An Analysis over Partial Replacement of Coarse Aggregate by Waste Tyre

Bal Gopal Guru[1], Gomati Rohidas[2], Madhusmita Ekka[3], Leena Seth[4]
[1]*Assistant Professor in Civil Engineering Department, VIT, Bargarh, Odisha, India*
[2, 3, 4] *Students of Civil Engineering Department, VIT, Bargarh, Odisha, India*

***Abstract*— Nowadays the disposal of waste tyres is turning into a major waste management problem inside the world. It's far envisioned that 1.2 billion of waste tyres rubber is produced globally every year. Tyres have a tendency to re-emerge in time from the dump and micro-organisms may additionally take greater than eighty years to biodegrade them. Our present study aims to most appropriate use of waste tyre rubber. This research studied explores a detailed study of compressive strength of concrete by using waste tyre rubber as percentage replacement of coarse aggregate. The waste tyre rubber is chipped according to required shape so as to ideally replace coarse aggregate. The compressive strength test was carried out after 3 days, 7days, 14 days and 28 days of curing. The replacement of coarse aggregate was shown effective and compressive strength was gradually increase in the case of 10% replacement in M20 mix. By using waste tyre rubber in the concrete that results into a better disposal of waste rubber and also increased the characteristics strength of concrete.**

***Keywords*— waste tyre, compressive strength, workability**

I. INTRODUCTION

The shortage and accessibility at sensible rates of sand and aggregate are presently giving stress to the construction industry. A huge environmental issue has been occurred due to the deforestation and extraction of natural aggregates from river beds, lakes and other water bodies. Flooding and land sliding also occurred due to the disintegration of existing topography. Additionally, the filtration of rain water accomplished by deposits of natural sand is being misplaced, in this manner its causing contamination of water reserves used for human consumption. Hence, to anticipate this issue pollution authority are forcing increasingly strict restrictions on the extraction of natural aggregates and it's crushing. The most perfect way to overcome this problem is to discover the substitute aggregates for construction in place of conventional coarse aggregates. The materials which are considered as feasible for partial replacement of concrete include cellulose, fly ash, silica fumes, waste tyre, coconut shell and wood particles etc. Waste tyres is considered as the most recent waste materials that have been tested because of its vital use in the construction field.

In this context, the performance of waste tyre as partial replacement for coarse aggregates in M20 grade of concrete mix at different percentages and its effect on concrete properties like compressive strength is to be examined. Experimental program was planned to examine the mechanical properties of M20 grade concrete integrate waste tyre as coarse aggregate .The compressive strength was tested by using universal testing machine (UTM) for the cube specimens. The specimens were cast with M20 grade concrete using 0%, 5%, 10%, 15%, 20% and 25% partial replacement of waste tyre as coarse aggregate.

Recycling is the most excellent choice over disposal, in this way the disposal cost is minimized and also the natural resources were conserved. The efficient way to use waste tyre is partial replacement of coarse aggregate in concrete and by using rubber in concrete gives better environmental benefits.

II. LITERATURE REVIEW

1. Siddique and Naik (2004) observed that the addition of tyre in concrete though reduces the strength of the concrete but the main benefit is that it reduces the mass density reduce as low as 1750 Kg/m3.
2. Mavroulido.M and Figueiredo.J (2010). "Disposed of tyre as concrete aggregate, a conceivable outlet for utilized tyres" it can be concluded that in spite of the observed lower values of the mechanical properties of concrete there is a potential large market for concrete products in which incorporation of tyre aggregate would be attainable. These can moreover incorporate nonprime structural applications of the medium to low strength requirements, profiting from other highlights of this type of concrete. Regardless of weather rubber tyre aggregate was utilized at moderately low rate in concrete, the measure of waste tyre rubber could be tremendously diminished because of the exceptionally extensive market for concrete products around worldwide. In this way, the utilization of disposed tyre rubber aggregates in concrete appears guarantee for developing an additional aggregate for used.

III. MATERIALS REQUIRED

Cement: Cement used in the experiment is pozzolana portland cement (ppc).

Aggregate:

Fine aggregate: The river sand was used as fine aggregate.

Coarse aggregate: Coarse aggregate having a nominal maximum size of 20mm was used.

Water: Fresh tap water was used .

Chipped rubber: It is used to replace the coarse aggregate and having the dimension of about 20 mm. The specific gravity of Chipped Rubber is 1.106.

Fig. 1 Cut piece of waste tyre

IV. METHODOLOGY

In our study different tests were conducted on the main ingredients used. Various tests that were conducted are as follows:

A. Cement Testing:

Consistency Test: To determine the quantity of water required to produce a cement paste of standard consistency the consistency test was conducted . The Vicat Apparatus was used for the consistency test.

Initial Setting Time: The objective of this test is to determine the interval between the time when water was added to the cement and the time at which the needle fails to pierce.

Final Setting time: The aim of this test is to determine the time interval between the initial setting time and the time when water was added to the cement.

Compressive Strength: The strength carrying capacity of cement was tested by compressive strength test of cement.

Fineness: we have to determine the fineness of cement by dry sieving according to IS: 4031 .The fundamental principle behind this test is to examine the proportion of cement whose grain size is bigger than specified mesh size.

Soundness To know the soundness of cement this test was determined by Le-Chatelier method as per IS: 4031.

B. *Moulding of Waste Tyre Concrete*

After completion of different test on material tyre concrete were casted.

At first tyre was taken 5% of coarse aggregate, cement, fine aggregate were taken according to M20 mix design.i.e.1:1.5:3 ratios. water cement ratio was taken as 45% of cement.

All these ingredients were thoroughly blended with water and then poured in the mould having dimension of 15cm*15cm*15cm. Similarly 3 cubes of same mixture were moulded.

Next day the cubes were unmoulded and were kept in the curing tank for curing. on 3rd day of casting 3 cubes were taken out from the curing tank and were left for few minutes to dry. After drying they were weighed and their compressive strength was tested simultaneously by using the compression testing. other 3 cubes were taken out from the curing tank on 3rd day of casting and their compressive strength was tested in the same manner as that of 3rd day.

Like wise tyre was taken 10%,15% and 20 % of coarse aggregate and 9 cubes were casted for above percentages by using the same procedure. the compressive strength of the cubes were tested on the day of 3rd,7th,14th and 28th days by following the above same procedure.

All results that were obtained after testing the compressive strength has been described in the result and discussion section. The compressive strength of all percentages have been compared to find out which percentage of reinforcement gives the most excellent result.

C. Problem Arise Due To Waste Tyre

Around the world, the manufacturing of rubber increases each year. approximately one crore 10 lakhs all kinds of new cars are delivered each year to the Indian roads. The growth of approximately 3 crores discarded tyres each year poses a potential risk to the environment. Water amassing inside the tyres offers ideal temperature and moisture situations for the spread of mosquitoes, rats, mice and vermin at the same time, the amount of oxygen that exists inside of the tyres is sufficient to motive fire in appropriate conditions, with resulting bad affects on the atmosphere and human fitness. it's far very tough to dispose the waste tyre because the availability and capability of landfill areas decreases. It creates unattractive appearance. If burnt underneath traditional uncontrolled style it creates harmful vapors.

V. RESULT AND DISCUSSION

These are the extension of the test being performed in the previous part and all the result which has been given below:

TABLE 1- compressive strength of cubes using tyres after 3 days

Percentage of tyre	Cement (KG)	Sand (KG)	Aggregate (KG)	Tyre (KG)	Load (KN)	Area (mm2)	Compressive strength (KN/mm2)
0%	1.5	2.25	4.5	0	234	22500	10.37
5%			4.275	0.225	243	22500	10.78

10%			4.05	0.45	265	22500	11.69
15%			3.825	0.675	253	22500	11.23
20%			3.6	0.9	240	22500	10.59

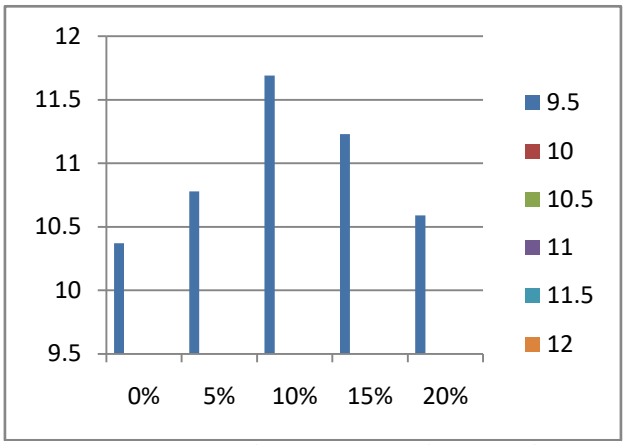

Fig. 2 Compressive Strength of cubes using Tyre after 3 days of curing

The Estimations of compressive strength of various rate expansion of Tyre following 3 days of curing has been analyzed by plotting Compressive strength v/s percentage tyre. In the wake of plotting it is being observed that the compressive strength of cubes is most noteworthy in 10% tyre and least in plain concrete (i.e. 0%)

TABLE 2- compressive strength of cubes using tyres after 7 days

Percentage of tyre	Cement (KG)	Sand (KG)	Aggregate (KG)	Tyre (KG)	Load (KN)	Area (mm2)	Compressive strength (KN/mm2)
0%	1.5	2.25	4.5	0	364	22500	16.14
5%			4.275	0.225	375	22500	16.7
10%			4.05	0.45	385	22500	17.1
15%			3.825	0.675	380	22500	16.9
20%			3.6	0.9	365	22500	16.2

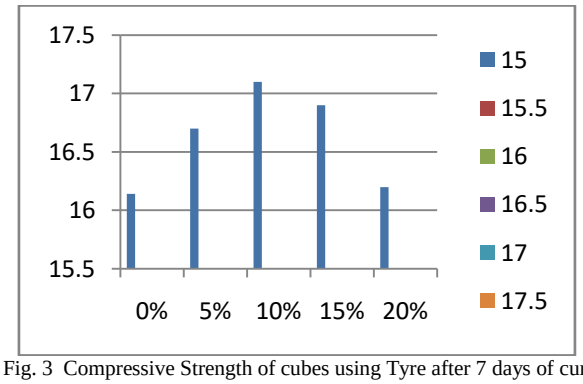

Fig. 3 Compressive Strength of cubes using Tyre after 7 days of curing

The Estimations of compressive strength of various rate expansion of Tyre following 7 days of curing has been analyzed by plotting Compressive strength v/s percentage tyre. In the wake of plotting it is being observed that the compressive strength of cubes is most noteworthy in 10% tyre and least in plain concrete (i.e. 0%).

TABLE 3- compressive strength of cubes using tyres after 14 days

Percentage of tyre	Cement (KG)	Sand (KG)	Aggregate (KG)	Tyre (KG)	Load (KN)	Area (mm2)	Compressive strength (KN/mm2)
0%	1.5	2.25	4.5	0	508	22500	22.54
5%			4.275	0.225	515	22500	22.87
10%			4.05	0.45	530	22500	23.4
15%			3.825	0.675	523	22500	23.2
20%			3.6	0.9	502	22500	22.3

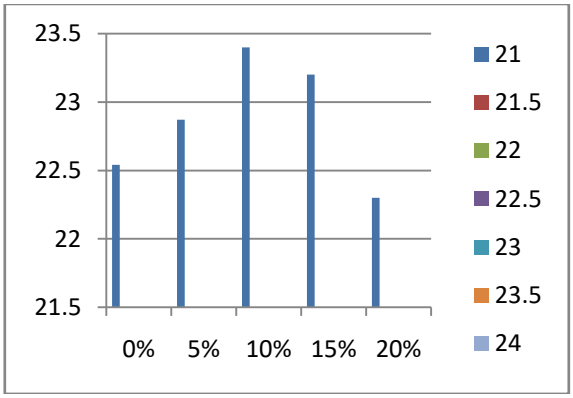

Fig. 4 Compressive Strength of cubes using Tyre after 14 days of curing

The Estimations of compressive strength of various rate expansion of Tyre following 14 days of curing has been analyzed by plotting Compressive strength v/s percentage tyre. In the wake of plotting it is being observed that the compressive strength of cubes is most noteworthy in 10% tyre and least in 20%.

TABLE 4- compressive strength of cubes using tyres after 28 days

Percentage of tyre	Cement (KG)	Sand (KG)	Aggregate (KG)	Tyre (KG)	Load (KN)	Area (mm2)	Compressive strength (KN/mm2)
0%	1.5	2.25	4.5	0	628	22500	27.89
5%			4.275	0.225	628	22500	27.9

10%			4.05	0.45	645	22500	28.7
15%			3.825	0.675	635	22500	28.2
20%			3.6	0.9	620	22500	27.52

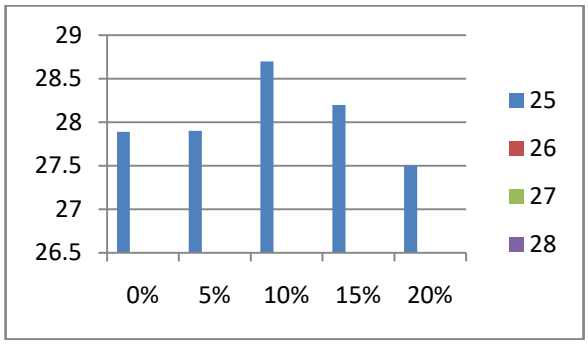

Fig. 5 Compressive Strength of cubes using Tyre after 28 days of curing

The Estimations of compressive strength of various rate expansion of Tyre following 28 days of curing has been analyzed by plotting Compressive strength v/s percentage tyre. In the wake of plotting it is being observed that the compressive strength of cubes is most noteworthy in 10% tyre and least in 20%.

TABLE 4- COMPRESSIVE STRENGTH OF CUBES USING 5%,10%,15% AND 20% TYRE AT 3RD, 7TH 14TH AND 28TH DAY

	DAY 3	DAY 7	DAY 14	DAY 28
0%	10.37	16.14	22.54	27.89
5%	10.78	16.7	22.87	27.9
10%	11.69	17.1	23.4	28.7
15%	11.23	16.9	23.2	28.2
20%	10.59	16.2	22.3	27.52

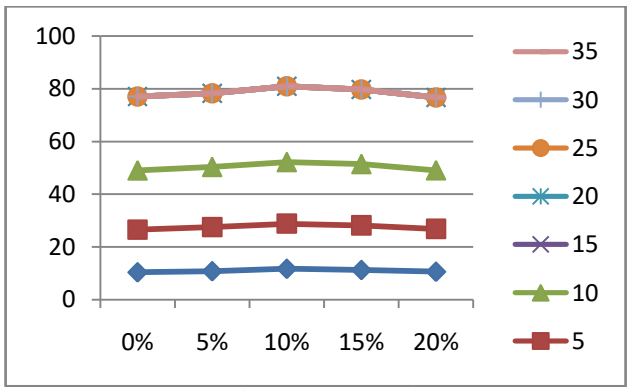

Fig. 6 Compressive Strength of cubes using Tyre after 3rd, 7th, 14th and 28th days of curing

From the above tables and diagram the accompanying focuses can be induced:

The Adhesive Capability of tyre is very low as compared to Coarse and fine aggregate.

Concrete having 0% tyre i.e. plain solid outcomes in a compressive strength which is equivalent to the trademark quality i.e. 25N/mm2.

At the point when tyre was included upto 5% of total aggregate, the compressive strength got following 28 days was 28.16N/mm2 which is significantly more than the trademark quality and the quality acquired by plain concrete.

The compressive strength after 3rd ,7th ,14th and 28th day is highest in case of addition of 10% tyre.

The compressive strength after 3rd,7th,14th and 28th day in case of 5% Tyre addition is more than that of the plain concrete. 6.After 10% expansion of tyre, expansion of Tyre by 15% and 20% outcomes in lesser compressive quality however higher that plain solid outcomes.

VI. CONCLUSION

On the basis of the above experimental results the following points are encapsulate with respect to the effect of rubber on the compressive strength of concrete:

Compressive strength of concrete is negligibly increased with the addition of 5% tyre waste.

Results are more effective for replacement of 10% coarse aggregate by Tyre.

Compressive strength of concrete decreased with addition of 15% of rubber. Compressive strength of concrete in 20% replacement of tyre decreases in greater extent with respect to 10% replacement of tyre.

Using rubber as a replacement of coarse aggregate is one of the economical way for their disposal in an eco-friendly manner. Aside of this the tyre fails to give the strong adhesion property as Aggregate.

REFERENCES

[1]. K. Vamshi krishna1, J.Venkateswara Rao, — study the behavior of fiber reinforced concrete for rigid pavements, IOSR Journal of Mechanical and Civil Engineering, 2014.
[2]. Kotresh K.M,Mesfin Gatahun Belachew- study on waste tyre rubber as concrete aggregates