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### Experimental study for partial replacement of coarse aggregate with recycled rubber crumb

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#### ABSTRACT

Concrete is most widely used building material in the world, as well as the largest user of natural resources with annual consumption of 12.6 billion tons. The major part of concrete besides the cement is the aggregate. Aggregate include sand and crushed stone / Gravel. Use of these conventional materials in concrete is likely to deplete the resources unless there is a suitable substitute. Rubber which is generated in large quantities as waste does not have useful disposal till now. But rubber is found to possess properties that are required for viable replacement of coarse aggregate in concrete. Hence we in this project have aimed to study the effectiveness of rubber as substitute for coarse aggregate and utilize the crumb rubber tyres in concrete, to minimize global warming. Aggregate properties viz., specific gravity, water absorption, acid resistance were to be conducted to ascertain the properties concrete specimens were to be casted and tested for concrete mix with various percentage of replacement (2.5% , 5% & 10%) and its viability for replacement are discussed in this project.

**Keywords:**Rubber, Compressive strength, Splitting tensile strength, Flexural Strength, Fine aggregate, Coarse aggregate, Superplasticizer.

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#### INTRODUCTION

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..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. It is used in many works such as Road construction, Mould making etc [1-5]. Alteration of building

materials has an important role in the building sector. Various numbers of attempts have been thus made in the construction material field to get into use refused waste products like damaged used tyres, into valuable and gainful items. Success in this case will have a great contribution towards the decline of waste material dumping problems by utilization of the waste materials as a raw matter for other construction requirements.

#### OBJECTIVES

This study was conducted to achieve the following objectives:

- To study the strength developments hardened concrete with waste Rubber tyre crumb.
- To determine the effect of various percentage of waste rubber tyre crumb as partial coarse

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aggregates replacement towards compressive strength of concrete.

- To determine the water absorption of concrete containing various content of ceramic tile as partial coarse aggregates replacement material.

## Cement

Cement is the essential ingredient to bind all other materials to form workable concrete. The Ordinary Portland Cement of 53 grades was used in this experimentation conforming to IS: 12269:1987 is used in this experimental project.

PROPERTY	SPECIFICATIONS
Specific gravity	3.15
Fineness	6 %
Normal consistency	31
Initial setting time	32 Minutes

## Fine Aggregate

Locally available zone II m sand used as fine aggregate. The specific gravity was determined and was found as 2.7& fineness is 4.66, conforming to I.S. – 383-1970.

## Coarse Aggregate

Crushed angular shape aggregate from a local source was used as coarse aggregate. The specific gravity was not recycled in any form at present. This cause impacts to environment, so it can be reused as construction materials.an attempt has been made to find the suitability of the ceramic industrial wastes as a possible replacement for conventional coarse aggregate. Mainly this type of recycled aggregate is used for the developments of concrete with non-conventional aggregates to

improve the properties of concrete and reduce the cost. Specific gravity - 2.53.

## Waste Rubber Tyre Crumb

Crumb rubber having size between 4.75 mm to 20 mm is used in the concrete being made for the experiment. The specific gravity was determined and was found as 0.917.

## Mix Design

Mix design can be defined as the process of gathering the required ingredients in the required quantities in order to mix them in proper ratio to get the concrete having desirable strength, durability and workability. In this experimental investigation I have prepared a concrete having mix proportions of M-30 which is tabulated below for 1 cubic meter.

Content	M1 (0%CR)	M2 (2.5%CR)	M3 (5%CR)
Cement(kg/m3)	351	351	351
Fine aggregate(kg/m3)	835.46	835.46	835.46
Coarseaggregate(kg/m3)	1083.12	1039.92	988.50
Crumb rubber	0	21.135	42.27
Water (kg/m3)	158	158	158
W/C ratio	0.45	0.45	0.45
Superplasticizer(kg/mm)	0	1.35	1.35

Mixing of Concrete, Casting and Curing of test Specimens Hand mixing was done during the entire process of casting of specimens. Initially the dry mix constituents of the mix namely cement, fine aggregate and coarse aggregate was mixed for

two minutes in the mixer and then the water were added and mixing continued for another 2 minutes. The total mixing time was kept at 4 minutes until a homogeneous mixture was obtained. Compaction was achieved by means of Tamping rod.

### Fresh concrete

The fresh concrete properties slump test is conducted. The slump value of concrete was 72mm.

### Hardened concrete

The hardened concrete specimen properties are checked by compressive strength, split tensile strength and flexural strength.



**TESTS ON HARDENED CONCRETE**

### Compressive strength

Compressive strength is defined as the capacity of a material or structure to resist compression when a load is applied on it, in order to push it together. In other words, we can say compressive strength of a material can also be defined as the minimum amount of load required at which that particular material breaks down. In this experiment we have tested all the cubes that we had casted

with different ratios of crumb rubber for their compressive strengths. Cube specimen of size 150 mm were casted as per the Indian Standard specification IS: 516-1959. After finishing, the samples were covered with sheets to minimize the loss of moisture. The specimens were deMolded , after 24 hours and then kept in water for curing. The compressive strength test was carried out after 7 and 28 days.

Grade of Concrete	% of Rubber crumb mixed	7 days (N/mm <sup>2</sup> )	28 days (N/mm <sup>2</sup> )
	0	17	-
M30	2.5	15	-
	5	17.5	-



### Flexural strength

Flexural strength is defined as the tendency of the material to oppose its deformation when a specific amount of load is applied on it. It is also known as bend strength and fracture strength. The

beams of size  $10 \times 10 \times 50$  cm that we have casted were compacted in vibrators and then after demolding and curing them the tests were conducted on them after 7 and 28 days respectively to check there flexural strengths [6-8].

Grade of Concrete	% of Rubber crumb mixed	7 days (N/mm <sup>2</sup> )	28 days (N/mm <sup>2</sup> )
M30	0	2.49	-
	2.5	2.43	-
	5	2.57	-

### Split tensile strength

Split tensile strength is defined as the tendency of a material to oppose an applied force trying to pull it apart. The tensile strength of a material can be defined as the minimum amount of force that is required to split that specific material apart. The

cylinders of size 150 mm by diameter and 300mm by length that we have casted were compacted in vibrators and then after de-molding and curing them, the tests were conducted on them after 7 and 28 days respectively to check there split tensile strength.

Grade of Concrete	% of rubber crumb mixed	7 days (N/mm <sup>2</sup> )	28 days (N/mm <sup>2</sup> )
M30	0	1.58	-
	2.5	1.45	-
	5	1.61	-

### CONCLUSION

According to the experimental investigation, the utilization of rubber tire as partial replacement of Coarse aggregates has been used in three different proportions 2.5% and 5% with silica fumes as mineral admixture. Based on the results, following conclusions are drawn:

- As the percentage of crumb rubber is increased, the workability of the concrete also increases.
- In comparison to the previously done experimental investigations with crumb rubber in the absence of silica fumes, this research has shown comparatively better adhesive and bonding

properties and hence comparatively better values for compressive, tensile and flexural strength.

- The increase in the workability also shows decrease in the voids due to the betterment in the compaction but due to the decrease in the other properties it is not significant.
- For larger percentage of rubber in concrete, the decline rate of compressive strength is higher than normal concrete.
- Better results were obtained when 5% of rubber is used for substituting the natural aggregate in the rubberized concrete.

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