International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-4, November 2019

Strength Properties of Tyre Rubber Concrete

Sulagno Banerjee, Jessy Rooby

Abstract: Due to the fast development in vehicle industry, utilization of tyre is expanding everyday and there is no reuse of the equivalent to diminish the natural contamination. The transfer of waste tyres is confronting serious issues in India. The developing issue of waste tyre transfer in India can be eased if new reusing courses can be found for the surplus tyres. It is evaluated that 1.2 billions of waste tyre rubber delivered all inclusive in a year. It is assessed that 11% of postconsumer tyres are traded and 27% are sent to landfill, accumulated or dumped wrongfully and just 4% is utilized for structural building ventures. Subsequently endeavors have been taken to distinguish the potential utilization of waste tyres in structural building ventures.In this present study, cubes are casted of M25 grade by replacing 5, 10, 15 percent of tyre rubber aggregate with coarse aggregate and compared with regular M25 grade concrete. Properties of fresh concrete like workability, compressive strength,split tensile strength,flexural strength of hardened concrete were identified. The aim is to investigate the optimal use of waste tyre rubber as coarse aggregate in concrete composite.

Keywords: rubber concrete, recycled coarse aggregate, Waste material

I. INTRODUCTION

In a quick creating nation like India there is increment in urbanization coming about increment in utilizing of vehicles all things considered. With the expansion of vehicles the quantum of utilized and rejected tires is additionally being expanded. These squanders and rejected tyres gravely influence the earth. To help the general public especially to have the better condition these waste tires can be used into concrete construction. It is the essential point of our examination to present another Technology which will be valuable to condition. Through this examination we are going to discover the reasonable extent and level of blending the recycled coarse rubber aggregates acquired from waste tires with the locally accessible materials required for concrete. For this reason, there is various research center tests on arranged examples and the outcomes so got have been investigated appropriately. Concrete , the ingredients of which are cement ,steel , aggregates (sand, stone-chips) is the most important material in construction work. Hence, there is a high demand for those materials in the commercial sector. It is known fact that in general aggregates used in concrete are obtained by mining. Unfortunately mining causes severe environmental damages by lowering the ground water table.

Manuscript published on November 30, 2019.
*Correspondence Author
Sulagno Banerjee*, Research scholar of Civil Engineerieng Department, Hindustan Institute of Technology and Science, Padur, Chennai, Tamil Nadu, India & Assistant Professor, Civil Engineerieng Department, Elitte College Of Engineering, Sodepur, Kolkata, India
Jessy Rooby, Professor of Civil Engineering Department, Hindustan Institute of Technology and Science, Padur, Chennai, Tamil Nadu, India,

It also disintegrates rock strata which is mainly responsible for earthquake as well as land slide. Engineers are certainly trying to figure out an alternative materials as a solution of the aforesaid problem. Number of researchers have conducted to find out the alternative use of the above traditional materials. Emiroglu et al [1] found that Slump relies on rubber content and there is a steady diminishing in strength with the increase of rubber. Gammel et al [2] tested concrete with 10% - 25% crumb rubber replacement along with Silica fume and Rubcrete. Sali Tayeh et al [3] found satisfactory performance against impact load and bending load with expanded in level of sand substitution by the crumb rubber. Helme et al [4] suggested 25% substitution demonstrated compressive quality inside permissible range for most utilizations of concrete of the control mix design. Naito et al [5] found unit weight of C R C decreases linearly. Richardson et al [6] found concrete strength reduction is an indication of air void / crumb spacing which offers freeze / thaw protection. Richardson et al [7] concluded addition of 0.5% and 1% rubber crumb by mass of concrete to replicate levels of air entrainment that will give durability. Naik et al [8] discovered that it is conceivable to make generally high strength rubber concrete utilizing magnesium oxy chloride cement, which gives better bonding attributes to rubber and fundamentally improves the performance of rubcrete. Senthilet al [9] found grade of concrete plays the major role in the ductility performance of rubber replaced concrete.

II. EXPERIMENTAL STUDY

A. Experimental Investigation

A.0 Materials used

A.1 Cement and Aggregates

In the present study Ordinary Portland Cement of grade 43, confirming to IS: 8112–1989[10] was used for preparing the concrete. The specific gravity of cement was 3.15. Fine aggregate- Natural River sand passing through 4.75 mm IS sieve is used for making concrete. As per IS: 383–1970[11] natural river sand was categorized under grading zone I. The specific gravity and fineness modulus of sand is found to be 2.65 and 3.05. Coarse aggregate Coarse aggregate was passed through 80 mm sieve and retained on 4.75 mm sieve confirming IS: 383–1970[11] was used for concreting. The specific gravity and fineness modulus of coarse aggregate is found to be 2.695 and 7.7.

A.2 Water

Clean portable water free from suspended particles, chemical substances, biological elements etc., is used both for mixing of concrete and curing.

A.3 Rubber aggregate

This study has concentrated on the performance of a single gradation of rubber prepared by manual cutting (Pic1). The maximum size of the rubber aggregate was 40 mm.

The properties of the rubber used as aggregate is given below in Table1:

Table 1 Rubber Properties

PARAMETERS	UNIT	STANDARD SPECS
ACETONE EXTRACTION	%	5-10
ASH CONTETNT	%	4 Max
BULK DENSITY	gm / cc	0.30 - 0.45
SIEVE ANALYSIS PASSING 40 MM SIEVE	%	99
SIEVE ANALYSIS PASSING 2 MM SIEVE	%	1

Pic1Rubber aggregate

B. Mix Design (as per IS 10262 – 2009)

Based on the trial mixes the final design mix was prepared for M25 grade of concrete as per IS 10262:2009[12]. The concrete mix proportions were shown in Table2

Table 2 Mix proportions

Grade of concrete	Target mean strength (N/mm^2)	W/C ratio	Mix Proportion
M 25	31. 60	0.45	1:2.2:2.72

C.Preparation of test specimens

Standard steel moulds were used for casting cubes of size 150mm x 150mm x 150mm. The details of the test specimens are shown in Table 3.

Table 3 Details of cube specimen

Marking	% of replace ment	Water (kg)	Cement (kg)	C.A (kg)	F.A (kg)	Rubber(kg)
SC	0	2.52	5.6	15.12	6.72	0
SCR5	5	2.52	5.6	14.36	6.72	0.76
SCR10	10	2.52	5.6	13.60	6.72	1.52
SCR15	15	2.52	5.6	13.18	6.72	2.34

D. Tests for properties

The compression test,split tensile strength,flexural strength, workability test were carried out to determine the strength and workability.

D.1 Workability test

For workability, slump test and compaction factor for the concrete was found out and it is tabulated below in Table 4. Slump test was conducted using Slump cone apparatus to determine the workability and it is shown in Pic2. The variation of slump with different percentages of rubber is shown in Figure1 and the variation of Compaction factor with different percentages of rubber is shown in Figure2.

Pic 2 Slump test and glenium

Table 4 Result of workability test (without admixture)

specimen	% of rubber aggregate replaced	Slump value (mm)	Compacting factor
SC	0	80	0.84
SCR5	5	60	0.76
SCR10	10	0	0.70
SCR15	15	0	0.70

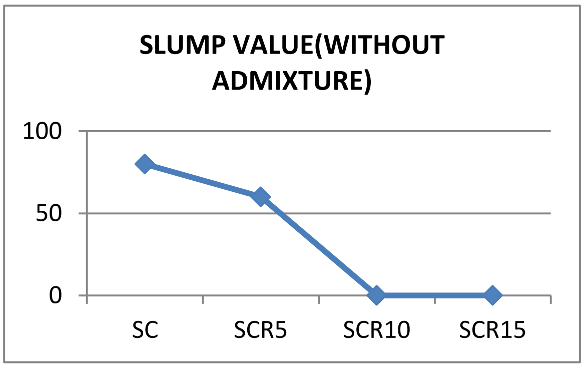

Figure 1

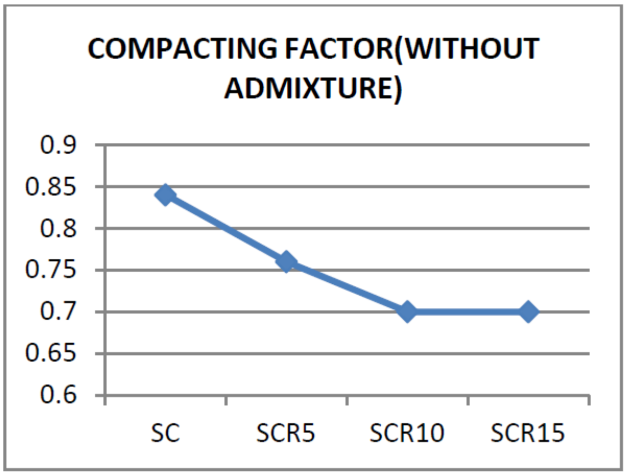

Figure 2

The replacement of coarse aggregate by scrap tyre rubber effects on the workability of the concrete. The workability of rubberized concrete shows a decrease in workability with increase of rubber. To increase the workability we use Glenium super-plasticizer (Pic2) as 0.5% of cement in rubber concrete. The result and differences are shown in table 5 and fig 3,4,5&6.

Table 5 Result of workability test (with admixture)

specimen	% of rubber aggregate replaced	Slump value (mm)	Compacting factor
SC	0	100	0.89
SCR5	5	90	0.86
SCR10	10	72	0.80
SCR15	15	68	0.78

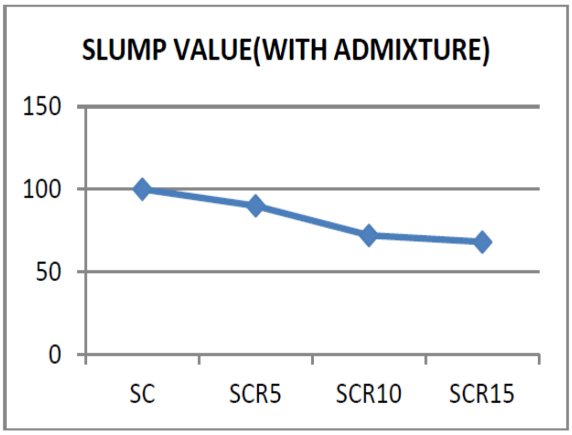

Figure 3

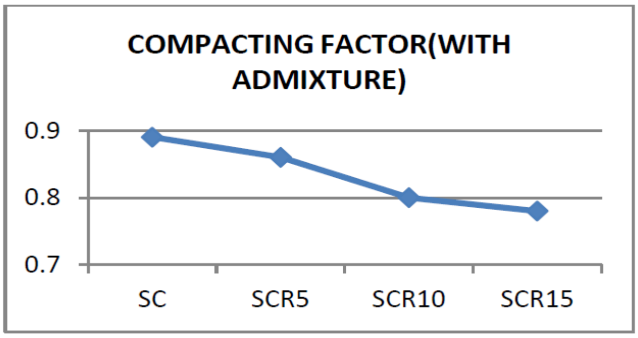

Figure 4

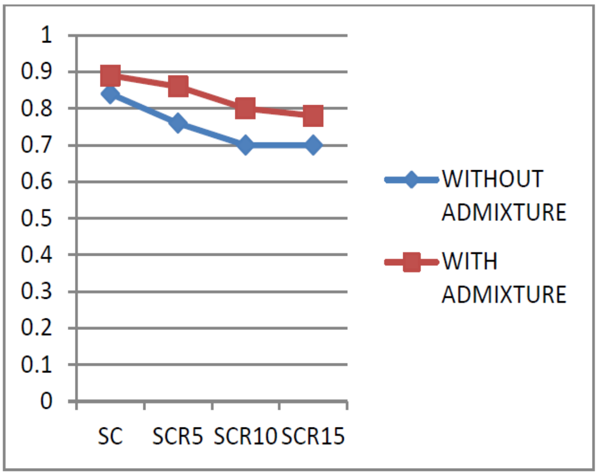

Figure 5(compaction factor)

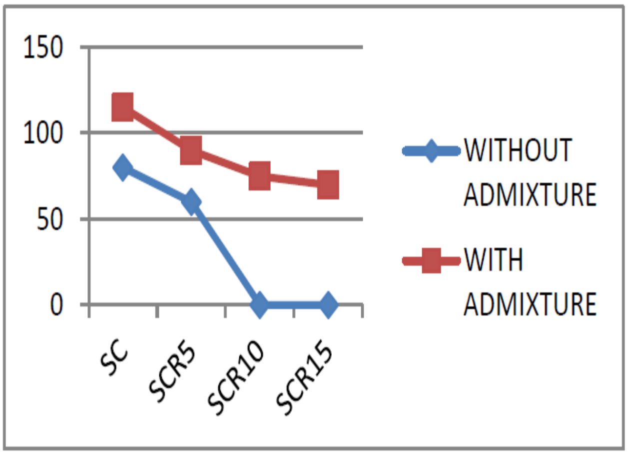

Figure 6(slump value)

D.2 Compressive strength

The compressive strength of the specimens was determined in a universal testing machine of 200 tones capacity (Pic.4) and it is tabulated below in Table6 & Table7 &fig 7.The failure pattern of the cube is shown in Pic.3

Table 6 Compressive strength (without admixture)

specimen	% of rubber aggregate replaced	7 days strength (MPa)	28 days strength (MPa)
SC	0	20.0	30.90
SCR5	5	16.8	28.5
SCR10	10	15.0	23.8
SCR15	15	12.6	19.1

Table 7 Compressive strength (with admixture)

specimen	% of rubber aggregate replaced	7 days strength (MPa)	28 days strength (MPa)
SC	0	21.2	32.31
SCR5	5	17.7	29.35
SCR10	10	15.4	24.70
SCR15	15	13.1	20.00

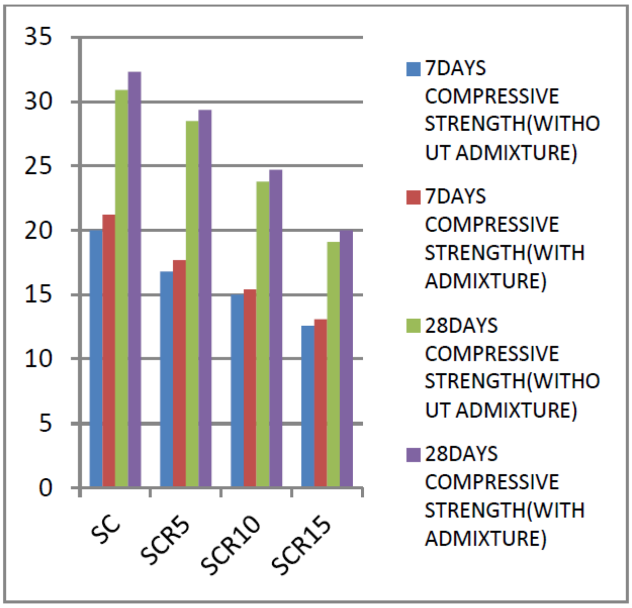

Figure 7(compressive strength)

Pic 3- Cube after failure

Pic 4-Compression Test

D.3 Split Tensile strength

The split tensile strength of the specimens was determined in a universal testing machine of 200 tones capacity (Pic.5) and it is tabulated below in Table8 & Table9 and the variation is shown in fig 8.

Pic 5-Split tensile Test

Table 8 Split tensile strength (without admixture)

specimen	%of rubber aggregate replaced	7days strength (MPa)	28days strength (MPa)
SC	0	1.90	2.95
SCR5	5	1.57	2.74
SCR10	10	1.40	2.20
SCR15	15	1.24	1.95

Table 9 Split tensile strength (with admixture)

specimen	%of rubber aggregate replaced	7days strength (MPa)	28days strength (MPa)
SC	0	2.1	3.2
SCR5	5	1.7	2.9
SCR10	10	1.55	2.5
SCR15	15	1.30	2.15

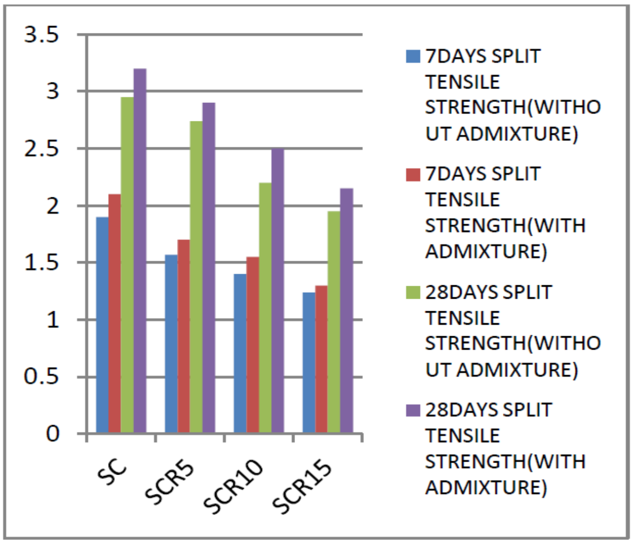

Figure 8(split tensile strength)

D.4Flexural strength

The flexural strength of the specimens was determined in a flexural testing machine (Pic.6) and it is tabulated below in Table10 & Table11 and the variation is shown in fig 9.

Pic 6-Flexural Test

Table 10 Flexural strength (without admixture)

specimen	% of rubber aggregate replaced	7days strength (mpa)	28 days strength (mpa)
SC	0	3.10	4.85
SCR5	5	2.69	4.50
SCR10	10	2.42	3.78
SCR15	15	2.10	3.10

Table 11 Flexural strength (with admixture)

specimen	%of rubber aggregate replaced	7days strength (mpa)	28 days strength (mpa)
SC	0	3.40	5.10
SCR5	5	2.85	4.72
SCR10	10	2.50	3.95
SCR15	15	2.15	3.25

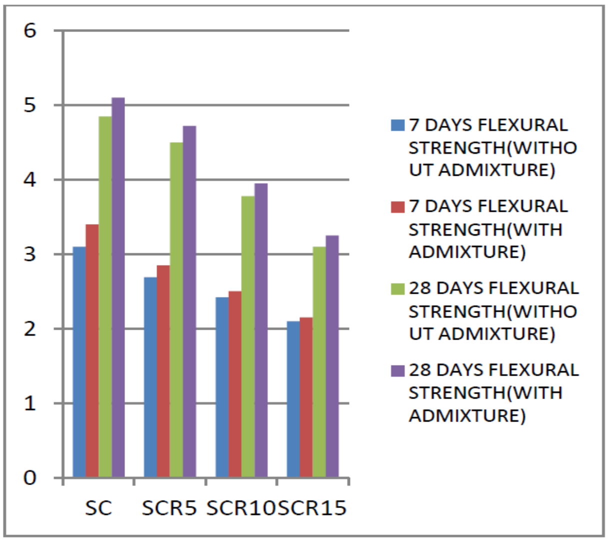

Figure 9(flexural strength)

III. CONCLUSION

The following conclusions of the test results can be produced using the different trials directed on the structural behaviour of rubber concrete -

1. It is observed that the compressive strength, split tensile strength as well as the flexural strength decreases as the addition of percentage of rubber increases.
2. 5 & 10 percent replacement of rubber aggregate may achieve the compressive strength as that of the normal concrete with some few alterations like adding extra silica or by replacing cement with more fine particles such as GGBS.
3. Adding admixture can increase the strengths slightly.
4. It can be concluded that despite the reduced compressive strength of rubberized concrete in comparison to conventional concrete, there is a potential large market for concrete products in which inclusion of rubber aggregates would be feasible which will utilize the discarded rubber tyres, the disposal of which is a big problem for environment pollution.
5. It is recommended to replace 5-10% of waste tyre rubber aggregate with coarse aggregate, which will be the optimum replacement in concrete composites.

REFERENCES

1. M. Emiroglu.S. Yildiz O Kestemur.M.H. Kelestemur, “Bond performance of rubber particles in the self-compacting concrete” ISBN: 978 - 88 - 907078 - 3 – 4 2012 Publisher creations
2. EL Gammel,A-K Abdel, Gawad,Y- EL Sherbini,A. Shalaby,”Compressive strength of concrete utilising waste tire rubber”. Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 1 (1): 96-99
3. Ali Tayeh,”Effect of replacement of sand by waste “.Civil and Environmental Research ISSN 2224-5790 (Paper) ISSN 2225-0514 (Online) Vol.3, No.13, 2013
4. Jenna Lee Helme, “Concrete, A use for use Tires “ cssf projects 2010
5. Clay Naito,,M. Asce,,Joe states,,Christopher Jackson,,Bryan Bewick. “Assessment of crumb Rubber concrete for flexural structural member”. AESC , Journal of civil engineering vol 26 issue 10
6. Alan Richard son ,Kathryn Coventry,JacquesPienaan, “The potential for achieving freeze/thaw protection in concrete through addition of rubber crum” Paper’s No. BUE-FISC – 2.
7. A. Richardson,K. Coventry,U. Dave,J. Piemar, “Freeze / thaw performance of concrete using granulated rubber crumb”.journal of green building vol 6 november 10.
8. Tarun Naik, Rafat Siddique,”Properties of concrete containing scrap tire rubber – an overview”. Report No. CBU-2002-06 REP-459 February 2002, centre for bi product utilization
9. Senthil Vadivel, R. Thennozhi,”Experimental study on waste tyre rubber replaced concrete-ecofriendly construction materials”. Journal of Applied Sciences Research;Jun2012, p3966
10. IS, 8112–1989 Indian Standard,of OPC 43 BIS, New Delhi
11. IS383–1970 , Indian Standard of aggregate, BIS, New Delhi
12. IS 10262-2009 Indian Standard of concrete mix design, BIS, New Delhi
13. IS, IS 516:1959 Indian Standard of strength test, BIS, New Delhi
14. IS 1199-1959 , Indian Standard of workability test , BIS New Delhi

AUTHORS FROFILE

Sulagno Banerjee- Having almost 15 years' experience in academic and consultancy. Writer of various technical paper in so many journals, some of them are scopus indexed. Presented papers in national and international conferences. Currently holds position of associate professor in ELITTE COLLEGE OF ENGINEERING and doing PhD from Hindustan Institute of Technology and Science, Chennai.

Aritra Mandal – Having almost 10 years' experience in academic and consultancy. Writer of various technical paper in so many journals, some of them are scopus indexed. He presented papers in national and international conferences. Currently holds position of assistant professor in Techno India group and doing research on concrete from Hindustan Institute of Technology and Science, Chennai.

DR. JESSY ROOBY - Having almost 23 years' experience in academic. Writer of various technical paper in so many journals, some of them are scopus indexed. Professor and former HOD of civil engineering department, Hindustan Institute of Technology and Science.

.