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Strength Performance of Crumb Rubber Concrete

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Abstract: *The total cost of concrete is attributed to the cost of its ingredients which is expensive, this leads to the usage of economically alternative materials in its production. This requirement has drawn the attention of investigators to explore new replacements of sand with crumb rubber at different proportions. Crumb Rubber is a by-product of the tyre manufacturing industry and it is a fine powder of rubber slag. Compressive strength of M40 grade of concrete with a 0.4 water to cement ratio was investigated; in which, crumb rubber shall be used at varying percentages 0%, 10%, 20%, 30% as a partial replacement to sand in concrete in order to find out the optimum percentage of crumb rubber. In our experimental investigations, the addition of crumb rubber to concrete as a partial replacement of sand is detrimental to the overall strength of the specimen, but not so much that it may not be used in small amounts. The concrete mix of M40 prepared was tested at 7, 14 & 28 days. The use of crumb rubber overcomes the pollution problem in the environment and it helps in the durability of concrete.*

Keywords: *Optimum dosage of crumb rubber, Compressive strength of Concrete, concrete mix design, Curing, weak bonding.*

I. INTRODUCTION

The use of rubber products is increasing every year worldwide. So many recycling methods for the rubber tyre are carried out according to the need. From this one of the processes is to make the tyre rubber into crumb rubber. It is used in many works such as road construction, mould making etc. In the study of replacement of the coarse and fine aggregate in concrete with crumb rubber for moulding pedestrian blocks. The concrete acts as a binder mixed with crumb rubber can make the concrete blocks more flexible and it provides softness to the surface. In this study it is observed that pedestrian blocks with crumb rubber performed quite well in skid and abrasion resistance. In this study the process of making the concrete is economical due to the simplicity of the manufacturing process.

A. Properties of Crumb Rubber

- 1) Appearance Black
- 2) Fineness Modulus 4.48%
- 3) Specific gravity 1.72 to 1.75

B. Physical Properties of Crumb Rubber

- 1) It has particle size of 10 to 80 mesh.
- 2) Relative density: 1.72 to 1.75.

C. Chemical Composition Of Crumb Rubber

- 1) Acetone Extract 10%
- 2) Rubber Hydrocarbon 25%
- 3) Carbon Black Content 30%
- 4) Natural Rubber Content 31%
- 5) Ash Content 4%

II. LITERATURE REVIEW

M. R. Wakchaura and Prashant. A. Charan : In this study they did partial replacement of fine aggregate as crumb rubber as 0.5%, 1%, 1.5% and 2% in M25 grade of concrete and its effects on concrete properties like compressive strength, flexural strength were investigated. They found that at ratio 0.5% and 1% there is no effect on the concrete properties would occur, but there was a considerable change for 1.5% and 2% replacement ratio.



Nithiya P and Portchejian G: The concrete mixes were made by replacing fine aggregate with 5%, 10%, 15% and 20% for M20 grade concrete. It is founded that it is optimum upto 5% addition of crumb rubber, further increased in crumb rubber percentage decreases the compressive strength.

S. Selvakumar and R. Venkatakrishnaiah: They did concrete mix as per IS: 10262-2009 for M30 grade of concrete for their investigation. They were tested for 7 and 28 days with replacement of fine aggregate with 5%, 10%, 15%, 20% of crumb rubber. Finally, they concluded that compressive strength of crumb rubber concrete with 10% replacement it gives acceptable strength. He investigated the strength properties of concrete using crumb rubber with partial replacement of 5%, 10%, 15%, 20%, which results increase in compressive strength with 5% replacement.

Prof.Pankaj Bhausaheb Autade: He examined the effect of M40 Grade concrete while partially replacing it as fine aggregate, the result obtained as reduction of about 10%-20% in compressive strength was noticed in the proportion of 80% and 100% in concrete.

III. EXPERIMENTAL STUDY

Crumb rubber is recycled rubber produced from automotive and scraps tires. During the recycling process, steel and tire cord are removed, leaving tire with granular consistency. It can be used for construction and pavements.

Properties of Crumb Rubber

- 1) *Appearance* : Black
- 2) *Fineness Modulus*: 4.8%
- 3) *Specific Gravity*: 1.72 to 1.75

A. *Physical Properties of Crumb Rubber*

- 1) It has particle size of 10 to 80 mesh
- 2) Relative density: 1.72 to 1.75

B. *Chemical Composition of crumb Rubber*

- 1) Acetone Extract :10%
- 2) Rubber Hydrocarbon: 25%
- 3) Carbon Black Content :30%
- 4) Natural Rubber Content: 31%
- 5) Ash Content: 4%

Experimental Program Is Carried Out In Two Stages

First preliminary tests are conducted in fine aggregate, coarse aggregate and cement. The tests include particle size distribution of fine aggregate and coarse aggregate, specific gravity of cement, specific gravity of fine aggregate, specific gravity of coarse aggregate. The test data of the material is obtained, the concrete mix design for M40 grade is designed using IS codes: IS. Three set of cubes are casted for M40 grade of concrete casting of specimens were done. The plain samples of cubes were cured for 7, 14, 28 days in a water tank.

In the second stage of the project, the experimental was designed to investigate the strength of Crumb Rubber concrete by replacing (0%, 10%, 20% 30%) of sand with Crumb Rubber. 3 set of cubes were casted and tested for compressive strength for M40 grade. The casted concrete was removed from moulds and placed in water tank. The compressive strength at 7, 14, 28 days of curing were studied.

Table 1.Compressive Strength (N/mm²)

S.NO	DAYS	CONVENTIONAL CONCRETE (0%) (N/mm ²)	CRUMB RUBBER CONCRETE (10%) (N/mm ²)	CRUMB RUBBER CONCRETE (20%) (N/mm ²)	CRUMB RUBBER CONCRETE (30%) (N/mm ²)
1.	7	32.45	31.05	28.65	10.58
		32.55	33.26	27.98	12.28
		33.47	32.23	28.32	11.45
2.	14	43.42	41.25	39.56	12.38
		42.79	43.25	41.68	11.98
		44.56	45.21	40.23	13.78
3.	28	48.09	49.00	44.25	14.52
		50.45	51.25	45.89	14.75
		51.10	52.22	47.36	14.01

Table 2.Compressive Strength (N/mm²)

S.NO	DAYS	CONVENTIONAL CONCRETE (N/mm ²)	CRUMB RUBBER(10%) (N/mm ²)	CRUMB RUBBER(20%) (N/mm ²)	CRUMB RUBBER(30%) (N/mm ²)
1.	7	32.83	32.18	28.31	11.43
2.	14	43.59	43.23	40.49	12.71
3.	28	49.88	50.80	45.83	14.42

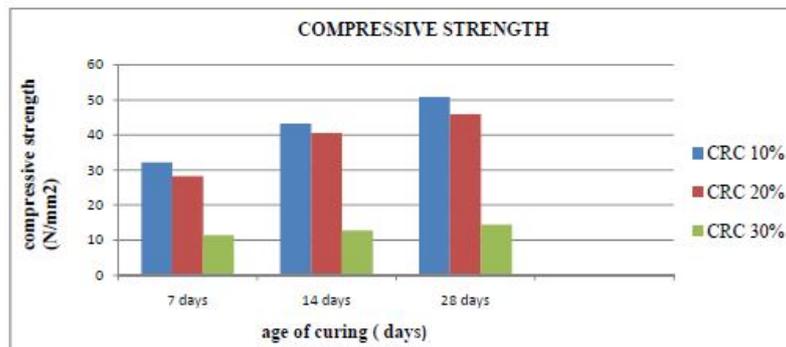


Fig1.Compressive Strength of Crumb Rubber Concrete

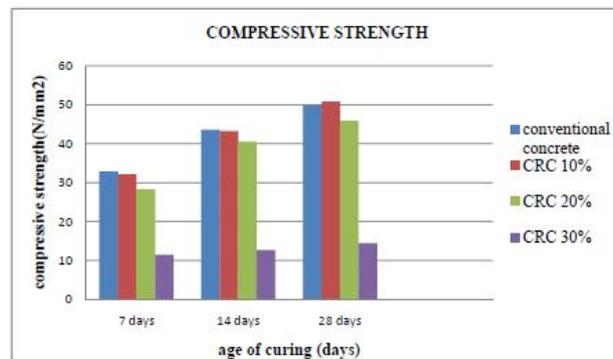


Fig.2Variation of Compressive Strength with Age of Curing

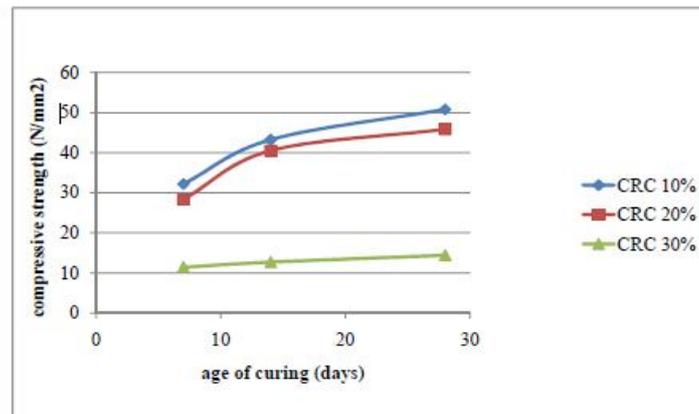


Fig. 3 Compressive strength result of concrete on replacing sand with crumb rubber

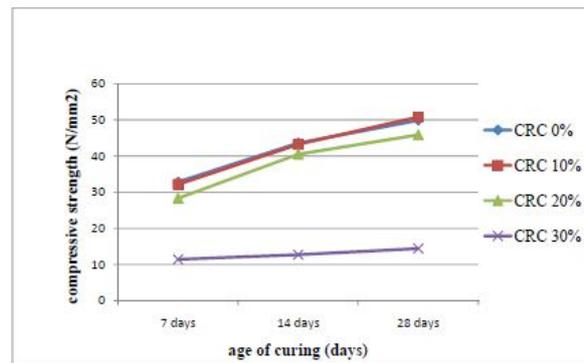


Fig: 4. Variation of Compressive Strength with Age of Curing

IV. CONCLUSIONS

On the basis of experimental investigation and the test results, following conclusions are drawn:

- A. It is observed that the decrease in compressive strength is due to weak bonding between rubber particles and cement paste.
- B. The compressive strength increases up to 10% and then gradually decreases.
- C. It is use for small structures like road curbs and non-bearing walls etc.
- D. The workability of rubberized concrete decreases with increase in rubber content which could be compensated by increasing the dosage of chemical admixtures.

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