STUDY OF PERFORMANCE ENHANCEMENT OF CONCRETE BY REPLACING COARSE AGGREGETE AS TYRE RUBBER

M.Harikaran[1]

[1] *Assistant Professor, Department of Civil Engineering* [1]*mhk91karan@gmail.com*

Mahendra College of Engineering, Attur Main Road, Minnampalli, Salem -636 106, Tamilnadu

Abstract- The search for a new and viable alternative is important for protection of innate resources and reduction in manufacturing cost. Steel slag, coconut shell and over burnt brick have already been tested and used as alternative materials for coarse aggregate. The desolate tyre rubber is a assured material in the building industries as part of coarse aggregate replaced due to its light weight, energy absorption, elasticity and heat insulating properties. This has the other advantage of saving in innate aggregate consumed in the creating of concrete and also this concrete will be light in weight. In this work, analysis have been executed to appraise this tire rubber as supplementary coarse material and this will be beneficial for future application for innate aggregate in concrete. This study reports split stretchy strength, compressive strength & flexural strength variation in concrete with 5%, 10%, 15%, and 20% replacement of coarse aggregates by waste tyre rubber.

Keywords- Mix proportioning, waste tyre rubber, compressive strength.

I. INTRODUCTION

Concrete is the most desired building material. The term “concrete” has its origin from the Latin term “concretes”, which means to grow together. The current utilization of concrete in the world is appraised to be approximately 12 million tons per Annam. Different countries in the world has different rate of producing rubber, for example United States make 3.6M tons of rubber per year. One possibility of decomposition is burning, but that would also outcome in harmful to environment. Rooted on these problems, waste tyres rubber can be consumed as aggregates in the concrete. However the availability of its ingredients is gradually decreasing with more and more demand for concrete. Commented that the recycled tyre rubber waste is an optimistic material in the building industry and the unique reason for this is the lightweight of the resulting concrete when the tyre rubber is comprised in it as an aggregate substitute (partial).Coarse aggregate is some of the ingredients facing acute shortage. So we need to search for a new and viable alternative is important for conservation of natural resources and reduction in manufacturing cost. Steel slag, coconut shell and over burnt brick have already been tested and used as alternative materials for coarse aggregate. Tire rubber is a optimistic material in the building industries as partial substitution of coarse aggregate due to its light weight, energy absorption, elasticity and heat insulating properties. This has the other advantage of saving in innate aggregate consumed in the creating of concrete. In this work, analysis have been executed to appraise this tire rubber as supplementary coarse material and this will be beneficial for future application for innate aggregate in concrete. In this experimental investigation, the influence of partially replacing coarse aggregate through waste tyre rubber on the compressive energy of concrete has been reported.

METHODOLOGY:

Five different mixes consists of 0%, 5%, 10%, 15%, and 20% replacement of coarse aggregate with waste rubber are tested according to the workability aspect, compressive strength, ultrasonic pulse velocity and density. The cube sample size of 150 x 150 x150 mm, the cylinder sample size of 150mm diameter 300mm height and the prism sample size of 100x100x500mm are workout for each mix design. A total of 90 concrete samples were tested to be analysed. All the specimens are then cured in water for 7 days and 28 days before testing. For each mix design, three trails were tested and the average readings were recorded.

II. MATERIAL STUDY

3.1 Cement

A binding components and substance to make objects stick to each other. In this work. Ordinary Portland cement 53 grade confirming to IS 12269:1987 was used in every part of the examination.

3.2 Coarse Aggregates [Natural]

Machinery tool crushed locally obtainable hard basalt, well graded 20 mm and down size were used. Testing of aggregates was carried out as per IS 383 – 1970

3.3 Fine Aggregate [River sand]

Locally obtainable river sand passing down in 4.75mm sieve as per IS: 383- 1970 were used as fine aggregates. The aggregates confirmed to grouping Zone II category. Table 1 shows the physical appearance of fine and coarse aggregate.

Table 1 Physical Properties of Fine Aggregate and Course Aggregate

DESCRIPTION	FINE AGGREGATE	COARSE AGGREGATE
Specific gravity	2.64	2.84
Water absorption	0.42%	1.54%
Fineness modulus	3.48	6.48
Surface moisture	Nil	Nil
Bulk density	1450 kg/m^3	1765kg/m^3

3.4 Tyre rubber

Rubber can be defines as any solid medium that upon vulcanization and becomes elastic. There are two types of rubber which are innate rubber and synthetic rubber. All rubberlike medium are polymers, which are high molecular weight composite made up of lengthy chains of one or more types of molecules, such as monomers. Innate rubber is made from the white liquid that can be extracting from trees and it is called latex. Over 99% of the world's innate rubber is made from the latex that arrive from a tree variety called Heve a brasiliens is, generally known as the rubber tree. Innate rubber consists of the combination of monomer and produces Isoprene polymer.

It has been well surveyed that about 1 billion of worn out automobile tires are generated each year universally. Exactly, 275 million of used rubber tires compiled in the US and about 180 million in European Union. In addition to that, the traditional ways of recycling tires in our country like as a shoe making material and other tools is decreasing nowadays. This is contemplate as one of the big environmental task facing municipalities throughout the world because used rubber is not easily biodegradable even after a long spell of landfill research. The best management master plan for scrap tires that are worn out beyond hope for restate is recycling. Application of fragment tires should reduce environmental problems and maximize safe keeping of innate resources. One feasible provision for this problem is to integrate rubber particles into cement-based materials. Scrap tires can be rip up into basic materials for use in hundreds of small rubber products. The other part of the complication is that aggregate production for construction purpose is continuously leading to the exhaustion of innate resources. Besides, some countries are depending on bring aggregate into their country from abroad and it is surely very costly. For example, the Netherlands does not possess its own aggregate and has to import. This deal leads to an immensely growing interest for the use of substitute materials that can replace the innate aggregates. Therefore, the use of used tire rubber as an aggregate can provide the solution for two vital issues: The environmental issues created by waste tires and the depletion of innate resources by aggregate production accordingly the scarcity of innate aggregates in some countries.

Table 2 Physical Properties of Fine Slag

PROPERTIES	RESULT
Specific gravity	1.14
Size	20mm
Water absorption	0.25%

III. MIX DESIGN

4.1 IS Code mix design

The mix design for concrete M25 grade is arrived based on the code IS 10262:2009, and the obtained mix proportion is given in below table.

Table 3 IS Mix Design

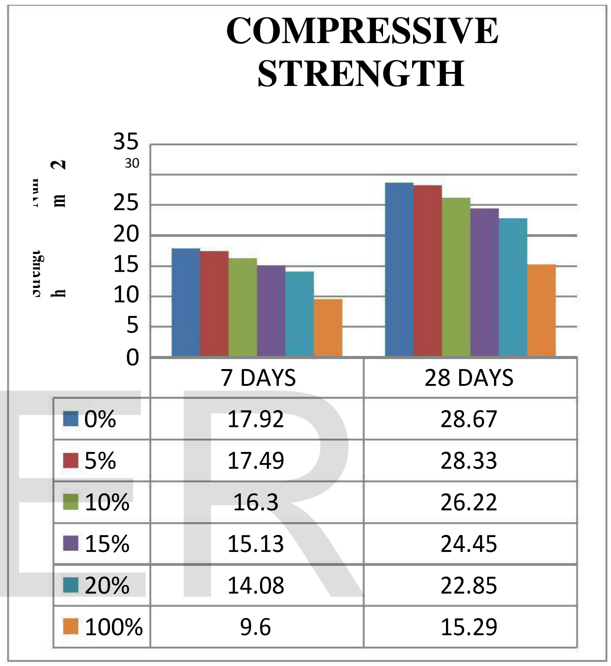
Grade of Concrete	Cement in kg kg/m^3	Fine Aggregate in kg kg/m^3	Coarse Aggregate in kg/m^3	W/C	% replacement of tyre rubber
M25	446.4	661.10	1160.36	0.5	5
M25	446.4	661.10	1160.36	0.5	10
M25	446.4	661.10	1160.36	0.5	15
M25	446.4	661.10	1160.36	0.5	20

IV. RESULTS AND DISCUSSION

5.1. Compressive strength

Compressive strength test on cubes and cylinders were carried out using the Universal Testing Machine (UTM). Compressive test were carried out on cubes of size 150 × 150 × 150 mm after 7 days and 28 days. For each test and for each mix three samples were tested. The compressive strength was quantified using the diction Fc= P/A for cubes, Where, Fc is the compressive stress in MPa. P is the maximum load applied in Newton and A is the cross sectional area in mm^2.The compressive strength test setup for cube.

Cube specimen

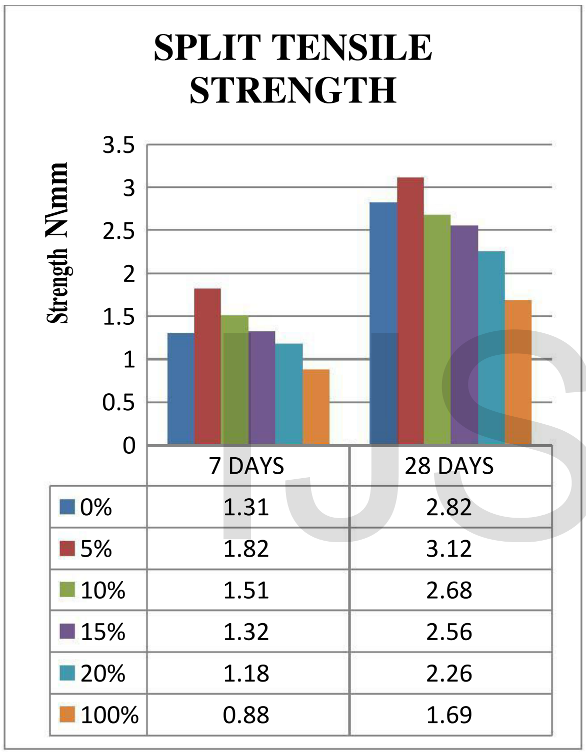


Compressive Strength

5.2 Split Tensile Strength:

Split tensile strength test was used to find out the tensile strength of concrete. The test was performed on cylinder with the dimension of 300 mm in length and 150 mm diameter after 7 days and 28 days using the CTM. The split tensile strength was assessed by using the expression $F_{ct} = 2P/\pi dl$, where, F_{ct} is the split tensile strength in MPa, P is the compressive load on the cylinder (in Newton), *l* is the length of the cylinder in mm, and *d* is the dia of the cylinder in mm. The split tensile strength test for cylinder.

Cylinder Specimen



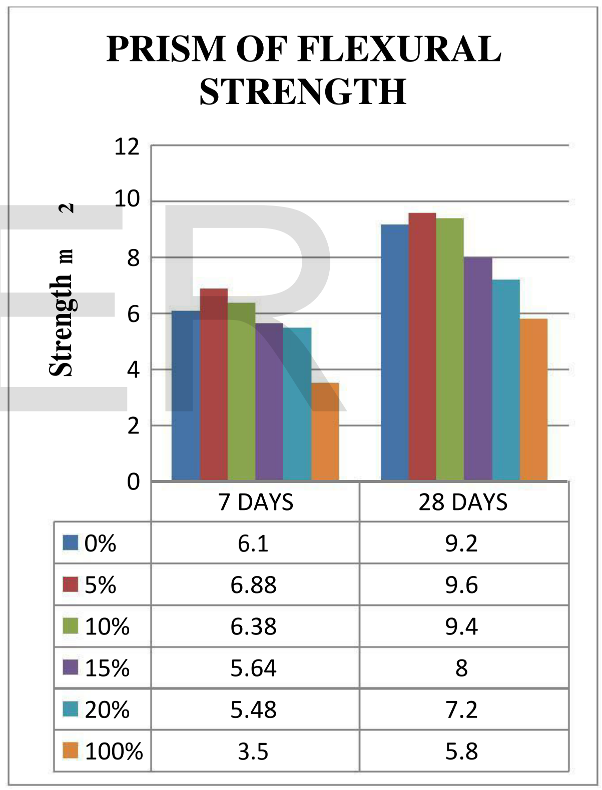
	7 DAYS	28 DAYS
0%	1.31	2.82
5%	1.82	3.12
10%	1.51	2.68
15%	1.32	2.56
20%	1.18	2.26
100%	0.88	1.69

Split Tensile Strength

5.3. Flexural Strength:

Flexural strength test was used to determine the flexural strength of concrete. The test was performed on prisms of dimensions 100 × 100 × 500 mm. Cured for 28 days by immersing under water. After 28 days flexural strength was determined by the two point loading technique, computed by using the expression $F_b = PL/bd^2$, where F_b is the flexural strength in MPa, P is the maximum applied load in Newton, span length is L in mm, width of the specimen is B in mm, and d is the depth of the specimen in mm. The test setup for flexural strength for prism.

Prism Specimen



	7 DAYS	28 DAYS
0%	6.1	9.2
5%	6.88	9.6
10%	6.38	9.4
15%	5.64	8
20%	5.48	7.2
100%	3.5	5.8

Flexural Strength

V. CONCLUSION

The common objective of this investigation was to analyse the fresh and hardened properties of a concrete produced by substituting part of the innate coarse aggregates with an waste tire rubber aggregate which one is locally available. From the test results of the specimen, as compared to the normal concrete properties, the following endings are drawn out. From the results show that the compressive strength is not increased when compared to the normal mix but 5% replacement of rubber, produce the same strength of nominal mix. The results show that the tensile strength is increased when compared to the normal mix in the volume of 5% coarse aggregate was substituted by rubber aggregate. The results show that the flexural strength is increased when compared to the conventional mix in the volume of 5% of rubber aggregate is used for coarse aggregate.

FURTHER RESEARCH RECOMMENDATION:

Investigation has to be made on the occurrence of any chemical reactions that might take place between the rubber aggregate and other ingredients of the rubberized concrete to make sure that there are no undesirable outcome or effects similar to the alkali silica and alkali carbonate reactions.

Single graded rubber aggregates of size 20mm has been used in this research. Investigation on the effects of different size of aggregates, different percentage replacements other than those made in this research has to be carried out in the near future.

If we need to increase the strength in higher proportion of rubber mix. Can we try steel and glass fiber in addition.

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