PARTIAL REPLACEMENT OF FINE AGGREGATE USING WASTE TYRE RUBBER IN CONCRETE

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Abstract— **The use of waste tyre disposal is crucial for environmental issues. It is suggested that rubber granules might serve as a lightweight alternative to fine aggregate. These waste products can be employed to enhance the ductility and fracture resistance of concrete, among other mechanical attributes. The compressive and tensile strengths of concrete containing rubber granules are examined during periods of 7 days, 14 days, and 28 days. These mixes were compared to natural concrete, and the behaviour of the rubber granules in the concrete was observed. This concrete mixer treats waste rubber with a replacement proportion of fine aggregate. Rubber granules were substituted with natural fine aggregate in amounts of 5%, 10%, 15%, 20%, and 25%. The suggested approach stimulates the use of recycled rubber in concrete and is simple to implement by the precast industry to produce precast concrete goods that contribute to environmentally friendly and sustainable buildings.**

Keywords: Rubber concrete Compressive strength Compressed rubber concrete

I. Introduction

One of the major problems facing the entire planet is the excessive dumping of trash. Because waste tyres take a very long time to disintegrate, even after extensive usage, their disposal is a serious issue. Rubber products may also be made using waste rubber as a raw material. Cement, coarse aggregate, and fine aggregate are used to create concrete. Due to the high demand for concrete as a building material, it is necessary to use substitute materials that may be obtained from recycled or waste materials in order to protect the natural coarse aggregate.

Rubber is inexpensive compared to other components of concrete and is easily accessible in the form of old tyres. Waste tyre disposal and burning are exceedingly complex and polluting processes. Concrete that has been rubberized can be used to make lighter concrete. Cement is a material that is widely used in building. The use of tyre granules as a partial replacement for fine aggregate in concrete is one of the various methods suggested for using used tyres.

MATERIALS

The cement used for the paper is Portland pozzolana cement and coarse & fine aggregate are recently used along with rubber granules. The reference grade of concrete used is M35 grade rubber granules is a recycled rubber produced from automotive and truck scrap tires higher content of waste tyre crumb rubber particles used in concrete increases workability of concrete and produces the lightweight concrete here fine aggregate is partially replaced using rubber granules.The percentage replacement of natural fine aggregate with rubber granules was 5%,10%,15%,20%and 25%.

TABLE 1 : Test on the cement

SI no	Name of the test	Result
1	Fineness	9%
2	Standard consistency	32%
3	Initial setting time	Less than 30 minutes
4	Final setting time	10 hrs
5	Specific gravity	

TABLE 2 : Test on fine aggregate

SI no	Name of the test	Result
1	Specific gravity	2.65
2	Particle size distribution	Zone 3,Fineness modulus 2.76, Uniformity coefficient 2.5
3	Bulking of sand	Max bulking 35.2%, Water content at max bulking 7%
4	Water absorption	1.25%

TABLE 3: Test on coarse aggregate

SI no	Name of the test	Result
1	Specific gravity	2.65
2	Grain size analysis	Fineness modulus 5

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		Uniformity coeeficient-1.28
3	Water absorption	1.55%

MIX DESIGN

In present study M35 grade concrete was designed. The weight ratio of mix proportion is 1:1.33:1.91 keeping water cement ratio 0.6.It was proposed to investigate the properties of brick.

In this experimental work,physical property of materials used in the experimental work were determined.M35 grade of reference concrete was mixed and cured in potable water.

TABLE 4:Mix design For cube

Sl no	Rubber granules%	Water	Cement	Coarse aggregate	Fine aggregate	Rubber granules
1	Normal cube	0.66	1.762	4.20	2.60	
2	5%	0.66	1.762	4.20	2.47	0.130
3	10%	0.66	1.762	4.20	2.34	0.260
4	15%	0.66	1.762	4.20	2.21	0.390
5	20%	0.66	1.762	4.20	2.08	0.520
6	25%	0.66	1.762	4.20	1.95	0.650

TABLE 5: Mix design For cyclinder

Sl no	Rubber granules%	Water	Cement	Coarse aggregate	Fine aggregate	Rubber granules
1	Normal cyclinder	1.053	2.772	5.70	4.478	
2	15%	1.053	2.772	5.70	3.806	0.672
3	20%	1.053	2.772	5.70	3.584	0.894
4	25%	1.053	2.772	5.70	3.358	1.12

COMPRESSION STRENGTH TEST

To determine the strength of concrete, this test is run on hardened concrete. The concrete specimens were subjected to a predetermined rate of loading while being compressed uniaxially to a load per unit area of cross section. Concrete's compressive strength is measured in N/mm2. This test was run on standard cubes that were 0.2032m x 0.127m x 0.0635m in size. A concrete mixture in various ratios was made and poured into a cube mould. The original configuration was then left for 24 hours. Six samples were created for each mix percentage, with three samples for testing over the course of seven and twenty-four days. The specimens were evaluated using a compression testing machine (CTM) following the end of the curing time. The CTM contained specimens that had been surface-dried.

Compressive strength =P/A

Here, P = load on the cube

A= cross-sectional area of cube

TABLE 6: Compressive strength after 14days

Sl no	Mix specimen	Load (KN)	Compressive strength
1	Normal cube	340	340
2	5%	345	345
3	10%	364	364
4	15%	400	400
5	20%	420	420
6	25%	412	412

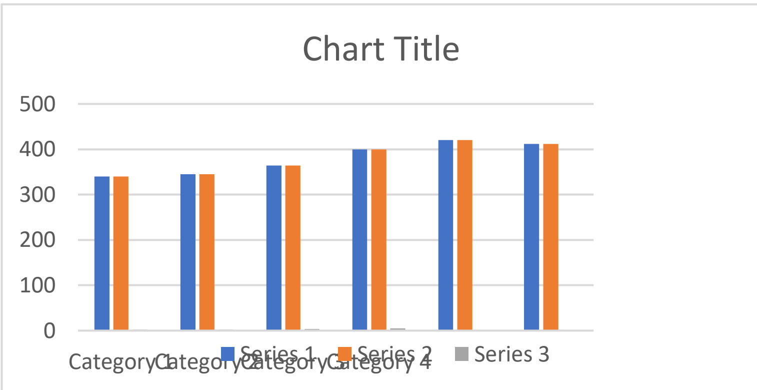
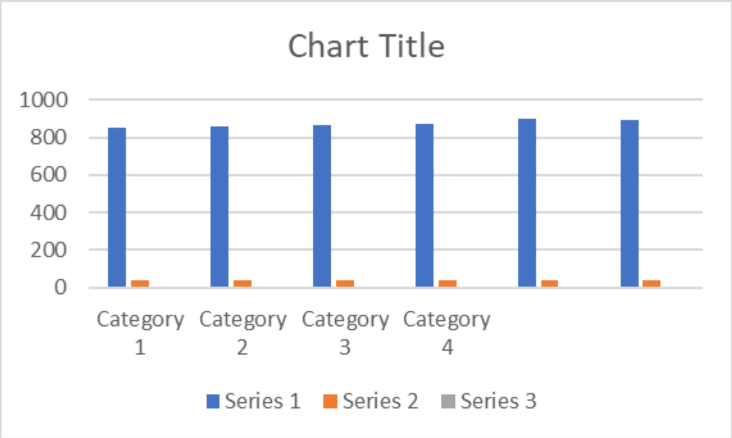


TABLE 7: compressive strength after 28 days

Sl no	Mix specimen	Load (KN)	Compressive strength
1	Normal cube	850	37.77

2	5%	855	38
3	10%	865	38.44
4	15%	873	38.8
5	20%	900	40
6	25%	895	39.77



SPILT TENSILE TEST

The cylindrical specimens of 150 mm diameter and 300 mm height are casting has been done and tested after 3 , 7 and 28 days of curing. The specimen is placed horizontally on the Universal Testing Machine and maximum load is applied on it.

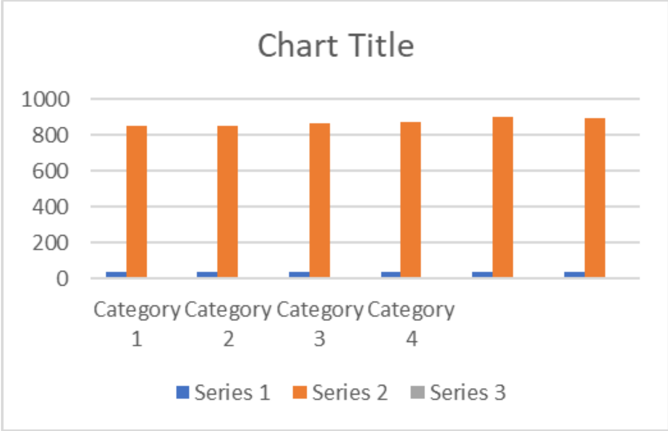


TABLE 8: Spilt tensile strength after 28 days

Sl no	Mix specimen	Spilt tensile strength Mpa
1	Normal cyclinder	150
2	15%	150
3	20%	180
4	25%	172

CONCLUSION

The objective of this study is to improve rubber concrete's material qualities. In order to make used rubber useful for building, a revolutionary concrete casting process was created. Instead of employing coarse particles, 100% chipped rubber was used to cast the concrete sample. After that, a specifically made mould was used to compress the new rubber concrete to lessen its volume. The research's conclusions are outlined as follows:

For the same replacement ratio of chipped rubber, all compressed rubber concrete specimens exhibit much higher elastic modulus and concrete strength than uncompressed rubber concrete specimens. Concrete strengths and elastic moduli are, respectively, 35% and 29% higher in compressed rubber concrete specimens with a 20% rubber replacement ratio than in NAC samples. Concrete specimens made of compressed rubber with a 30% rubber replacement ratio have properties similar to NAC specimens in terms of strength and elastic modulus. According to the study, compressed rubber concrete may be used in construction with a 30% rubber replacement ratio without sacrificing elasticity or compressive strength. For the same replacement ratio of chipped rubber, all uncompressed rubber concrete specimens exhibit higher peak strain, ultimate strain, and specific toughness than compressed rubber concrete specimens. When compared to NAC and uncompressed rubber concrete, compressed rubber concrete specimens had lower peak strain, ultimate strain, and specific toughness.

The precast concrete business can swiftly make precast rubber concrete items such as bricks and blocks, pavement blocks, wall panels, beams, slabs, and barriers owing to the technology. The cost of the things produced by this technology is comparable to traditional or existing concrete products, in addition to the fundamental advantages of supporting eco-friendly buildings and resource conservation. More crucially, it is feasible to keep the present infrastructure and manufacturing process in place with the addition of a second compression process during the last phase of production.
Compared to uncompressed rubber concrete, compressed rubber concrete has a denser microstructure and fewer pores. This denser structure is produced not just by regions with rubber particles but also by regions without rubber particles. Because of the densification of the microstructure of concrete, the material's strength and elastic modulus have increased.

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