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Study of the effect of addition of shredded rubber into the Portland cement concrete at different replacement levels

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Abstract :

The use of scrap tyre rubber in the preparation of concrete has been thought as an alternative disposal of such waste to protect the environment. In this study an attempt has been made to identify the various properties necessary for the design of concrete mix with the coarse tyre rubber chips as aggregate in a systematic manner. Scrap tyre rubber chips, has been used as coarse aggregate with the replacement of conventional coarse aggregate Concrete is one of the most popular building materials. The construction industry is always increases its uses and applications.

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Therefore, it is required to find alternative materials to reduce the cost of concrete. On the other hand, Non-biodegradable waste i.e. water bottles, cool drink bottles and disposable glasses, shredded or crumbed rubber etc., is creating a lot of problems in the environment and its disposal becoming a great difficulty. The objective of this study is to investigate the use of rubber pieces as coarse aggregate in the concrete. Compressive strength, of concrete is measured and comparative analysis is made.

Key Words: Rubberized concrete, Waste tyres, Shredded tyres, Recycled waste materials, Concrete, Rubber, Environment, Sustainability

INTRODUCTION: There is a major issue for all the 3rd world countries and that is worn tyre's management. As we know that the number of vehicles that is increasing, and with that there are few countries which are presently known for development of the industrial area and those are surely a big environmental issue because of absence of a plan that is adequate to eliminate the waste.

We are now not able to estimate worn tyres' mass that is burned or thrown in the dumpsters there for the public because of the absence of statistics related to this topic. Let us do this by comparing these countries with the Europeans that has taken charge of this issue with the help of legislation, recycle, re-search. And by this we can conclude that there are several countries who have postponed the solution and worn tyres in mass can be considerable only.

Incorporation of rubber aggregates which results from cutting of the worn tyres in cement concretes is one of the best recommendations for solving this issue. There are various researches that has been carried out which concerns the using of the aggregates of the rubber which results from crushing the worn tyres. "Moreover, the benefit which we can gain from using the cement concretes for the roadways makes us think about multiplying the studies on the cement composites that incorporate rubber aggregates since the rigidity of the cement concretes can make it possible either to decrease the granular layer necessary to the asphalt road- way or to allow the use of less resistant concretes". And this is the scene with the using of concretes that have a great part of aggregates of the rubber that result from worn tyres.

Even though there are many sustainable destinies for used tyres, the construction industry has shown little understanding of the potential of this waste. However, a number of promising possibilities have been emerging that have some weight in the market: asphalt, kinder- garden and sports area pavements, impact barriers on roads, and breakwaters. These applications prove how interesting it is to pursue new research fields that could show how end- of-life tyres can be reused competitively in the sector. We are replacing conventional aggregates' part by aggregates of rubber that result from cutting of the worn tyres keeping in mind the ecological concern and saving of traditional aggregates.

LITERATURE REVIEW:

"Concrete is a composite material composed of coarse granular material (the aggregate or filler) embedded in a hard matrix of material (the cement or binder) that fills the space between the aggregate particles and glues them together".

Considering concrete as a composite material which is having binding medium and in that it has aggregate's particles. Cement, water and aggregate are there in the concrete. In

attaining the physical properties which they desire of the finished material, sometimes there are reinforcements and additives in the mixture. These mixtures started to form a fluid mass which is molded in the shape easily after they are mixed together. By binding rest of the ingredients together that forms durable stone-like material, a hard matrix is formed by the cement.

In the world, there is concrete which is most widely used as the material for construction. And it is also helpful in various structures like dam, etc. "Its worldwide production exceeds that of steel by a factor of 10 in tonnage and by more than a factor of 30 in volume. The present consumption of concrete is over 10 billion tons a year, that is, each person on earth consumes more than 1.7 ton of concrete per year. It is more than 10 times of the consumption by weight of steel. Famous concrete structures include the Hoover Dam, the Panama Canal and the Roman Pantheon". The ancient Romans were the earliest large-scale users of the technology of the concrete and it was mainly used in empire of Roman. There was Colosseum that situated in Rome and that was mainly built with the help of Concrete. Until the technology of concrete was again discovered in 18th century, it becomes rare after collapsing of Roman Empire. And now we can see that it is the mostly used man-made material.

OBJECTIVES:

Replacing use of waste rubber with coarse aggregate for positive variations for various things is the main purpose of this study. After that consequence of the material which is used as admixture is then determined by cement motor's testing workability, etc. And a complete characterization and application's evaluation will be enabled by these tests.

The main objectives of the study are summarized below;

1. "The main objective of this study is to investigate the effect of addition of shredded rubber into the Portland cement concrete in three different replacement levels i.e. 5%, 10% and 15% by mass of coarse aggregates and evaluates the fresh and hardened rubberized concrete properties".
2. To examine the consequences of surface treatment of rubber on various properties of rubberized concrete is secondary aim.
3. "To prepare lightweight concrete by using waste rubber as partial replacement of

course aggregate".

4. "Utilization of waste rubber in the concrete construction sector, hence eliminating the need of land fill disposal of this non bio-degradable waste".

METHODOLOGY:

COLLECTION OF RAW MATERIALS:

- Cement, tyre rubber, sand and sodium hydroxide are used in this study.
- Tyre rubber is bit difficult to find but the rest three can be found easily in the market.
- From Batamalo, we collected tyre rubber and from chemistry laboratory of the universe, we have collected Srinagar and sodium hydroxide.
- "Cement is a dispersed solid whose particle size is ranging from 0.1 to 250 micron-meter".
- "The rubber thus obtained was brought down to a size com- parable to the size of coarse aggregate."

MATERIAL TESTING:

Following tests were conducted on the materials used.

(a) **Cement tests**

(b) Tests for sand

(c) Tests for gravel

Consistency test for cement:

- "Standard consistency of a cement paste is defined as that consistency which will permit a vi-cat plunger having 10 mm dia and 50 mm length to penetrate to a depth of 33-35 mm from top of the mould. In the project we weighed approximately 400gm of cement and mix it with a weighed quantity of water (w/c ratio = 0.26)". The time for the mixing is given 3-5 minutes.

Water Absorption Test for Aggregates:

- For removing finer particles and dust, you have to wash aggregate's sample

thoroughly and then you weigh them and then place them in the basket, after that they are immersed in the water for 24 hours.

- After removing them from water, you start allowing them to drain for few minutes and with the help of piece of cloth you have to dry it gently.
- After drying they are weighed again.

Workability test:

- Measurement of workability was done by performing the slump cone tests on every concrete mix. The metallic slump mould has an top dia of 10 cm and bottom dia of 20 cm with a height of 30 cm. "The thickness of the mould sheet is 1.6 mm. The mould is filled in four layers with freshly prepared concrete and each layer is tamped 25 times by using a tamping rod".

Compression Test:

- For this test, aggregates in desired proportions were taken as shown in the table 12. " The cement, sand and aggregates were then mixed in dry condition with a trowel for 1minitues and then water was added. The quantity of water was taken as 700 grams.

Split tensile strength:

- In this method a cylindrical specimen of 20cm height and10cm dia are casted at a w/c ratio of 0.45.
- The mixture is placed into the moulds with proper compaction and then struck off level.
- These moulds are left undisturbed for 24 hours after which they are removed from the mould for curing.
- "The procedure is repeated for different specified replacement levels".
- "The samples are tested after 28 days for split tensile strength".

ANALYSIS:

Through the result we are able to observe variations of various mixes' compressive strength, tensile strength, etc and that too where we are replacing coarse aggregates by different tyre rubber percentages.

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- **SPLIT TENSILE STRENGTH TEST:**

"When load is applied along the generatrix, an element on the vertical diameter of the cylinder is subjected to horizontal stress of magnitude";

$$Stress = \frac{2p}{\pi LD} \quad (\text{N/mm}^2)$$

28 days split tensile strength

Sample	Strength(N/mm^2)
PC	2.38
UTR-5	2.1
UTR-10	1.9
UTR-15	1.6
NTR-5	3.82
NTR-10	5.72
NTR-15	6.36
CTR-5	4.76
CTR-10	4.28
CTR-15	4.076

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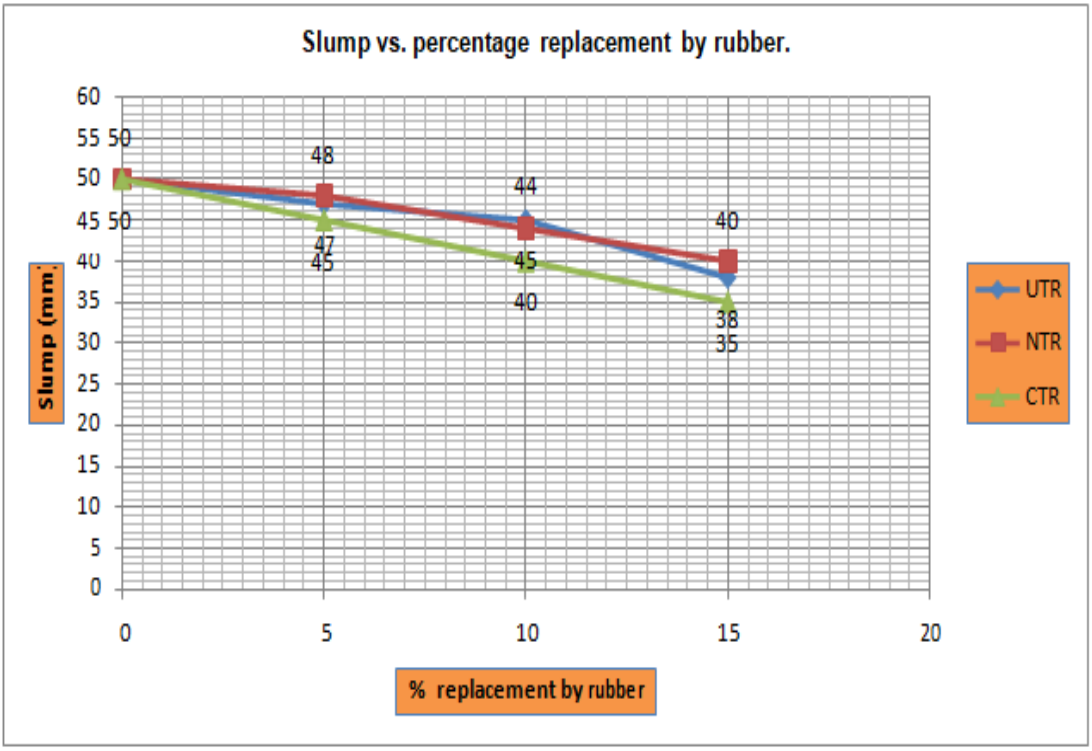

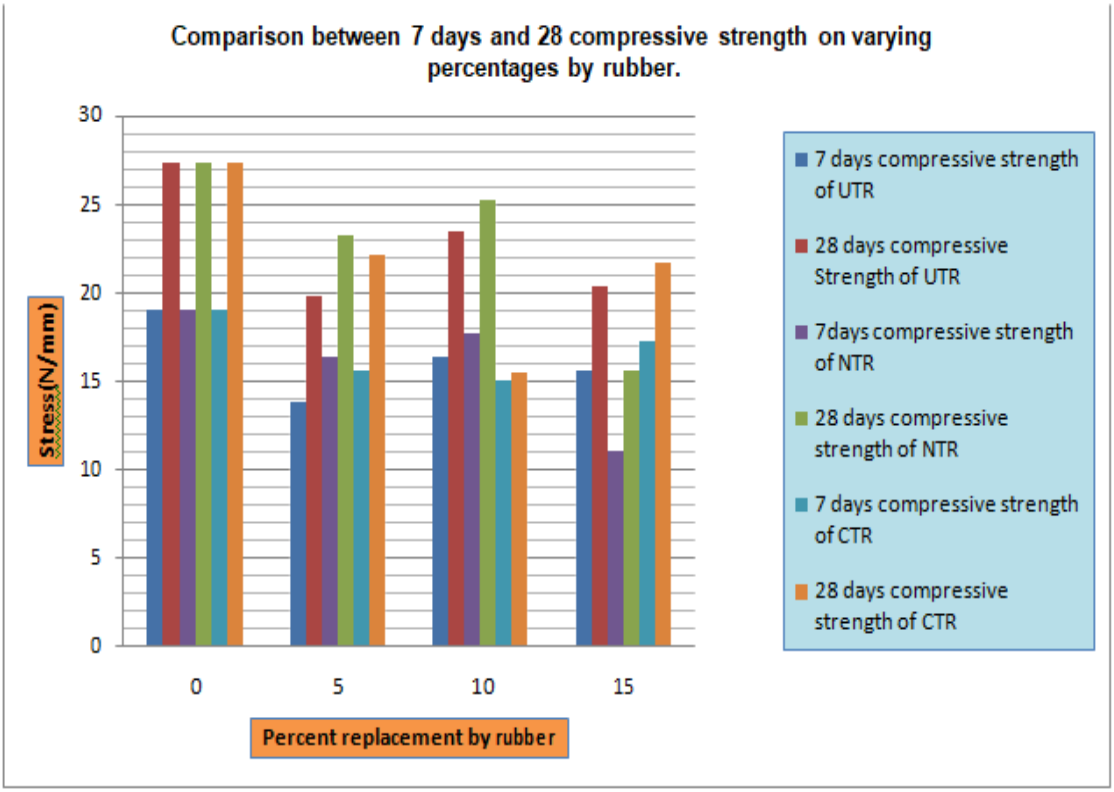

Comparison between 7 days and 28 compressive strength on varying percentages by rubber

CONCLUSION:

1. In various structural applications, concrete's reduced compressive strength is limited because of the inclusion of aggregates of the rubber but along with that it is having various desirable characteristics also such as higher impact, toughness, etc.
2. For various construction applications, these properties might prove to be beneficial.
3. With the help of NaOH and paste of cement to rubber aggregates, it becomes possible making relatively high strength rubber concrete.

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