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Sustainable Utilization of Waste Butyl Rubber as a Partial Replacement of Coarse Aggregate in Concrete

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ABSTRACT: All through the improper disposal of old tires is a huge environmental issue that affects the entire world. It can lead to uncontrolled fires, pollution of the soil and vegetation, and other environmental problems. Finding alternate uses for these tires is therefore desperately needed, with a focus on recycling the used tire. It is now theoretically possible to utilize used tires in concrete, and the resulting material is referred to as lightweight concrete. A mixed ratio of concrete designs are prepared using the IS code book technique for the M30 cement concrete evaluation. The sample specimens are cast using waste butyl rubber in various rates to replace the coarse aggregate.

KEYWORDS: Waste Butyl Rubber, Environmental concern, M30 grade concrete, compressive, split tensile and flexural strength

I. INTRODUCTION

A startling number of old rubber tires amass annually throughout the world; India alone is home to 275 million of them. Because of their low density and poor degradation, these tires are landfills that we are unable to bury. There are other options for getting rid of these tires, like filling up large holes in the ground or dumping them. Furthermore, mosquitoes, which are known to transmit a wide range of diseases and present a serious and hazardous risk to human health, are greatly honored by these landfills. An estimated 1.2 billion garbage tires made of rubber are generated each year worldwide. Furthermore, it's believed that only 4% of tires are used, 27% are unlawfully piled, stockpiled, or disposed of, and 11% are exported after being used 27% are illegally piled, hoarded, or discarded, and only 4% are used for civil engineering projects. Thus, attempts have been made in civil engineering projects to recycle waste tire rubber. The additional benefit of partially replacing rubber tire aggregates in concrete is the preservation of natural aggregates.

II. LITERATURE REVIEW

Chandran (2017) The Chandran (2017) In order to strengthen concrete and preserve the environment, this study investigates the possibility of adding discarded tires into the substance as varying-sized chips.

Ishwariya (2016) An investigation of the partial substitution of crumb rubber for coarse aggregate in an experimental setup. For the purpose of this investigation, we replace the coarse aggregate in regular concrete grades of M30 with crumb rubber.

Jeevana et al. (2023) Concrete preparation involves replacement the coarse aggregate with waste rubber. In place of the coarse aggregate, waste rubber tire is put in amounts of 5%, 10%, and 15%.

Paul Sibiyone et al. (2017) conducted experimentally used rubber waste as coarse aggregate. Tests are conducted on flap rubber partial replacements of coarse aggregate, looking at compressive, flexural, and split tensile strengths.

III. MATERIALS USED

Cement: Generally, Portland Pozzolana cement is used for plain cement concrete. Cement is an ingredient of concrete which is an essential construction material.



Waste butyl rubber: Butyl rubbers are also known as "butyl". Silicone is a type of synthetic rubber made by modifying the naturally-occurring chemical element of silicon.

Technically, silicone could be considered part of the rubber family. Butyl rubber is a synthetic rubber with a wide range of applications, including tires, inner tubes, hoses, and seals.

Polytancrete ngt (ASTM C 494 TYPE F): By lowering the mix's water content, the polymeric liquid additive Polytancrete NGT Super Plasticizing additive helps to strengthen mortar or concrete. It can also be applied to fresh or cured concrete to alter and enhance a number of its qualities. NGT stands for National Green Tribunal.

Pidicrete URP (ASTM C 190-85): Fixit Pidicrete URP (Universal Repair Polymer) is an SBR (styrenebutadiene) latex which is a ready-to-use bonding agent for waterproofing and repairs. It will be in a liquid consistency that strongly bonds to both old and new concrete structures and plasters. features of Dr.Fixit Reduces shrinkage, Prevents cracking of cement, Good repair solutions, Good repair solutions, Bonds strongly with most of the building materials and Prevents dust and corrosion.

Fine aggregate: Fine aggregates are basically any naturally occurring sand particles that are extracted from the earth during the mining process. Fine aggregates are defined as particles that are 4.75 mm or less in size. Natural sand or any other type of crushed stone makes up fine aggregates. In our project we use M Sand.

Coarse aggregate: Particulate matter larger than 4.75mm of coarse aggregate. Generally speaking, 20mm is the most common size of aggregate used in construction.

IV. PROPERTIES OF MATERIALS

Table No. 1 Characteristics of cement

| S.NO | ANALYSIS | VALUES |
|------|--------------------------------|-------------|
| 1. | Consistency | 30% |
| 2. | Specific gravity | 3.15 |
| 3. | Initial setting time of cement | 35 Minutes |
| 4. | Final setting time of cement | 450 Minutes |
| 5. | Fineness test | 4% |

Table No. 2 Properties of Waste Butyl Rubber

| S.NO | PROPERTY | WASTE BUTYL RUBBER |
|------|------------------------------|-------------------------|
| 1. | Elasticity | Degree can various |
| 2. | Unit weight | 1150(Kg/m3) |
| 3. | Tensile strength | 2000 Kg/cm ² |
| 4. | Swelling in organic solvents | Large |
| 5. | Water absorption | Small |
| 6. | Elongation at break | 800 % |
| 7. | Specific gravity | 2.33 |

Table No. 3 Properties of Pidicrete URP

| | |
|-------------------|--|
| Usage/Application | Roof Waterproofing |
| Type | SBR Latex- (Styrene Butadine Rubber Latex) |
| Color | Pink |
| Ph Value | 7.7 |
| Form Of Chemical | Liquid |
| Brand | Dr Fixit |
| Model No | 301 Pidicrete URP |

Table No. 4 Characteristics of fine aggregate

| S.NO. | RESULT ANALYSIS | VALUE |
|-------|---|------------------------|
| 1. | Specific gravity(G) for manufactured sand | 2.65 |
| 2. | Bulk Density | 1632 kg/m ³ |
| 3. | Fineness modulus for manufactured sand | 3.9% |

Table No. 5 Characteristics of Coarse aggregate

| S.NO. | RESULT ANALYSIS | VALUE |
|-------|---------------------|--------|
| 1. | Water absorption | 1.5% |
| 2. | Crushing strength | 18.60% |
| 3. | Specific gravity(G) | 2.75 |
| 4. | Fineness modulus | 7.31 |

V. MIX PROPORTION

Table No. 6 Proportion of coarse aggregate with butyl rubber

| MIX DESIGNATION | PROPORTION OF COARSE AGGREGATE WITH BUTYL RUBBER |
|-----------------|--|
| 0% | - |
| 5% | 95% Coarse aggregate + 5% Butyl rubber |
| 10% | 90% Coarse aggregate + 10% Butyl rubber |
| 15% | 85% Coarse aggregate + 15% Butyl rubber |

VI. RESULT AND DISCUSSION

Concrete's compression strength is one of its main features in strength. This test was used to find out the compressive strength test samples. It was done by compressive testing machines. Compressive of concrete mixers made for conventional concrete and percentage replacement of waste rubber tyre materials was determined at 7 & 28 days.

Table No. 7 Compressive strength result of M30 grade of concrete at 7 and 28 days

| PERCENTAGE OF WASTE BUTYL RUBBER | COMPRESSIVE STRENGTH (N/mm ²) | |
|----------------------------------|---|---------|
| | 7 DAYS | 28 DAYS |
| CC | 19.45 | 34.52 |
| 5% | 18.70 | 33.58 |
| 10% | 16.59 | 31.46 |
| 15% | 15.60 | 30.53 |

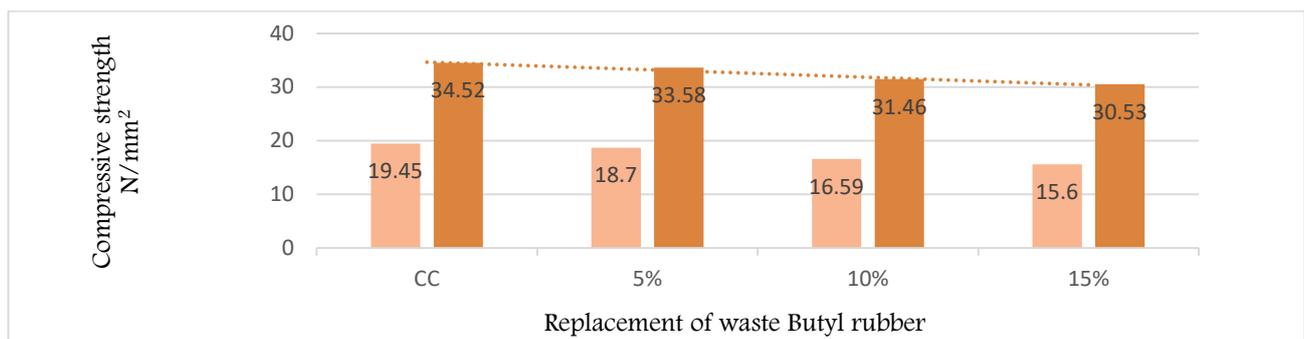


Figure 1. Graphical representation of Compressive strength test at 7 and 28 Days

One of the primary and most important qualities of concrete is its tensile strength. Concrete is usually not anticipated to bear direct tension due to its brittle nature and poor tensile strength. Identifying the test specimens' maximal load carrying capability is the primary goal of this experimental test.

Table No. 8 Split tensile strength result of M30 grade of concrete at 7 and 28 days

| PERCENTAGE OF WASTE BUTYL RUBBER | SPLIT TENSILE STRENGTH (N/mm ²) | |
|----------------------------------|---|---------|
| | 7 DAYS | 28 DAYS |
| CC | 4.16 | 4.71 |
| 5% | 3.77 | 4.69 |
| 10% | 3.55 | 3.67 |
| 15% | 3.32 | 3.52 |

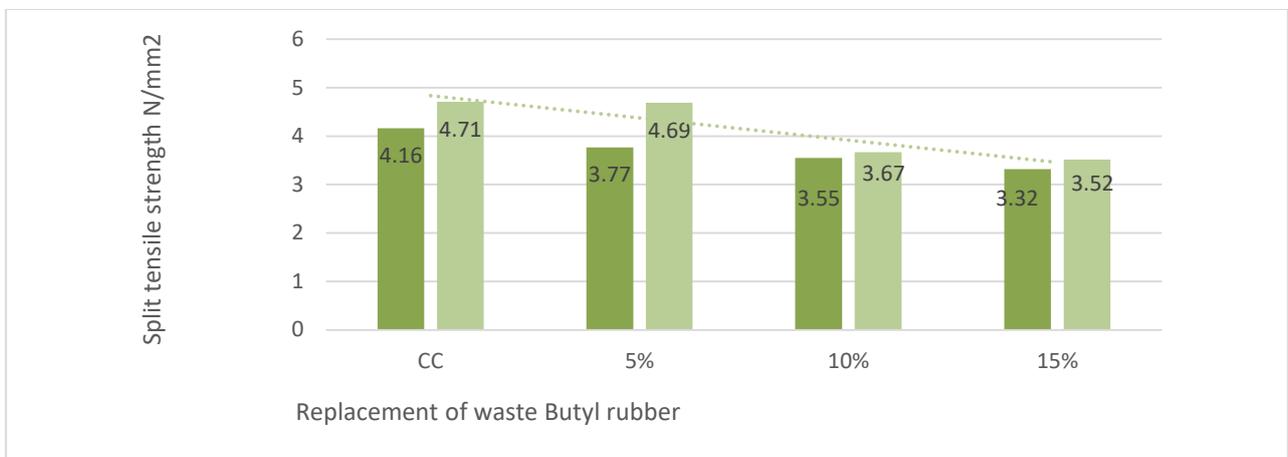


Figure 2. Graphical representation of Split tensile strength test at 7 and 28 Days

Flexural strength of the specimens were tested in (UTM) of capacity 1000 kN. The prism was casted in the size of 500x100x100mm. The load was given to the sample by two point load method. In each percentages of waste rubber tyre M30 grade was determined at 7 & 28 days.

Table No. 9 Flexural strength result of M30 grade of concrete at 7 and 28 days

| PERCENTAGE OF WASTE BUTYL RUBBER | FLEXURAL STRENGTH (N/mm ²) | |
|----------------------------------|--|---------|
| | 7 DAYS | 28 DAYS |
| CC | 2.80 | 3.79 |
| 5% | 2.67 | 3.47 |
| 10% | 2.61 | 3.31 |
| 15% | 2.13 | 3.16 |

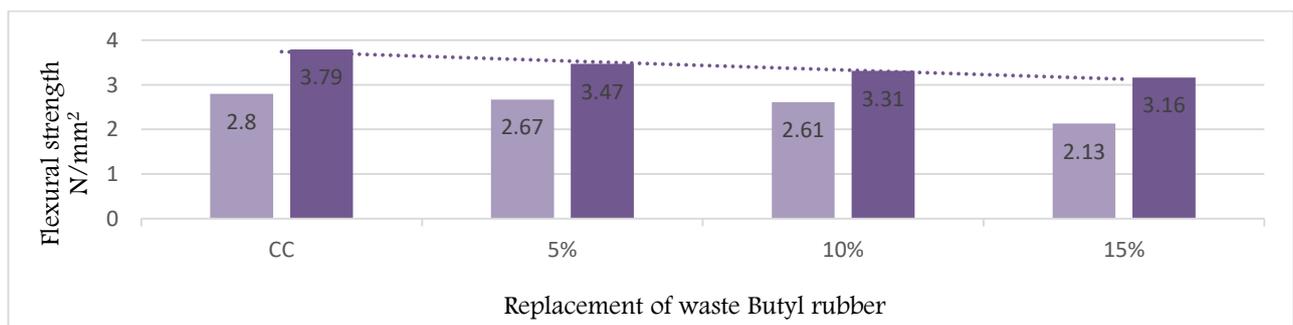


Figure 3. Graphical representation of Flexural strength at 7 and 28 days

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