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Utilization of Waste Rubber Tire as a Fine Aggregate in Road pavement

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ABSTRACT

The use of waste material like crumb rubber in road construction is being increasingly encouraged, so to reduce the environmental impact. The rubber tyre waste increasing rapidly due to rise in vehicles. Tyres from vehicles is made up of synthetic crumb rubber. Disposal of these rubber is a serious environmental problem. This waste rubber can be used to partially replaced the conventional material which is lead to improve the mechanical characteristics of road.

Concrete is a composite material consist of cement, water, fine aggregate and coarse aggregate. High strength concrete was prepared of w/c 0.55.

In this present study a comparison is carried out between the conventional concrete blocks and the advanced concrete blocks which is made-up of partially replacing fine aggregate with crumb rubber, i.e., 10% and 20% of unit weight of sand and analyse them.

KEYWORDS:Concrete block, crumb rubber, compressive strength, conventional & advanced concrete block.

1. INTRODUCTION

The rapid increase in the number of vehicles in last decades is accompanied by rapid growing amount of rubber tyre waste of 1.5 plus billion waste tyre that are generated every year worldwide, 6% are in India. India is the world third largest producer and fourth largest consumer of natural rubber. Within the country the automobile industries are the largest consumer, according to the report. business standard reported that India produces 6.5 lakh tyres per year.

Several studies on the effect of incorporation of shredded rubber tyre as aggregate on concrete performance have been reported in the literature. this research consists of analysis the effect of addition of rubber particles on physical and mechanical properties of concrete.

In order to produce new material which can satisfy some technical application and to help decision maker to make solutions for management for rubber waste. The use of shredded rubber may reduce the cost and help to preserve natural resources.

The aim of the present work is to study the possibility of crumb rubber in road pavement. The crumb rubber particles are used to partially replace fine aggregate in concrete. As partial substitution by unit weight of fine aggregate at a rate varying of 10% and 20% And compare between the conventional block and advanced block size of 150 mm x150 mm x 150 mm

cubic mould. The effect of adding crumb rubber as partially replaced fine aggregate is evaluated by laboratory test.

STRUCTURE OF PAPER

The paper is organized as follows: In Section 1, the introduction of the paper is provided along with the structure, important terms, objectives and overall description. In Section 2 we discuss methods and test performed. In Section 3 we have shows the project results ccording to objectives. Section 4 concludes the paper with references.

OBJECTIVES

1. Comparable study of workability of conventional (Standard) & crumbed rubber design concrete.
2. To find the correct proportion to use of crumbed rubber in design concrete block to achieve maximum compressive strength.
3. To compare the compressive strength of designed block to conventional (Standard). concrete block.
4. For making the conventional or designed concrete block cost effective and light weight as compared to conventional.

2. METHODS AND TEST PERFORMED

Methodology and Test performed:

1) Fineness test on cement (IS: 269-1989 and IS: 4031-1988)

1. Weight accurately 100 gm of cement and place it on a standard 90-micron sieve.
2. Breakdown any air set lumps in the cement sample with fingers.
3. Continuously sieve the sample giving circular and vertical motions for a period of 15-20 minutes. And if the percentage of residue of a given sample is less than 10% of taken sample is adequately fine as per IS: 269-1976.

Results:

- Fineness of cement = W2 /W1 X 100
  = 3 / 100 x 100
  = **3 %**

2) Soundness of cement (IS: 269-1989 and IS: 4031-1988)

1. Placed the lightly oiled mould on lightly oiled glass sheet and fill it with cement paste formed by gauging cement with 0.78 times the water required to give a paste of standard consistency.
2. The paste shall be gauged in the manner and under the condition proscribed in determination of consistency of standard cement paste, taking care to keep the edges of the mould gently together.
3. While this operation is being performed cover the mould with another piece of glass sheet, place a small weight on this covering glass sheet and immediately submerge the whole assembly in water at a temperature of 27 degrees Celsius and keep there for 24 hours.
4. Measure the distance separating the indicator points.
5. Submerge the mould again in water at a temperature prescribe above.
6. the water to boiling, with the mould kept submerged for 25-30 minutes and kept it boiling for 3 hours.
7. Remove the mould from the water allows it to cool and measure the distance between the indicator points.
8. The difference between these two measurements represents the expansion of the cement.
9. For good quality cement this expansion should not be more than 10 mm.

Results:

Expansion of cement paste after 24 hours found to **7.5 mm.**

3) Workability by slump cone: - (BIS req. IS:2386 (part 2)-1963 req.)

1. Mix the dry get a uniform constituent thoroughly to Colour and then add water.
2. The internal surface of mould is to be thoroughly cleaned and placed on a smooth horizontal, rigid and non- absorbent surface.
3. Placed the mix concrete in the cleaned. Sump cone in 4 layers catch approx. 1/4 in height of the mould Tamp each layer 25 times. with tamping rod.
4. Remove the cone immediately, rising it slowly and carefully in the vertical direction.

5. AS soon as the. Concrete settlement Comes to a stop, measure the subsistence of the Concrete in cm, which gives the Slump value.

Results:

Type of concrete	Workability (mm)
Conventional concrete	30
10 % partial replacement	80
20 % partial replacement	110

4) Fineness modulus of fine aggregate: -

1. Take a 1kg sand from sample by quartering in the plane dryer plate.
2. Arrange the sieve in order 4.75, 2.36, 1.18(600, 300,150 micron) pan
3. Fixing them in sieve shaking machine with the pan at the bottom and coves at the top.
4. Keep the sand in the top sieve, carry-out the sieving in the set of sieves and arranged before not less than 10 min.
5. Find the weight retained in each sieve.

Fineness modulus of Coarse aggregate = Sum (cumulative % retained) /100

Results:

Standard readings	Sample Readings (Mean of 3)
2.2 - 2.6	2.4

6) Standard consistency of cement paste (IS: 269-1989 and IS: 4031-1988)

1. Prepare a paste of weighed quantity of cement (300 gm) with the weight of quantity of portable water, started with 26% water of 300 gm of cement.
2. Take care that the time of gauging is not less than 3 minutes, not more than 5 minutes and the gauging shall be completed before setting occurs.
3. The gauging time shall be counted from the time of adding the water to the dry cement until commencing to fill the mould.
4. Fill the vacant mould with this paste the mould resting upon a porous plate
5. After complete filling the mould, trim the surface of the paste, making it in level with the top of the mould. The mould may slightly be shaken to expel the air.
6. Place the test block with the mould together with the non- porous testing plate, under the rod bearing the plunger (10 mm dia.) lower the plunger gently to touch the surface of the test block and quickly release, allowing it to penetrate into the paste.
7. This operation shall be carried-out immediately after filling the mould.
8. Prepare trial paste with varying percentage of water and test as described above until the amount of water necessary for making the standard consistency as defined above is obtained.
9. Express the amount of water as a percentage by weight of the dry cement.

Results:

- Normal consistency = Weight of water / weight of cement x 100

= 128 / 400 x 100

= 32 %

7) Abrasion test (IS: 2386- part 4- 1963)

1. Take the sample of 10-20 mm sized aggregate, placed it in Loss Angeles abrasion machine and rotate it for 30-33 rpm up to 500 revolutions.
2. Removed the sample from the machine and placed it on 1.70mm sieve.
3. Placed the sample in an oven to dry.
4. The percentage oss or the difference between the original mass and final mass is calculated.
5. L.A abrasion oss value of 40 indicates that 40% of the original sample mass passed through the sieves.

8) Aggregate Impact test

1. IS: 2386 (Part IV) - 1963,

Apparatus - The apparatus shall consist of the following: a) An impact testing machine of the general form and complying with the following:

2. Total weight not more than 60 kg nor less than 45 kg.
3. The machine shall have a metal base weighing between 22 and 30 kg with a plane lower surface of

not less than 30 cm diameter, and shall be supported on a level and plane concrete or stone block or floor at least 45 cm thick.

4. A cylindrical steel cup of internal dimensions: Diameter 102 mm Depth 50 mm and not less than 6.3 mm thick with its inner surface casehardened, that can be rigidly fastened at the centre of the base and easily removed for emptying.
5. A metal tup or hammer weighing 13.5 to 14.0 kg, the lower end of which shall be cylindrical in shape, 100.0 mm in diameter and 5 cm long, with a 2-mm chamfer at the lower edge, and case-hardened. The hammer shall slide freely between vertical guides so arranged that the lower (cylindrical) part of the hammer is above and concentric with the cup.
6. Means for raising the hammer and allowing it to fall freely between the vertical guides from a height of 38OA5.0 mm on to the test sample in the cup, and means for adjusting the height of fall within 5 mm.
7. Means for supporting the hammer whilst fastening or removing the. cup.

Results:

Test	Results	Limit state as per IS 383: 2016	
		For wearing surface	Other than wearing surface
Impact value (%)	12.0	30 % max	45 % max
Loss Angeles Abrasion value (%)	14.0	30 % max	50 max

9) Compression Test on Concrete Block:

1. According to design mix of M20, the required volume of materials by weight batching should be added to concrete mixer for uniform mixing of concrete.

2. After the concrete complete ready, fill up the mould (15 cm x15 cm x15 cm) by oiling the mould internally.

3. Each layer must be compacted fully either by using a tamping rod or by using vibration techniques. If concrete is compacted by hand tamping, in 150 mm mould, then 35 strokes are given per layer uniformly covering the entire surface especially the corners. If 100mm mould is used then each concrete layer must be hand tamped giving 25 strokes.

4. To avoid entrapment of air in corners and the sides it is recommended to tamp the sides of the moulds either by using the tamping rod or by using a wooden mallet. Concrete in cube moulds can also be compacted using vibrations techniques. Electric or pneumatic hammer or vibrating table should be generally used. Never try to compact cubes using a needle or poker vibrator.

5. This will harm the needle vibrator and also due to the vibrations the mould will tend to move about a good deal on the base plate and may cause leakage of the cement slurry or disorient the shape of the cube.

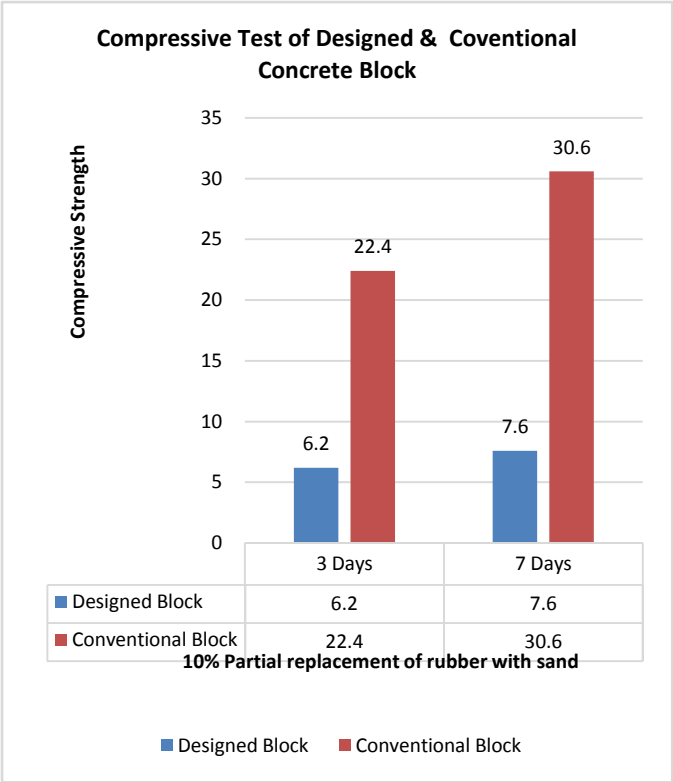
6. After that mark the cube with its specification and day of moulding and keep it for 24 hours in the mould. Place it for curing for defined period.

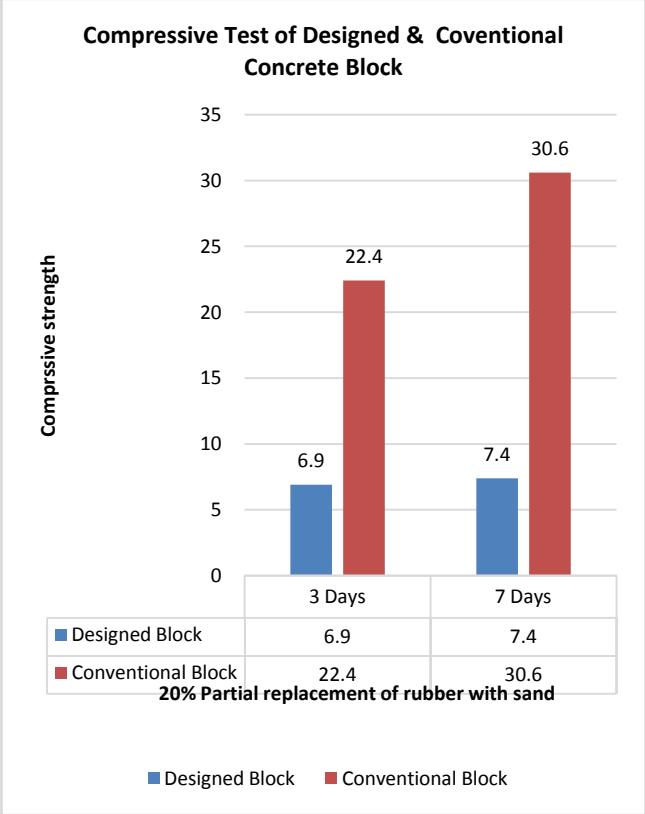
7. After curing place, the cube in Compressive Testing Machine with all precautionary measures. Note the results.

Method: -

1. Collection of crumb rubber as per designed mix requirements (M20). Perform the lab test on material and concrete which gives the idea about fineness of aggregate, soundness of cement, setting time, etc.
2. Find out the mix design ratio in which rubber is partially substitute the fine aggregate with reference to IS 10262.
3. After that make the concrete block (which is 150mm x 150mm x150mm in dimension) with 10% and 20% partially replaced sand with crumb rubber by unit weight of sand (weight batching).
4. Fill a set of three moulds with individually varying percentage of 10 % and 20 % mixes. Let it cure for 3 days and 7 days respectively.
5. After that compare the properties like compressive strength test of designed concrete blocks with conventional concrete blocks by lab testing under lab engineer.

3. RESULTS:





4. CONCLUSION

1. Workability of crumbed rubber design as compared to conventional (Standard) concrete at 10% & 20% found less workable.

2. 10% partial replacement is the correct proportion to use of crumbed rubber in design concrete block to achieve good compressive strength as compared to 20% partial replacement.

3. The compressive strength of designed block to conventional (Standard). concrete block found less.

4. If casting done on large scale the designed concrete block will be cost effective and light weight as compared to conventional.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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