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An Innovative Way of Enhancing the Concrete Property by Utilization of Crumb Rubber

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ABSTRACT: Concrete is a composite compound made of fine, coarse concrete that is bonded together with the adhesive of solid cement over time. Crumb rubber rubber is produced from rubber and truck tires. During the recycling process, the steel and tire wheel are removed, leaving the tire rubber in granular alignment. Granulate into size by passing through the screen, the size is based on the size or mesh.It is estimated that 1000 million tires reach the end of their lives every year and more than 5000 million are expected to be disposed of by 2030. Crumb rubber can be used to replace a portion of the concrete to provide for current and future needs leading to sustainable concrete construction and a green environment. Rubber is found to have the structures required for effective replacement of good concrete mix. Therefore, we in this project aim to study the effect of crumbling rubber elements as a replacement for concrete mixing. A total of 120 specimens (cubes, beams and cylinders) are incorporated with various replacement percentages of 2.5%, 5%, 7.5%, 10%, 12.5%, 15% of crumb rubber rubber and 1% of the fiber used in the experimental mixing was performed to identify concrete structures such as performance and flexibility, compression strength and strength density variability.

KEYWORDS: Crumb rubber, Fly ash,etc.

I. INTRODUCTION

One important part of solid waste which are disposed to landfills is accommodated by vehicle tyres. Tyre rubber is term usually refer to recycled rubber from automotive and truck scrap tyres. Because of the particular shape and impermeable nature of tyres, store water for a long period providing a breeding habitat for mosquitoes and various pests. The residue pollutes the soil which lefts after burning.. The tyres hold toxic and soluble components while waste tyres disposal areas contribute to the reduction of biodiversity Secondly the risk is always present as waste tyres are difficult to ignite.

Classification of scrap rubber tyre, usually three broad categories of discarded tyre rubber have been considered such as chipped, crumb and ground rubber: Chipped or Shredded rubber to replace the gravel. There is a need to shred the tyre in two stages, to produce rubber. The rubber has length of 300–430 mm long and width of 100–230 mm wide by the end of stage one. In the second stage 100–150 mm dimension is obtained by cutting.. .Utilization of waste rubber tyres in concrete provide a strong recommendation for the using this waste as a partial replacement of fine aggregate in concrete production. Minimizing the accumulation of the tyres, reducing the consumption of natural resources and the effective use of the solid waste have been facilitated by this.

Due to increase in disposal of rubber by incineration and land filling that creates environmental problems like air pollution, soil infertility By converting the used tyre of rubber into powder form and substituting it as fine aggregates in concrete the usage of rubber can be done and it can also be used in road construction. Tyre rubber can be replaced as partially but not fully which make effect on strength.

II. LITERATURE REVIEW

Research papers were studied for knowing the application scenario of different type of crumb used in concrete out of which few literature observations are mentioned below accordingly:

Mr. Neeraj Kumar Gupta et al. (2017) There is a great potential for the utilization of 20mm scrap tyre rubber aggregate in concrete mixes upto 6%.

K. Paul Sibiyone et al. (2017) This paper conclude that the maximum strength is obtained by 10% and

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40% replacement of coarse aggregate which gives more strength than the nominal concrete.

Sofi (2018) The compressive and flexural values were found gradually decreasing with increase in the amount of crumb rubber in concrete which were taken at 7th, 28th and 90th day. The highest reduction was related to 7.5% and 10% replacement for types of rubber used.

S. Selvakumaret al. (2015) From experimental work, the compressive strength of crumb rubber concrete with 5% replacement is higher than the strength of normal concrete and with 10% replacement gives acceptable strength.

III. METHODOLOGY

Testing plays an important role in controlling the quality of cement concrete works. Systematic testing of raw materials, the fresh concrete and the hardened concrete is an inseparable part of any quality control program for concrete which helps to achieve higher efficiency of the materials used and greater assurance of the performance of the concrete in regard to both strength and durability. This standard has been prepared with this object in view and provides a guide to the determination of compressive strength, split tensile test, flexural strength test and slump cone test.

1.Methodology (Table No. 1)

METHODOLOGY				
Material testing:	Mix design:	Concrete trials:	Concrete testing:	Result analysis:
° Cement -as per company test certificate ° Aggregate -Sieve analysis -Sp. Gravity -Water absorption ° Fly ash -Chemical properties -Physical properties ° Crumb rubber -Chemical properties -Physical properties	°Indian standard method ° Grade: M35 °Workability: 100mm °Exposure condition: Severe	Replacement of c/s by- - 0.0% CR - 2.5% CR - 5.0% CR - 7.5% CR - 10% CR - 12.5% CR - 15% CR CR- Crumb Rubber	° Workability ° Compressive - 3days -7days -28days ° Flexural -28days ° Split tensile - 28days ° Cost Analysis - Per cum.	° Strength ° Cost

2.Code and percentage of crumb rubber used in concrete (Table No. 2)

CODE	CM	CR2.5%	CR5%	CR7.5%	CR10%	CR12.5%	CR15%
CR	0	2.5	5	7.5	10	12.5	15

Indian standard method (IS 10262:2019) was adopted to find the proportion of concrete ingredients for M35 grade of concrete . table no. 3 shows the quantity of concrete ingredients per cum for all combinations.

3. Quantity(kg) of material per cum(Table No. 3)

MATERIAL/CUM							
CODE	CM	CR2.5	CR5	CR7.5	CR10	CR12.5	CR15
OPC	281.25	281.25	281.25	281.25	281.25	281.25	281.25
FLYASH	93.75	93.75	93.75	93.75	93.75	93.75	93.75
C/SAND	741.96	723.41	704.86	686.31	667.76	649.21	630.66
CRUMB RUBBER	0.00	18.55	37.10	55.65	74.20	92.74	111.29
CA1	450.25	450.25	450.25	450.25	450.25	450.25	450.25
CA2	675.29	675.29	675.29	675.29	675.29	675.29	675.29
WATER	168.75	168.75	168.75	168.75	168.75	168.75	168.75
ADMIXTURE	3.75	3.75	3.75	3.75	3.75	3.75	3.75

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[a] [b]

[c] [d]

[d] [e] [f}

(Fig1) [a] Preparation of crumb rubber [b] Weighing of crumb [c] Slump cone test [d] Tamping [e] Casting of cube [f] Testing of cube.

IV.EXPERIMENTAL RESULT AND DISCUSSION

Results obtained from concrete testing are represented in graphical format in following graphical figures.

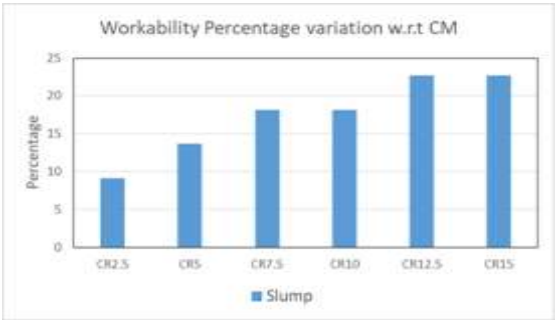

Fig.2 workability percentage variation

	COMPRESSIVE STRENGTH						
CODE		3D			482	21.42	
	LOAD	MPA	AVG	CR7.5	512	22.75	23.42
	485	21.55			587	26.08	
CM	584	25.95	22.8		492	21.86	
	470	20.88		CR10	564	25.06	23.6
	451	20.04			537	23.86	
CR2.5	516	22.93	23.11		493	21.91	
	593	26.35		CR12.5	536	23.82	23.46
	485	21.55			555	24.66	
CR5	592	26.31	23.24		491	21.82	
	492	21.86		CR15	568	25.24	23.28
					513	22.8	

Compressive strength at 3 days [Table No.2]

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	COMPRESSSIVE STRENGTH				764	33.95	
CODE		7D		CR7.5	898	39.91	37.91
	LOAD	MPA	AVG		897	39.86	
	698	31.02			764	33.95	
CM	787	34.97	34.88	CR10	879	39.06	38.4
	870	38.66			949	42.17	
	782	34.75			792	35.2	
CR2.5	864	38.4	36.66	CR12.5	846	37.6	38.17
	829	36.84			939	41.73	
	731	32.48			766	34.04	
CR5	901	40.04	37.06	CR15	871	38.71	37.95
	870	38.66			925	41.11	

Compressive strength at 7 days [Table No.3]

	COMPRESSIVE STRENGTH				1025	45.55	
CODE		28D		CR7.5	1210	53.77	50.88
	LOAD	MPA	AVG		1200	53.33	
	1025	45.55			1082	48.08	
CM	1143	50.8	47.86	CR10	1202	53.42	51.28
	1063	47.24			1178	52.35	
	998	44.35			1049	46.62	
CR2.5	1152	51.2	50.17	CR12.5	1235	54.88	51.24
	1237	54.97			1175	52.22	
	982	43.64			1112	49.42	
CR5	1153	51.24	50.57	CR15	1210	53.77	51.2
	1279	56.84			1134	50.4	

Compressive strength at 28 days [Table No..4]

	FLEXURAL STRENGTH				21	6.53	
CODE		28D		CR7.5	19	5.91	5.91
	LOAD	MPA	AVG		17	5.28	
	18	5.6			21	6.53	
CM	15	4.66	4.87	CR10	18	5.6	5.7
	14	4.35			16	4.97	
	20	6.22			21	6.53	
CR2.5	17	5.28	5.39	CR12.5	17	5.28	5.6
	15	4.66			16	4.97	
	20	6.22			20	6.22	
CR5	18	5.6	5.6	CR15	18	5.6	5.49
	16	4.97			15	4.66	

Flexural strength at 28 days [Table No. 5]

	SPLIT TENSILE STRENGTH				179	2.53	
CODE		28D		CR7.5	205	2.9	2.9
	LOAD	MPA	AVG		231	3.26	
	158	2.23			182	2.57	
CM	168	2.37	2.46	CR10	215	3.04	2.98
	197	2.78			235	3.32	
	175	2.47			180	2.54	
CR2.5	191	2.7	2.74	CR12.5	210	2.97	2.93
	216	3.05			232	3.28	
	178	2.51			179	2.53	
CR5	197	2.78	2.8	CR15	200	2.83	2.87
	220	3.11			230	3.25	

Split tensile strength test at 28 days [Table No.6]

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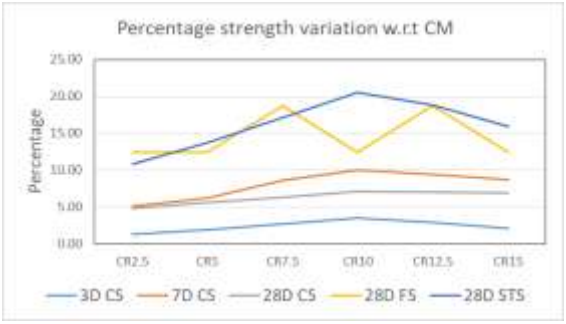

Fig.3 Percentage strength variation w.r.t CM

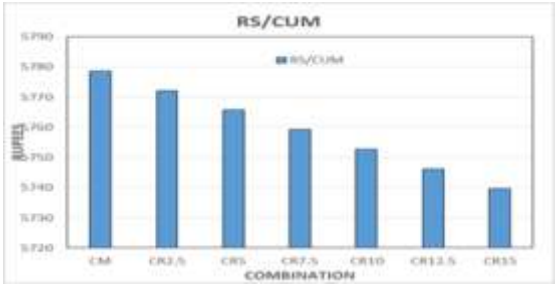

Fig.4Cost (RS/CUM) at all trials

A. compressive strength at 3 days.

1. With the use of 2.5% 5% 7.5% 10% 12.5% and 15% of crumb rubber the compressive strength can be found out to be increased by 1.36%, 1.95%, 2.73%, 3.51%, 2.92%,2.14% respectively when compared to conventional mix.
2. The strength found to be 22.8, 23.1, 23.2, 23.4, 23.6, 23.5, 23.3 Mpa with the addition of 0%, 2.5%, 5%, 7.5%, 10%, 12.5%,15%.
3. The addition of 10% crumb rubber the maximum compressive strength found to be 23.6 Mpa at 7 days.
4. With the addition of 10% crumb rubber strength development is better while at 12.5% strength dropped.

B. compressive strength at 7 days

1. With the use of 2.5%, 5%, 7.5%, 10%, 12.5% and 15% of crumb rubber the compressive strength can be found out to be increased by 5.10%, 6.24%, 8.66%, 10.06%, 9.43%, 8.79% respectively when compared to conventional mix.
2. The strength found to be 34.9, 36.7, 37.1, 37.9, 38.4, 38.2, 38.0Mpa with the addition of 0%, 2.5%, 5%, 7.5%, 10%, 12.5%,15%.
3. The addition of 10% crumb rubber the maximum compressive strength found to be 38.4 Mpa at 7 days.
4. With the addition of 10% crumb rubber strength development is better while at 12.5% strength dropped.

C. compressive strength at 28 days.

1. With the use of 2.5%, 5%, 7.5%, 10%, 12.5% and 15% of crumb rubber the compressive strength can be found out to be increased by 5.10%, 6.24%, 8.66%, 10.06%, 9.43%, 8.79% respectively when compared to conventional mix.
2. The strength found to be 34.9, 36.7, 37.1, 37.9, 38.4, 38.2, 38.0Mpa with the addition of 0%, 2.5%, 5%, 7.5%, 10%, 12.5%,15%.
3. The addition of 10% crumb rubber the maximum compressive strength found to be 38.4 Mpa at 7 days.
4. With the addition of 10% crumb rubber strength development is better while at 12.5% strength dropped.

D. split tensile strength at 28 days

1. With the use of 2.5%, 5%, 7.5%, 10%, 12.5% and 15% of crumb rubber compressive strength can be found out to be increased by 12.50%, 12.50%, 18.75%, 12.50%, 18.75%, 12.50%the respectively when compared to conventional mix.
2. The strength found to be 4.98, 5.60, 5.60, 5.91, 5.60, 5.91, 5.60 Mpa with the addition of 2.5%, 5%, 7.5%, 10%, 12.5%,15%.
3. The addition of 7.5%& 10% crumb rubber the maximum compressive strength found to be the same 5.91 Mpa at 28days.
4. With the addition of7.5%, 10% crumb rubber strength development is better.

E. flexural strength test at 28 days.

1. With the use of 2.5%, 5%, 7.5%, 10%, 12.5% and 15% of crumb rubber compressive

strength can be found out to be increased by 10.86%, 13.71%, 17.14%, 20.57%, 18.86%, 16.00%the respectively when compared to conventional mix.

2. The strength found to be 2.48, 2.75, 2.82, 2.90, 2.99, 2.94, 2.87 Mpa with the addition of 2.5%, 5%, 7.5%, 10%, 12.5%,15%.
3. The addition of 10%crumb rubber the maximum compressive strength found to be the 2.99Mpa at 28days.
4. With the addition of 10% crumb rubber strength development is better.

V. CONCLUSION

In our task town making plans estimate is prepared on the

1. The workability of concrete increases upto 10-15% when 2.5% crumb rubber is used and decreases with each replacement further.
2. The compressive strength decreases about 5-10% with 12.5% and 15% replacement of fine aggregate by crumb rubber.
3. Initially, Compressive strength increases from 8-10% for 2.5% to 10% for 3 days, 7 days and 28 days.
4. The flexural strength and split tensile strength increases by 5-10% as compared with control mix till 12.5%. Later on it decreased for 12.5% and 15%.
5. The optimum increase in strength of compressive, flexural and split tensile was found between 10-15% and for our project it is 12.5%.

VI. ACKNOWLEDGEMENT

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VII. FUTURE SCOPE

Extending research on treated crumb rubber with similar percentage.
Extending research with addition of fibers.

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