

## International Journal of Innovative Research in Science, Engineering and Technology

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# Experimental Study on Strength and Durability Properties of Rubberized Concrete

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**ABSTRACT:** Recycling granulated waste tires (crumb rubber) has been widely studied for the last twenty years mostly relating to applications such as asphalt pavement, waterproofing system, membrane liners, etc., Use of alternative material in concrete opens a whole new range of possibilities in the construction industry. Sustainable technologies for concrete construction are not only essential for the development of eco friendly construction but also to manage huge quantity of solid waste disposal without compromising durability. In this study, the use of crumb rubber to replace fine aggregates in concrete was studied. It is believed that concrete acting as a binder mixed with crumb rubber can make concrete more flexible and thus, provide softness to the surface. The objective of this paper is to investigate the mechanical and durability properties of concrete when crumb rubber is used as partial replacement of fine aggregate in different percentage (5%, 10%, 15%, 20% and 25%) by volume. Laboratory trials were conducted to investigate the effect of crumb rubber. A comparison was also made between mixtures containing various percentages of crumb rubber to determine the optimum crumb rubber content and the test results also compared with conventional concrete (without crumb rubber).

**KEYWORDS:** Crumb rubber.

### I. INTRODUCTION

In the concrete preparation, the most commonly used coarse and fine aggregate has likely become scarce it is today. Now construction people need the alternatives to natural aggregates. Therefore, finding alternatives to naturally available materials is important to sustaining construction industry. A review of recent research has shown than it is possible to use industrial by products as well as other materials in the concrete preparation as a replacement for cement and aggregates. The waste tyre crumb rubber was used as an alternative of river sand and its properties were investigated. So in such cases waste materials are used to modify the mechanical and durability properties of concrete to make it suitable for any situation. This would also additional benefits in terms of reduction in cost, energy savings, promoting ecological balance and conservation of natural resources.

### OBJECTIVES

1. To minimise the risk of pollution
2. To evaluate the effect of rubberized concrete on the strength and such as,
  - a) Compressive strength
  - b) Tensile strength
  - c) Flexural strength.

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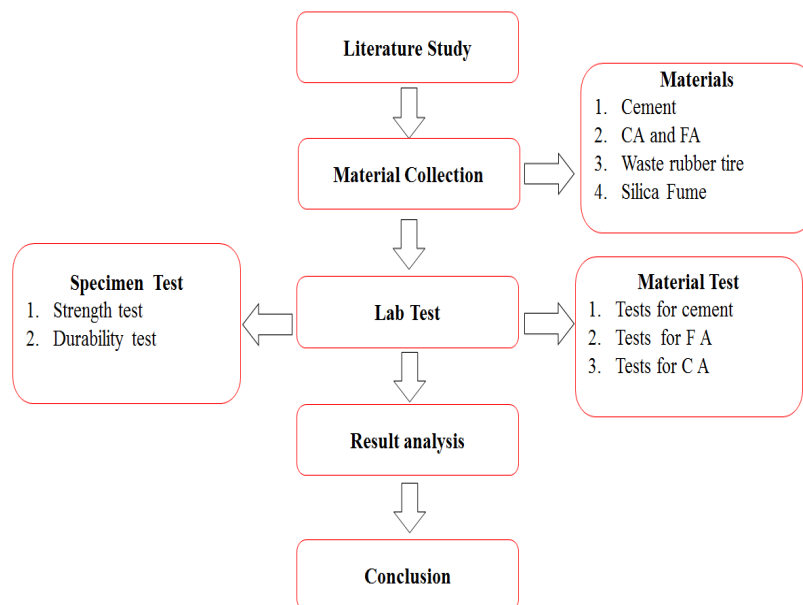
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3. To study the durability characteristics of rubberized concrete

## II. METHODOLOGY

The methodology adopted for the study comprises Literature review, procurement of materials, determination of material properties, preparation of mix design, determination of mechanical properties and analysis of results obtained from various tests to reach conclusion.



## III. MATERIALS USED

### (i) Fine Aggregate

In this present study, M sand was used as fine aggregate. The sand used for the experimental program was locally procured and conformed to Indian standard specification. The sand was first sieved through 4.75mm sieve to remove any particles greater than 4.75mm and then was washed to remove dust.

### (ii) Ordinary Portland Cement (OPC)

Cement forms the most important ingredient of concrete which act as a binder material to keep the sand and coarse aggregate together by filling the void spaces between the aggregates. The OPC was classified into three grades namely 33 grade, 43 grade and 53 grade depending upon the strength of cement at 28 days when tested as per IS 4031-1988. Ordinary portland cement was chosen instead of pozzolanic portland cement because of the presence of fly ash in PPC.

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## (iii) Coarse Aggregate

The usual range employed is between 9.5mm and 37.5mm in diameter. - Fine aggregates are usually sand or crushed stone that are less than 9.55mm in diameter. Typically the most common size of aggregate used in construction is 20mm. A larger size, 40mm, is more common in mass concrete. In this project 20mm aggregate are used.

## (iv) Silica Fume

It is very fine non crystalline silica produced in electric arc furnaces as a by-product of the production of elemental silicone or alloys containing silicone. It is also known as condensed silica fume or micro silica. It is amorphous silica with high SiO<sub>2</sub> content. It has extremely small particle size and large surface area. It is highly reactive pozzolan used to improve mortar and concrete.

## (v) Tyre Scraps

The rubber tyre waste powder will be formed by passing tyre rubber through rotating corrugated steel drums. The obtained material will have very large surface area. It will be useful to replace fine aggregate

## IV. EXPERIMENTAL RESULTS

- Mix design of M30

Mix proportion for 1 m<sup>3</sup> Concrete

Cement Kg/m <sup>3</sup>	Fine aggregate Kg/m <sup>3</sup>	Coarse aggregate Kg/m <sup>3</sup>	Water Litre
388.88	717.99	1174.25	175
1	1.85	3	0.45

- Selected Mixes

Mix des.	Description
N	Conventional mix
R 5	Replacing fine aggregate with 5% rubber and silica fume
R 10	Replacing fine aggregate with 10% rubber and silica fume
R 15	Replacing fine aggregate with 15% rubber and silica fume
R 20	Replacing fine aggregate with 20% rubber and silica fume
R 25	Replacing fine aggregate with 25% rubber and silica fume

Figures shows the results of experimental study.

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## a) Compressive Strength

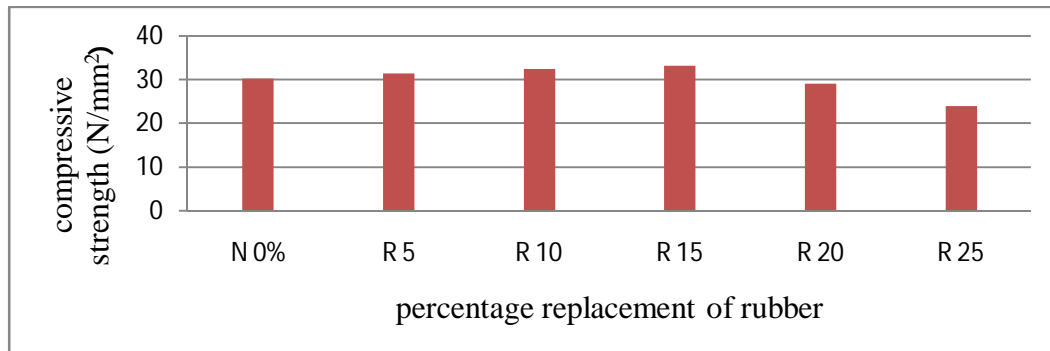


Fig 1. Variation of 28 day compressive strength at different percentage of rubber tyre powder

## b) Split Tensile Strength

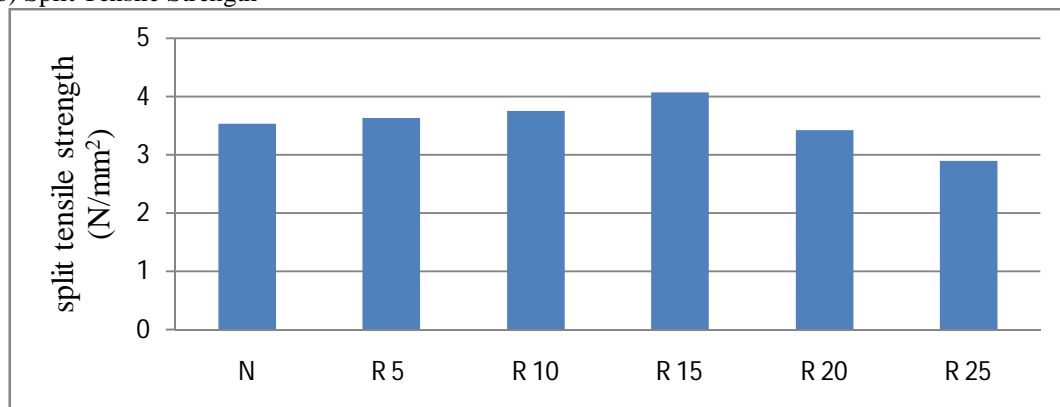


Fig 2. Bar chart showing variation of split tensile strength of concrete

## c) Flexural Strength

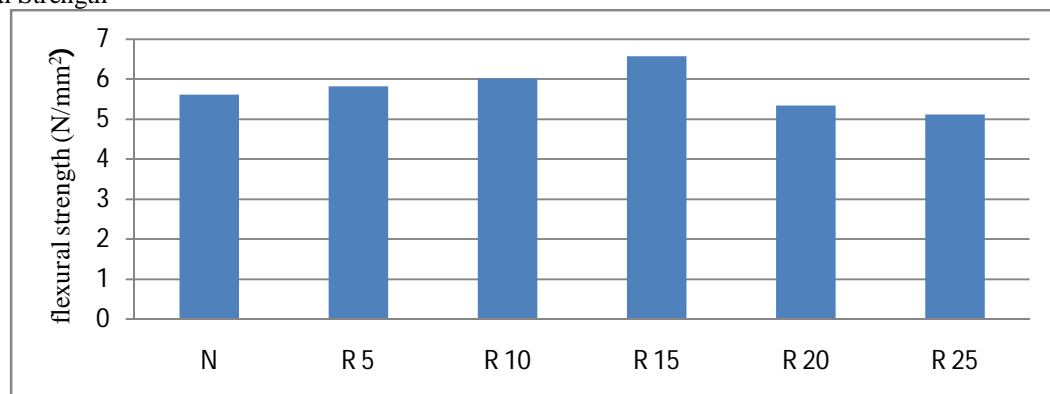


Fig 3. Bar chart showing variation of flexural strength of concrete

## • Durability Tests

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## a) Water Absorption

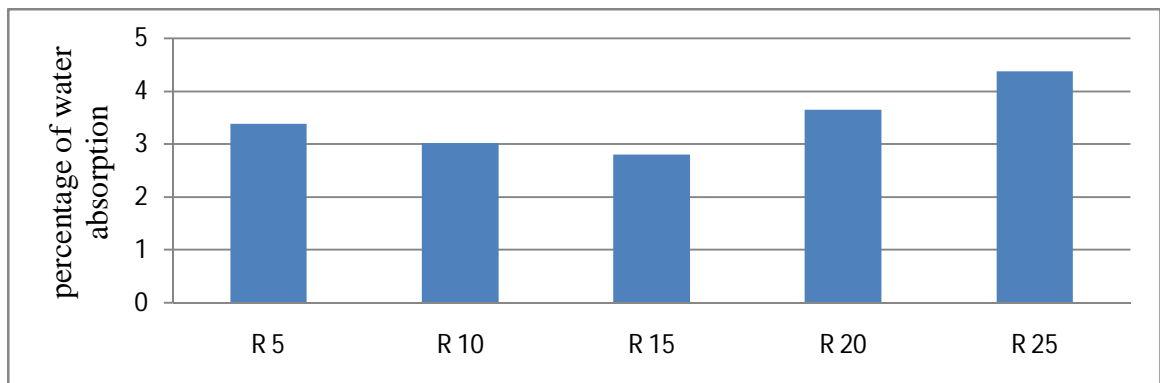


Fig 4.Bar chart showing water absorption

## b) Acid Attack Test

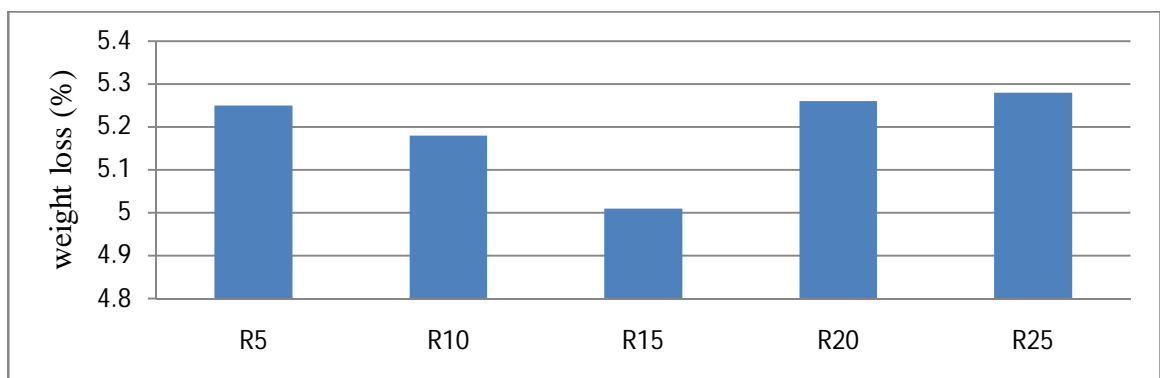


Fig 5.Weight loss of rubberized concrete after 90 days (acid resistance)

## c) Alkaline Attack Test

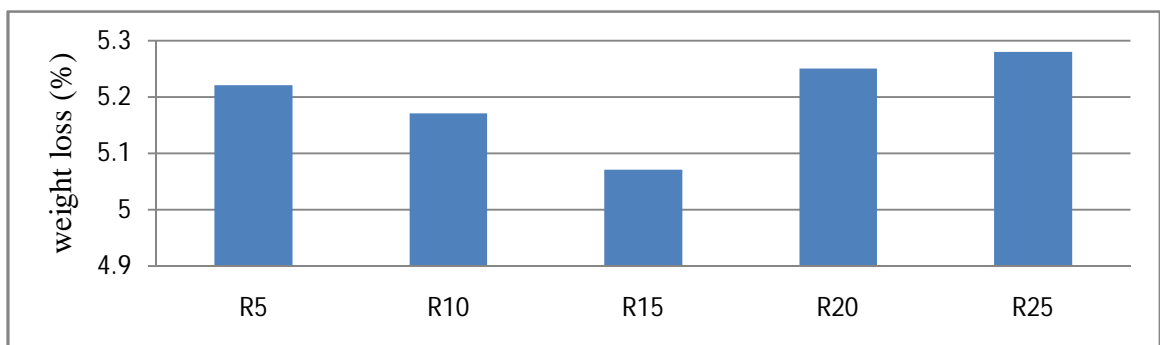


Fig 6.Weight loss of rubberized concrete after 90 days (alkali resistance)

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## V. CONCLUSION

- Use of the waste rubber tyre in concrete is a techno- economically feasible and environmentally consistent method of waste disposal.
- From the above study it is considered that a huge amount of waste aggregate can be used once again in construction field with the addition of some admixtures. Also that 15% replacement of rubber has a good effect on the concrete when compared to other replacement percentage. Hence 15% replacement of rubber and addition of silica fume is effective and it helps the concrete to attain its maximum compressive strength in the curing period.
- Up to 15% replacement of fine scrap tyre rubber aggregate compressive strength is more than the compressive strength of traditional concrete. Above 15%, the compressive strength seems to be decreasing. This pattern also repeats for splitting tensile strength and flexural strength of concrete.
- Addition of tyre scrap also reduces the weight of concrete.
- It gives also acceptable durability properties such as water absorption, alkalinity resistance and acid resistance up to 15% replacement.
- Hence 15% rubber content is to be considered as the optimum amount.

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