of 15 years, it is possible that observe change from the functioning of recovery and recycling. Literature analysis, regulation and statistical data analysis are some of the important methods are used in the treatment process. [7] The paste, the fine aggregate and coarse aggregate are combined to form a concrete. The Portland cement and water are combined to form a paste. It will Coats the outer surface of aggregates. The functioning of the paste is to improve the strength to improve the strength to form the rocking substances are called concrete. In most of the infrastructure buildings like commercial, industrial and military structures, dams, quality of the concrete plays a key role. [8] In this case of using rubber tyres, we also need to get better strength properties. Mixing of cement with silica fumes have showed some good strength on compressive and split tensile. So, we also consider a silica fume as one of the admixture.

2. MATERIALS USED:

The main constituents of concrete are cement, aggregate and water. Admixtures are added if required.

2.1 CEMENT:

Portland pozzolana cement of grade 43 and specific gravity 2.9 is used in the mixture. Initial setting time of this cement is more and so it is useful for construction which involves delayed construction. Nowadays, PPC is used widely than OPC due to its advantages like more tensile strength, increased initial setting time, and good resistance against expansion.

2.2 SILICA FUMES:

Silica fume of grey color, density of about 550 kg/cm^3 with 2.2 specific gravity is used as replacement of fine aggregate due to its ability to increase the compressive strength of concrete, toughness and flexural strength of the concrete.

2.3 CRUSHED RUBBER TYRES:

In recent years, the disposal of tyre has been significantly increased. We have used rubber tyres as partial replacement for coarse aggregate after removing the inner reinforcement in the tyre .In nature, it gives high flexural strength by adding some admixture we can obtain the compressive strength in the concrete.

Advantages:

- It is economical.
- It helps to prevent pollution and overcome the problem of storing used tyres.
- Increase the flexural strength of the concrete.

3. EXPERIMENTAL INVESTIGATION:

The materials used in this project were crushed rubber tyres, silica fume, Portland Pozzolana Cement, fine aggregate, coarse aggregate and water.

3.1 Fine aggregate:

Locally available river sand belonging to zone 3 of IS 383-1970, was used in this project work. The sieve analysis data and physical properties of fine aggregate are used in table 1.

TABLE: 1 PROPERTIES OF FINE AGGREGATE

S.NO	CHARACTERISTICS	VALUES
1.	Type	Uncrushed(natural)
2.	Specific gravity	2.67
3.	Bulk density	1667kg/m^3
4.	Fineness modulus	2.74
5.	Grading	Zone 3
6.	Water absorption	1%

The above table shows that properties of fine aggregates such as specific gravity as 2.67, bulk density as 1667kg/m^3, water absorption as 1%.

3.2 Coarse aggregate:

As per IS 383-1970 the nominal size of coarse aggregate is 20 mm. therefore further details shown in the below table 2.

TABLE 2 PROPERTIES OF COARSE AGGREGATE

S.NO.	CHARACTERISTICS	VALUES
1.	Type	Crushed
2.	Specific gravity	2.71
3.	Bulk density	1764kg/m^3
4.	Fineness	6.40
5.	Maximum size	20mm
6.	Water absorption	0.80

The above table shows that the properties of course aggregate such as specific gravity 2.71, bulk density 1764kg/m^3,water absorption 0.80%.

3.3 Shredded Rubber Tyre:

The rubber tyre are collected and cut into small pieces. The rubber tyre piece that passes through 20mm sieve and retained in 12mm are used for the replacement of coarse aggregate. Specific gravity of rubber is 1.079.

3.4 Water:

Portable clean water was used in the present investigation for both casting and curing of concrete.

Mix design and mix details:

The design formulation is based on the IS 10262-2009 for M_{30} grade of concrete ($f_{ck=}$30 Mpa). Water cement ratio is calculated as 0.40. The mix ratio is (1:1.35:2.43).

3.5 Fresh concrete test:

Workability test was taken as per IS CODE 456-2000. The test conducted are slump cone test and flow table test. The test result satisfied the water cement ratio 0.40, which was calculated from mix design using IS CODE 10262-2009.

3.6 Hardened concrete test:

As per IS CODE 456-2000, the hardened concrete test for compressive strength and tensile strength were taken. The result was given below.

4. RESULT AND DISCUSSION

4.1 Compressive strength:

The compressive strength gain of concrete was determined at the time period of 7 days, 14 days and 28 days as present in table 3. The cubes were casted for compression test. The cubes were casted and tested as per IS 516-1959.

Fig 1 Compressive Strength

Table: 3 Compressive Strength of Concrete

Mix	PPC (%)	Silica fumes (%)	Compressive strength in (Mpa)		
			7 days	14 days	28 days
A_0	0	0	19	27	31.2
A_1	95	5	18	27	29
A_2	95	5	16.5	25.5	27
A_3	95	5	13.5	21	25.5

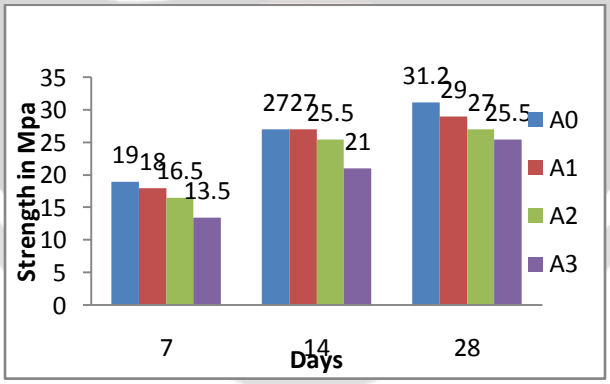

Fig 2 Graph of Compressive Strength

Table: 4 Identification of mix

Specimen	Mix
A_0	Control specimen
A_1	Replacement of coarse aggregate by (20% of rubber)
A_2	Replacement of coarse aggregate by (25% of rubber)
A_3	Replacement of coarse aggregate by (30% of rubber)

The compressive strength shown in fig was carried out as per IS code 516-1959. The compressive load results of the control specimen and the rubber replaced concrete was calculated for 7 days, 14 days and 28 days are given in the table 3. It had been observed that A_1 shows the highest compressive strength among the replaced specimens compared with $A_2$and A_3. The compressive strength of A_0 is moderately lower than conventional concrete.

4.2 Split tensile strength test:

Tensile strength of concrete was determined at the age of 7 days, 14 days and 28 days as presented in table 5. The cylinder were casted and tested as per IS 516-1959.

Fig 3 Split Tensile Strength

Table: 5 Split Tensile strength of concrete

Mix	PPC (%)	Silica fumes (%)	Tensile strength in (Mpa)		
			7 days	14 days	28 days
A_0	0	0	2.8	3.2	3.6
A_1	95	5	2.2	3.1	3.39
A_2	95	5	1.8	2.6	3.0
A_3	95	5	1.5	2.2	2.9

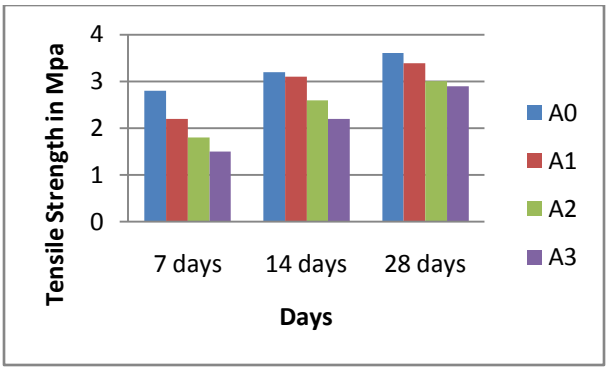

Fig:4 Graph of Split Tensile Strength

The test was carried out in CTM as shown in fig as per IS 5816-1999. The split tensile strength had been calculated for 7days, 14 days and 28 days for the control specimen as well as for the rubber replaced concrete. It had been observed that A_1 shows the highest split tensile strength among the replaced specimen compared with A_2 and A_3. The split tensile strength A_0 is to some extent lower than control specimen.

5. CONCLUSION

- Rubber replacing concrete can be used in light weight concrete as it decreases the density of the concrete.
- In 20% attain the compressive strength of concrete.
- Compressive strength of the concrete decreases as increase in replacement of rubber tyres.
- 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 a partial replacement.
- In India there is a few tyre recycle industries despite of 36 tyre manufacturers. So, there is need to increase in tyre recycle industry.
- Light weight rubber concrete used for the architectural use.

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