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"A Review on Self Compacting Concrete using Crumb Rubber as replacement for Coarse aggregate"

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Abstract— ***The discarding of waste tyres is serious concern all over the world as it causes environmental problems. In this project the main aim was to utilize the waste tyre rubber in concrete as a partial replacement instead of coarse aggregate. The use of waste tyre rubber in concrete makes it economical and moreover it becomes environmental friendly. The strength of concrete with partial replacement of waste tyre rubber chips at various percentages had been investigated. Compression , split tensile tests and flexural strength were carried out for three different percentages of rubber chips say, 0%,2% 4% and 6% at 28 days curing period. The tests results indicate that as the percentage of rubber chips increases, greater will be the strength of the concrete and in case of 4% replacement of waste tyre rubber chips in concrete it shows the maximum strength compared to the other percentage replacement that but it decreases at 6 %.The observed strength of control specimens and 4% replacement of waste tyre rubber chips in concrete found to be almost identical***.

Keywords :Waste crumb rubber,Coarse Aggregate, Compression, Split Tensile, Flexural Strength

I.INTRODUCTION

Concrete mixture, characterized by high resistance to segregation and which can be cast without compaction or vibration are termed as Self-Compacting Concrete (SCC). Better quality concrete and substantial improvement in working conditions are observed due to the exclusion of compaction or vibration. SCC mixes contains a very high content of fine fillers, including cement, which further leads to high compressive strength concrete.

The use of rubber product is increasing every year in worldwide. India is also one the largest country in population exceeds 100cr. So the use of vehicles also increased, according to that the tyres for the vehicles also very much used and the amount of waste of tyre rubber is increasing. This creates a major problem for the earth and their livings. For this issue, the easiest and cheapest way of decomposing of the rubber is by burning it. This creates smoke pollution and other toxic emission and it create global warming. Currently 75-80% of scrap tyres are buried in landfills. Only 25% or fewer are utilized as a fuel substitute or as raw material for the manufacture of a number of miscellaneous rubber goods. Burying scrap tyres in landfills is not only wasteful, but also costly. Disposal of whole tyre has been banned in the majority of landfill operations because of the bulkiness of the fires and their tendency to float to the surface with time. Thus, tyres must be shredded before they are accepted in most landfills. So many recycling methods for the rubber tyre are carried according to the need. From this one of the processes is to making the tyre rubber in to crumb rubber.

II. LITERATURE REVIEW

Ilker Bekir Topcu et al(1995) proposed the concrete was modified by mixing with crumb rubber in coarse aggregate in the ratio of 15%, 30% and 45%. In this study the changes of the properties of rubberized concrete were investigated according to the terms of both size and amount of rubber chips added. In this the physical and mechanical properties were determined according to that the stress strain diagram were developed from that the toughness value and the plastic and elastic energy capacities were determined.

Fattuhi et al(1996) proposed that, the cement paste, mortar, and concrete (containing OPC or OPC and PFA) mixes were prepared using various proportions of either rubber crumb or low-grade rubber obtained from shredding scrap tyres. Properties examined for the 32 mixes prepared included density, compressive strength, impact and fire resistances, and nailability. Results showed that density and compressive strength of various mixes were reduced by the addition of rubber. (Rubber type had only marginal effect.) Density varied between about 1300 and 2300 kg/m3. Compressive strength reduced by 70% when the proportion of rubber to total solid content by mass of concrete reached about 13%.

Piti Sukontasukkul et al(2004) proposed the paper on crumb rubber concrete. In their study they decided to replace the course and fine aggregate in concrete for moulding pedestrian blocks. They believe that the concrete acting as a binder mixed with crumb rubber can make the concrete blocks more flexible and it provide softness to the surface. In this study they saw that the 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.

Eldin and Senouci (1993), on the basis of test results, showed that there was about 85% reduction in compressive strength and 50% reduction in tensile strength when the coarse aggregate was fully replaced by coarse rubber chips. However, specimens lost up to 65% of their compressive strength and up to 50% of their tensile strength when the fine aggregate was fully replaced by fine crumb rubber. He also showed that when loaded in compression specimens containing rubber did not exhibit brittle failure.

III.EXPERIMENTAL PROGRAMME

3.1 Materials used

In this experimental study, cement, aggregates, water ,Crumb rubber are used.

Cement

Ordinary Portland Cement (OPC) of 53 grade with specific gravity of 3.15 was used in this experiment.

Sand

Locally available sand of specific gravity 2.6 passing through 4.75 mm IS sieve was used.

Coarse aggregate

Coarse aggregate of specific gravity 2.73 passing through 10 mm sieve and retaining on 4.75mm sieve was used.

Water

Potable water free from impurities was used.

IV. EXPERIMENTAL METHODOLOGY

4.1 Compressive strength test

In this test, the specimens of 150 X 150 X 150 mm were cast for M40 grade concrete. The percentage of crumb rubber added were 0, 2,4,6 % by weight of coarse aggregate After 24 hours the specimens were shifted to curing tank to cure for 7 and 28 days. After the curing period the cubes were tested in UTM. The compressive strength is noted. In each category 3 cubes were tested and their average value is reported.

4.2 Split tensile strength test

In this test, the cylindrical specimens of 300mm height and 150mm diameter were cast.. The percentage of crumb rubber added were 0, 2,4,6 % by weight of coarse aggregate After 24 hours the specimens were After 24 hours the specimens were shifted to curing tank to cure for 28 days. After the curing period the specimens were tested in UTM. In each category 3 cylinders were tested and their average value is reported.

4.3 Flexural strength test

In this test, the beam specimens of dimensions 500 X 100 X 100mm were cast. The percentage of crumb rubber added were 0, 2,4,6 % by weight of coarse aggregate After 24 hours the specimens were. After 24 hours the specimens were shifted to curing tank to cure for 28 days. These specimens were tested under 2 point loads. In each category 3 beams were tested and their average value is reported.

V. EXPERIMENTAL RESULTS

5.1 Compressive strength

Table 1

7 day compressive strength for SCC and Coarse aggregate replaced by crumb rubber

Mix ID	Strength in compression(N/mm^2)
0% CR (CVC)	26.85
0% CR+ SCC-M40	27.98
2% CR +SCC -M40(M1)	28.56
4% CR +SCC -M40(M2)	30.737
6% CR +SCC -M40(M3)	27.54

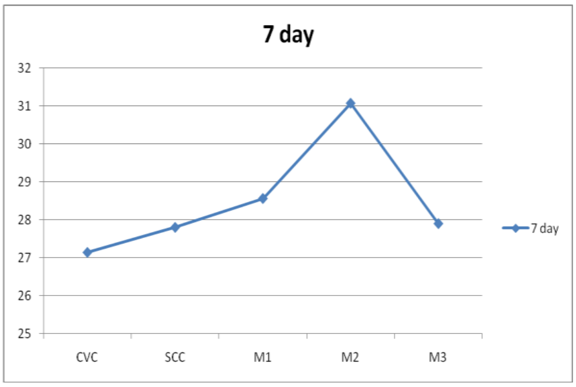

Fig 1 : Graph for **7 day compressive strength for SCC and Coarse aggregate replaced by crumb rubber**

Table 2

28 days compressive strength for SCC and Coarse aggregate replaced by crumb rubber

Mix ID	Strength in compression(N/mm^2)
0% CR (CVC)	43.055
0% CR+ SCC-M40	43.854
2% CR +SCC -M40(M1)	44.875
4% CR +SCC -M40(M2)	47.96
6% CR +SCC -M40(M3)	43.127

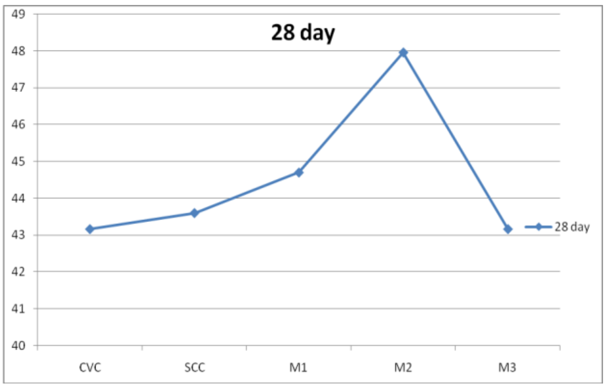

Fig 2 : Graph for 28 days compressive strength for SCC and Coarse aggregate replaced by crumb rubber

5.2 Split tensile strength

Table 3

28 days Tensile strength for SCC and Coarse aggregate replaced by crumb rubber

Mix ID	Tensile strength (N/mm^2)
0% CR (CVC)	4.082
0% CR+ SCC-M40	4.198
2% CR +SCC -M40(M1)	4.3
4% CR +SCC -M40(M2)	4.591
6% CR +SCC -M40(M3)	4.163

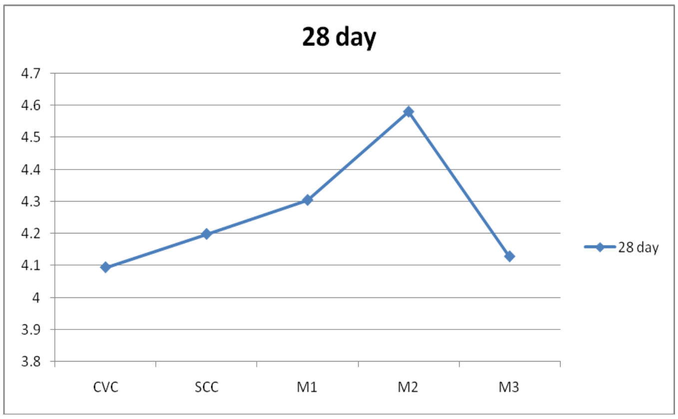

Fig 3 : Graph for 28 days Tensile strength for SCC and Coarse aggregate replaced by crumb rubber

5.3 Flexural strength

Table 4

28 days Flexural strength for SCC and Coarse aggregate replaced by crumb rubber

Mix ID	Flexural strength in N/mm^2
0% CR (CVC)	5.402
0% CR+ SCC-M40	5.454
2% CR +SCC -M40(M1)	5.8
4% CR +SCC -M40(M2)	6.18
6% CR +SCC -M40(M3)	5.3

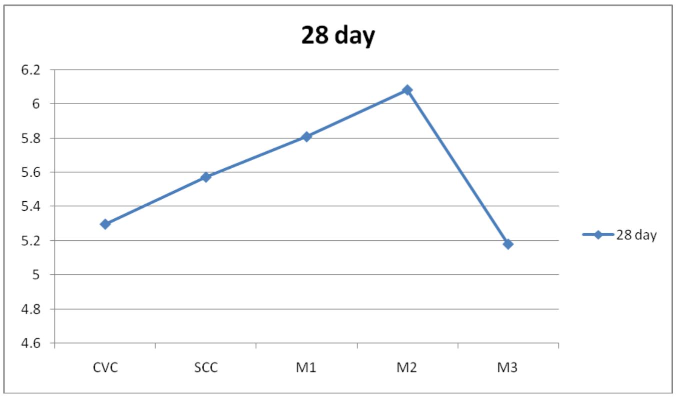

Fig 4 : Graph for 28 days Flexural strength for SCC and Coarse aggregate replaced by crumb rubber

VI CONCLUSIONS

1. Mix design for CVC of M40 is done according to IS code 10262 -2009 and a compressive strength of 43.13 N/mm^2 is achieved after 28 days.
2. SCC for M40 was planned with CR and it had a compressive strength of 44.11 N/mm^2 which is 2.27% greater than CVC of M40 grade.
3. Mix M2 containing 4 % of Crumb rubber acquire extreme compressive strength.
4. Mix M2 containing 4 % of Crumb rubber acquire extreme split tensile strength .
5. Mix M2 containing 4 % of Crumb rubber acquire extreme flexural strength.
6. Mix M2 containing 4 % of Crumb rubber acquire extreme compressive strength of 47.96 N/mm^2 at 28 days of curing .
7. Mix M2 containing 4 % of Crumb rubber acquire extreme split tensile strength of 4.591 N/mm^2 at 28 days of curing
8. Mix M2 containing acquire extreme flexural strength of 6.18 N/mm^2.
9. Finally it can be concluded that Mix 2 with 4 % of Crumb rubber was the optimum dosage to be used in the present study.

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