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Performance Evaluation of Waste Rubber, Steel Curls and Epoxy Resin In Concrete

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Abstract— Now a days, the waste tyre rubber and steel curls becomes most significant environment problem in global level. In day to day life waste tyre rubber and steel curls need to be dispose due to increase in the auto mobile production and Lathe industries wastes. The increase of these wastes produce rapid reduction of available site for waste disposal in many countries. Due to this problem many countries try to find out best replacement solution to dispose waste tyre rubber and reuse waste steel curls. Waste tyre rubber and steel curls with epoxy resin give good strength with light weight, elasticity, energy absorption, sound and insulating nature so that we can use this material in construction industry. In this project the density and compressive strength of concrete utilizing waste tire rubber, steel curls and epoxy resin has been studied. Waste tire rubber, steel curls and epoxy resin has been used in this study to replace the fine and coarse aggregate by weight using different percentages (10%, 20% & 66%). We know that the strength and the bonding between rubber particles and steel curls in concrete mix is the main significant in this study. So we try to determine the strength of rubcrete by using steel curls and different types of epoxy resins and check the properties of rubcrete cubes.

Keywords— Concrete, Waste Rubber, Steel Curls, Epoxy Resin, Treatment methods, Size and content effects, Environmental Hazard.

I. INTRODUCTION

Now a days, Solid waste management is the most significant problem in the world. Especially used tire wastes become a big problem for improving these materials. The world consumption of rubber (natural and synthetic) in 2012 was 26.15 kt. Most of this material is used in the tyre industry which sooner or later becomes waste.
In the word, many countries burn the waste tyre rubber to dispose it but at the end it is again produce environment pollution. Currently the concrete is the second most consumed material in the word which can consume good amount of waste tyre rubber and steel curls by changing and mix with epoxy resin and use it in concrete mix. Using rubber and steel curls in concrete by partial replacing fine sand do not increase compressive and tensile strength than an ordinary concrete but appropriate strength still can be obtained for use in structures and when we use epoxy resin with rubber and steel curls it gives good strength and vibration resistance better than normal concrete.
Tyres are usually used to substitute part of natural fine sand or as stabilizer of concrete mixture and steel curls used to give high strength of concrete. Thermal decomposition of these waste rubber and steel curls in the absence of oxygen can also produce by-products such as ash and iron powder that have low economic feasibility. Thus, reusing waste rubber tires and steel curls with epoxy resin as replacement of fine sand in concrete could be a potential solution in future.
In the lathe industries the steel curls are produced when we give finishing of different machines parts and after that we dumping that steel scraps or steel curls wastes in land fill and unfertile soil. Due to this dumping process of steel curls, the ground water and ground soil builds an unhealthy environment. Now a day's these steel scraps as a waste product used by advanced construction industry and also in transportation and highway industry. In addition to get sustainable progress and environmental compensation, lathe scrap as worn-recycle fibres with concrete are possible to be used.
The mechanical properties found in concrete by different test is to be increase due to the addition of steel scrap in concrete i.e. compressive strength, flexural strength, split tensile strength, impact strength, fatigue strength and split tensile strength were increased but up to 0.5-2.1% scrap content. When compared with usual concrete to SSFRC (steel scrap fibre reinforced concrete), flexural strength increases by 35-40% and considerable increases in tensile and compressive strength.



Fig. 1 Crumb Rubber



Fig. 2 Steel Curls



Fig. 3 Epoxy Resin

II. METHODOLOGY

In this project we have used mainly 8 types of concrete mixes to find out the different properties of concrete. The main aim of the study is to make standard concrete by using waste rubber, steel curls and epoxy resin and check its properties after and before temperature test (Fire Performance) such as Compressive strength in cubes, Split tensile strength of cylinder and Weight. After the different tests were carried out then we have compared these all results with each other and find out the performance of concrete in different conditions like before temperature test and after temperature test. I have used M30 grade concrete mix and added different percentage of Waste crumb rubber, Steel curls and Epoxy resin.

Table 1 Recommended Mix Proportion Design for M30 Grade Concrete.

Proportion	Water	Cement	Sand	Coarse Aggregate
				20 mm
By weight(kg/m³)	197.16	428.60	694.24	1132.71
weight(kg)	0.46	1	1.62	2.64
FOR 1 BAG OF CEMENT, THE QUANTITIES OF MATERIALS ARE:				
By weight	23 lit/bag	50 kg/bag	80.98 kg/bag	132 kg/bag

Table 2 Recommended Mix Proportion Design with Crumb Rubber.

Proportion	Water	Cement	Sand	Coarse Aggregate	Crumb Rubber
				20 mm	20% replacement of sand
By weight(kg/m³)	197.16	428.60	555.39	1132.71	138.85
weight(kg)	0.46	1	1.29	2.64	0.324
FOR 1 BAG OF CEMENT, THE QUANTITIES OF MATERIALS ARE:					
By weight	23 lit/bag	50 kg/bag	64.80 kg/bag	132 kg/bag	16.20 kg/bag

Table 3 Recommended Mix Proportion Design with Steel Curls.

Proportion	Water	Cement	Sand	Coarse Aggregate	Steel Curls
				20 mm	20% replacement of sand
By weight(kg/m³)	197.16	428.60	555.39	1132.71	138.85
weight(kg)	0.46	1	1.29	2.64	0.324
FOR 1 BAG OF CEMENT, THE QUANTITIES OF MATERIALS ARE:					
By weight	23 lit/bag	50 kg/bag	64.80 kg/bag	132 kg/bag	16.20 kg/bag

Table 4 Recommended Mix Proportion Design with Crumb Rubber & Steel Curls (20% Replacement of Sand).

Proportion	Water	Cement	Sand	Coarse Aggregate	Crumb rubber + Steel Curls	
				20 mm	10%+10% replacement of sand	
By weight(kg/m³)	197.16	428.60	555.39	1132.71	69.46	69.46
weight(kg)	0.46	1	1.29	2.64	0.162	0.162
FOR 1 BAG OF CEMENT, THE QUANTITIES OF MATERIALS ARE:						
By weight	23 lit/bag	50 kg/bag	64.80 kg/bag	132 kg/bag	8.10 kg/bag	8.10 kg/bag

Table 5 Recommended mix proportion design with crumb rubber & Steel curls (66% replacement of sand).

Proportion	Water	Cement	Sand	Coarse Aggregate	Crumb rubber + Steel Curls	
				20 mm	33%+33% replacement of sand	
By weight(kg/m³)	197.16	428.60	236.06	1132.71	229.09	229.09
weight(kg)	0.46	1	1.29	2.64	0.162	0.162
FOR 1 BAG OF CEMENT, THE QUANTITIES OF MATERIALS ARE:						
By weight	23 lit/bag	50 kg/bag	27.53 kg/bag	132 kg/bag	26.72 kg/bag	26.72 kg/bag

Table 6 Different Types of Concrete Mix.

SR. NO	TYPE OF CONCRETE
1	Concrete
2	Concrete + Resin
3	Concrete + Crumb Rubber
4	Concrete + Crumb Rubber + Resin
5	Concrete + Steel Curls
6	Concrete + Steel Curls + Resin
7	Concrete + Crumb Rubber + Steel Curls + Resin (10%+10% replacement of sand)
8	Concrete + Crumb Rubber + Steel Curls + Resin (33%+33% replacement of sand)



Fig. 4 Concrete Cubes



Fig. 5 Concrete with Diff. Materials



Fig. 6 Concrete Cube with Cracks



Fig. 7 Concrete with steel curls



Fig. 7 Concrete Crumb rubber



Fig. 9 Slump test

III. RESULTS AND DISCUSSION

Comparing the compressive strength results and weight of different types of concrete mix cube:

A. Comparison of weight of specimen at 28 days.

Table 6 Comparison of weight of Cubes

SR. NO	TYPE OF CONCRETE	AVERAGE WEIGHT OF CUBE (Kg)
1	Concrete	8.620
2	Concrete + Resin	8.620
3	Concrete + Crumb Rubber	7.880
4	Concrete + Crumb Rubber + Resin	7.880
5	Concrete + Steel Curls	8.320
6	Concrete + Steel Curls + Resin	8.320
7	Concrete + Crumb Rubber + Steel Curls + Resin (20% replacement of sand)	7.940
8	Concrete + Crumb Rubber + Steel Curls + Resin (33% replacement of sand)	7.800

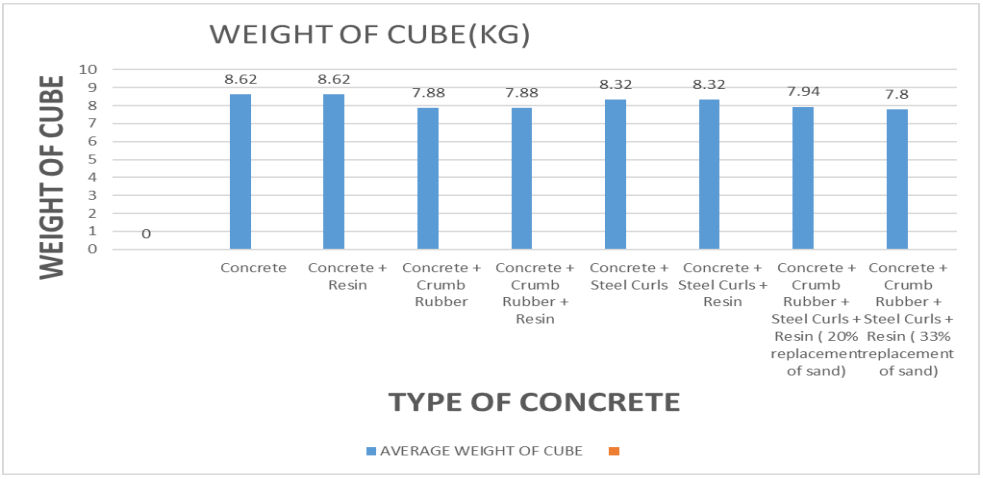

Fig. 10 Weight Comparison by Graph

B. Comparison of compressive strength of specimen at 28 days.

Table 7 Comparison of Compressive Strength of Cubes

SR. NO	TYPE OF CONCRETE	COMPRESSIVE STRENGTH OF CUBE (N/mm2)
1	Concrete	39.33
2	Concrete + Resin	40.00
3	Concrete + Crumb Rubber	32.00
4	Concrete + Crumb Rubber + Resin	33.60
5	Concrete + Steel Curls	41.11
6	Concrete + Steel Curls + Resin	41.60
7	Concrete + Crumb Rubber + Steel Curls + Resin (20% replacement of sand)	37.11
8	Concrete + Crumb Rubber + Steel Curls + Resin (33% replacement of sand)	37.60

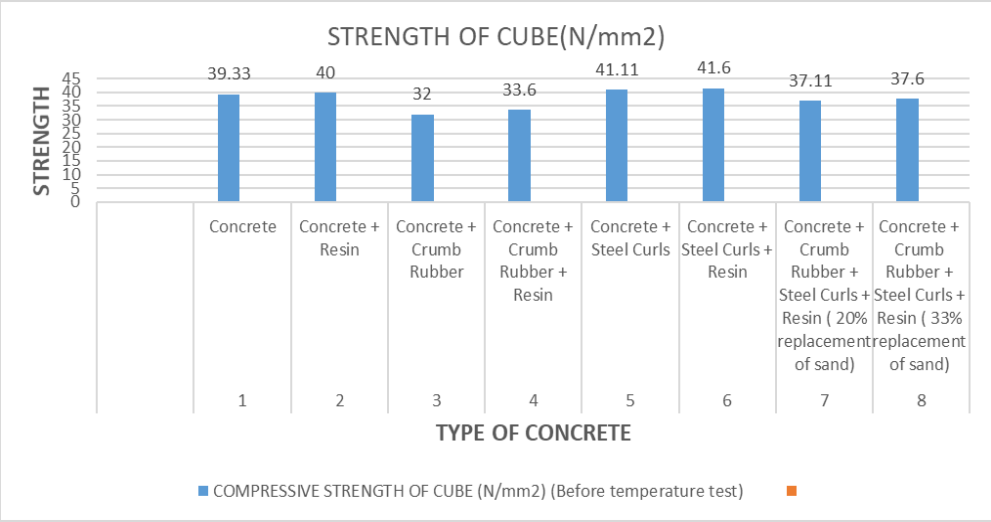

Fig. 11 Compressive Strength Comparison by Graph

IV. CONCLUSIONS

As per above results and graphs we can easily compare these all concrete mix made with the mixture of waste crumb rubber, steel curls and epoxy resin in different proportion and use it in future for any necessary work according to its load bearing capacity. Conclusions from above results can be summarized below:

1. The weight of concrete cube made with the replacement of fine sand (10% rubber), (20% rubber + steel curls + epoxy resin) and (66% rubber + steel curls + epoxy resin) shows that it can be easily decrease the dad load. The above results also show that the weight of (66% rubber + steel curls + epoxy resin) is lower than (10% rubber) and (20% rubber + steel curls + epoxy resin) of concrete structure. So, we can built light weight concrete structure with good compressive strength.
2. The reduction of strength is due to reduction in the density of the concrete. The rubberized concrete has light weight in compare with the normal concrete and steel curls concrete which could be an advantage in the architectural finishing, sports field especially in tennis field, and others such as Basketball and Volleyball but the disadvantage is that the strength of rubberized concrete (32.0 N/mm2) is reduced compared to steel curls concrete (41.11 N/mm2) and (steel curls + epoxy resin=41.60 N/mm2) concrete.
3. Use of rubber particles and steel curls in concrete can be useful against its environmental impacts. The use of rubber in concrete reduces its density, workability and strength but when we added the steel curls and epoxy resin, it will again gain its strength and density.
4. The rubberized concrete can be used in special circumstances, such as non-load bearing structural members, noise reduction, earthquake resistant structures, foundations for machineries and railway slippers but when we added steel curls and epoxy resin it can also give equal or more strength of regular concrete.

V. REFERENCES

[1] A.Sofi "Effect of waste tyre rubber on mechanical and durability properties of concrete" Ain Shams Engineering Journal. 2017.
[2] Anwar Khitab, Shtiaq Arif, Faheem Aslam Awan, Ateeq Anwar, Adil Mughal "Use of Waste Rubber Tyre in Concrete: Mini Review". International Journal for Innovative Research in Multidisciplinary Field. 2017, vol.3, no.12
[3] Blessen Skariah Thomas, Ramesh Chandra Gupta "A comprehensive review on the applications of waste tire rubber in cement concrete" Renewable and Sustainable Energy Reviews. 2016, vol.54, 1323–1333
[4] Abubaker M. Almaleeh, Stanley M. Shitote and Timothy Nyomboi "Use of waste rubber tyres as aggregate in concrete". Journal of Civil Engineering and Construction Technology. 2017, vol.8 no.2, 11-19
[5] M. A. Yazdi, J. Yang, L. Yihui, H. Su "A Review on Application of Waste Tire in Concrete" International Journal of Civil and Environmental Engineering. 2015 vol.9, no.12
[6] Baoshan Huang; Guoqiang Li; Su-Seng Pang; and John Eggers "Investigation into Waste Tire Rubber Filled Concrete" Journal of Materials in Civil Engineering. 2004, vol.16 no.3, 899-156.
[7] Rafat Siddique, Tarun R. Naik "Properties of concrete containing scrap-tire rubber" Waste Management. 2004, vol.24, 563–569
[8] Pooja Shrivastava "Reuse of Lathe Waste Steel Scrap in Concrete Pavements" Journal of Engineering Research and Applications, 2014, Vol. 4, Issue 12(Part 4), pp.45-54
[9] Nikhil Ramchandra Pardeshi1, Digvijay P. Singh, Sakshi Ramesh Patil, Pravin J. Gorde, PrachityP.Janrao "Performance and Evaluation Of Rubber As Concrete Material"