International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 03 | March 2022 www.irjet.net p-ISSN: 2395-0072

BEHAVIOR OF CONCRETE WITH PARTIAL REPLACEMENT OF C- AGGREGATES BY GRANULATED RUBBER

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Abstract - *The growth of about three crores of discarded tyre flaps per year poses a possible environmental danger. India has taken steps to improve its infrastructure in order to support the expansion of globalization. Municipalities have a difficult time managing rubber from discarded tyres, because it is difficult to biodegrade, even after extensive disposal remediation. However, wasted tyre rubber can be recycled. These scrap tyres can be used as construction materials for the benefit of society and, in particular, for a clean and healthy environment.*

In this study an attempt has made by the partial replacement of discarded waste granulated rubber as coarse aggregates in concrete. For this, an experimental study was carried out with M25 grade of concrete. Compression, Split Tensile and Flexural tests were carried out on the cubes, cylinders and beams by replacing the coarse aggregate by rubber aggregate in 0%, 2.5%, 5%, 7.5%, 10%, 12.5% and 15% with and without addition of superplasticizer (Glenium at 0.5%) at 7 days and 28 days. Then compare conventional concrete with rubber mix concrete. As per this study replacement of rubber aggregate is up to 7.5% is permissible, with further increase in rubber aggregate content results in decrease in strength. Hence it is feasible to replace rubber aggregate up to 7.5%.

Key Words: Granulated Rubber Aggregate, Coarse Aggregate, Partial Replacement, Glenium.

1. INTRODUCTION

Over 300 million scrap tyres had previously been accumulated. Those stockpiles contribute to a higher risk of fire, which is exceedingly dangerous and can occur as a result of lightning, spontaneous combustion, or carelessness. Diseases spread by rodent and insect infestations, as well as pollutants in the air, provide additional health hazards. Most landfills refuse to take tyres because they are damaging to the environment and are not biodegradable.

Municipalities have a difficult time managing rubber from discarded tyres, because it is difficult to biodegrade, even after extensive disposal remediation. However, wasted tyre rubber can be recycled. These scrap tyres can be used in concrete structure for the benefit of society and, in particular, for a clean and healthy environment.

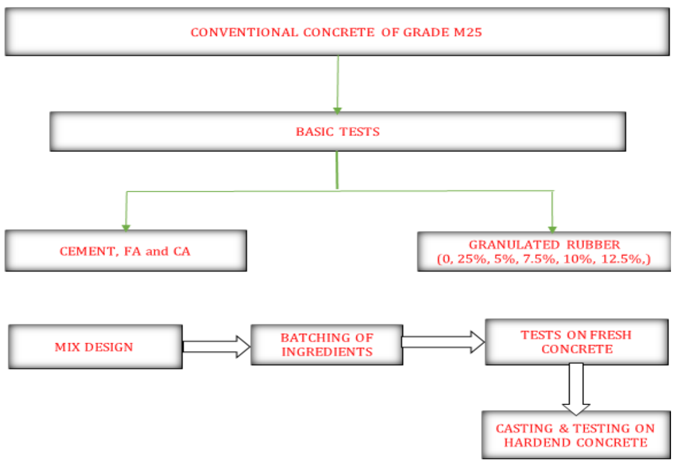
The introduction of new admixtures with aggregates used in the mix continually challenges, these drawbacks with hopes for change. C-aggregates are replaced with Rubber materials to mix the concrete.

One method is to include rubber material into the cementitious material. It's a great approach to change the characteristics of concrete as well recycling rubber tyre flaps. Waste tyre flap has already been considered as a component substitute in cementitious materials, and the results show that a concrete with better strength and soundproofing qualities may be achieved. According to studies, adding rubber to structurally strong floor slab improved flammability and reduced delamination harm. Culvert, walkways, jogging tracks, soundproof, and other auxiliary building components can all benefit from rubberized concrete.

2. OBJECTIVES

- Characterization of sand, cement, granulated rubber and coarse aggregate.
- To investigate the effect of granulated rubber as a partly alternative for C-Aggregate in mixture of concrete.
- To investigate the impact on the characteristics of hardened concrete mix.
- To propose the cost effective utilization of rubber in conventional concrete.

3. METHODOLOGY



4. EXPERIMENTAL PROCEDURE

4.1 Compression Strength Test

- The most frequent test on concrete is the compressive strength test, since it is simple to execute and most of the desired characteristics of concrete are numerically connected to its compressive strength.
- CTM machine of 2000KN capacity was found for compressive strength.
- Concrete cube specimens 0f 150mm x 150mm x 150mm were used to evaluate compressive strength.
- The test used to be carried out with the aid of setting a specimen between the surfaces of a CTM and to be utilized until the specimen fails as proven.
- The compressive strength of 3 test samples was evaluated and the average result was used.

$$\text{Compressive strength(Mpa)}=\frac{\text{Failure load}}{\text{cross sectional area}}$$

4.2 Split Tensile Strength Test

- Firstly, remove the wet sample from the water after 7, 28, or any desirable period of curing for determining tensile strength. Then, wipe out water from the surface of specimen.
- Then, on both ends of the specimen, draw diametrical lines t0 check that they are at the same axial location.
- Later, note down the dimension of the specimen and weight.
- Adjust the compression testing equipment to the proper range.
- Place the sample on the lower plate and cover it with a wooden strip.
- Aline the specimen such that the vertical lines on the ends are forced to rely over the bottom plate.
- Place the other wooden plank on top of the specimen.
- Lower the upper plate until it is barely touching the wooden strip.
- Continuously apply the load without shock at a rate of 0.7 to 1.4 Mpa/min (1.2 to 2.4 Mpa/min according to Indian standards 5816-1999).
- Finally, taking note of the breaking l0ad (P)

$$\text{Split tensile strength(Mpa)}=\frac{2 \text{ x Failure load}}{\pi \text{ x length x dia}}$$

4.3 Flexural Strength Test

- To minimize surface drying, which affects flexural strength, the test should be done on the specimen as soon as it is withdrawn from the curing environment.
- It's a good idea to place the specimen on the loading points. The hand-finished surface of the specimen should not be touched by loading points. The specimen and loading points will be in good contact as a result of this.
- The loading mechanism should be centered in reference to the applied force.
- At the loading locations, bring the block providing force into contact with the specimen surface.
- Applying loads ranging from 2% to 6% of the calculated ultimate load.
- Use 0.10 mm and 0.38 mm leaf-type feeler gauges across a length of 25 mm or more to see if any gap between the specimen and the load-applying or support blocks is greater or less than either of the gauges.
- Use leather shims (6.4mm thick and 25 to 50mm long) to fill in any gaps bigger than 0.10mm. They should cover the whole width of the specimen.
- Capping or grinding should be considered to close gaps bigger than 0.38mm.
- Continuously load the specimen until it fails (the IS recommends 400 kg/min for 150mm specimens and 180 kg/min for 100mm specimens, with a stress increase rate of 0.06+/-0.04N/mm^2 according to the BIS).
- Finally, compute average depth and height by measuring the cross section of the tested specimen at each end and in the middle.

$$\text{Flexure tensile strength(Mpa)}=\frac{\text{Failure load x length}}{\text{width x depth\^{}2}}$$

5. EXPERIMENTAL TEST RESULTS

5.1 Compression Strength Test Results

Sl No	Specimen	CS - WOA		CS - WA	
		Day 7	Day 28	Day 7	Day 28
1	SC	20	31.12	22.3	33.7
2	SCR2.5	18.9	30.2	21.4	32.5
3	SCR5	17.3	29.5	18.1	31.4
4	SCR7.5	16.4	27.4	17.6	28.3
5	SCR10	15.8	24.6	16.9	26.0
6	SCR12.5	14.1	22.9	15.4	24.1
7	SCR15	13.2	21.1	14.6	22.1

CS – Compressive strength Mpa, WOA- without admixture
WA- With admixture

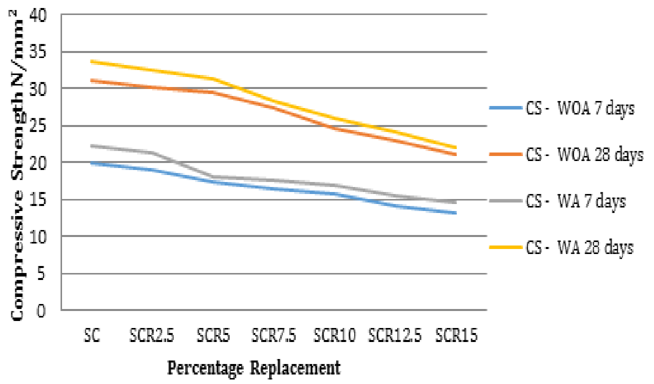


Chart -1: Compression Strength

5.2 Split Tensile Strength Test Results

Sl No	Specimen	STS - WOA		STS - WA	
		Days 7	Days 28	Days 7	Days 28
1	SC	1.95	3.23	2.31	3.40
2	SCR2.5	1.83	3.09	2.13	3.27
3	SCR5	1.7	2.9	1.91	3.15
4	SCR7.5	1.63	2.71	1.86	2.97
5	SCR10	1.57	2.43	1.74	2.73
6	SCR12.5	1.49	2.38	1.67	2.51
7	SCR15	1.38	2.20	1.51	2.39

STS – Split tensile strength Mpa, WOA- without admixture
WA- With admixture

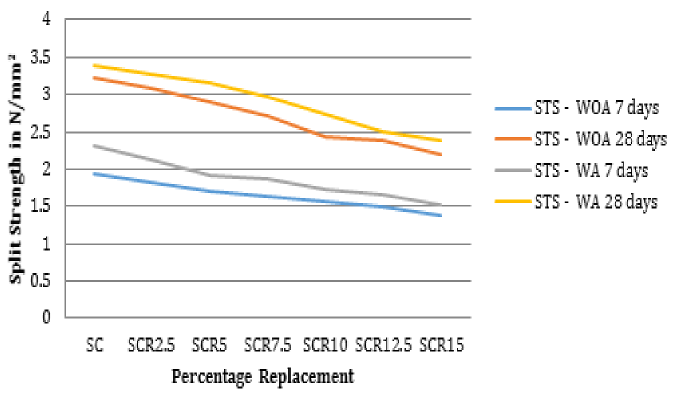


Chart -2: Split Tensile Strength

5.3 Flexural Strength Test Results

Sl No	Specimen	CS - WOA		CS - WA	
		Days 7	Days 28	Days 7	Days 28
1	SC	3.31	4.96	3.68	5.31
2	SCR2.5	3.15	4.85	3.43	5.14
3	SCR5	2.90	4.72	3.29	4.97
4	SCR7.5	2.74	4.43	3.08	4.68
5	SCR10	2.65	4.21	2.84	4.38
6	SCR12.5	2.4	3.89	2.51	4.18
7	SCR15	2.27	3.41	2.36	3.82

CS – Flexural strength Mpa, WOA- without admixture
WA- With admixture

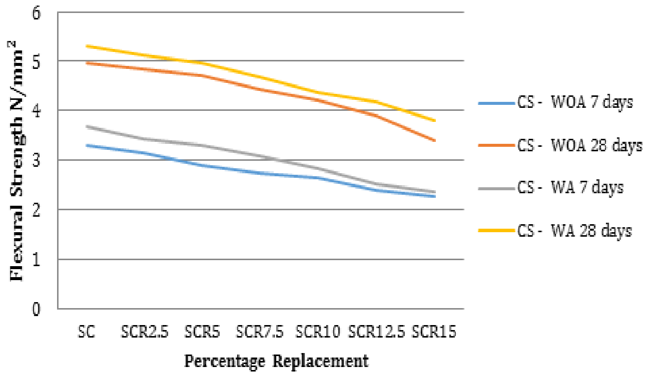


Chart -3: Flexural Strength

6. CONCLUSIONS

1. Because the rubber that is used as a whole is smooth, the overall functioning does not vary significantly when considering rubber. Rubber has a low water intake limit, just like it has a low water ingestion limit. However, as the amount of rubber in cement increases, its utility decreases.
2. According to this study, up to 7.5% rubber replacement is permissible; however, additional expansions in the rubber content resulting in a loss of strength properties. As a result, you'll be able to possible to replace up to 7.5% of the rubber in total.
3. When the rubber material expanded, it caused the cement to thin out. When entire replacement is required, this type of total substitution is advantageous in torsional behavior and crack resistance of concrete.
4. The use of rubber waste in solid blends has shown to be quite helpful in producing green, low-cost and light-weight concrete.

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