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A Study of Rubber as A Construction Material

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ABSTRACT

Concrete is one of the most widely used construction materials. Cement, sand and aggregate, which are the most important constituents used in concrete production, are then vital materials needed for the construction industry. This inevitably led to a continuous and increasing demand of natural materials used for their production. The need for the utilization of the natural resources emerges a growing concern for protecting the environment and a need to preserve natural resources (such as aggregate) by using alternative materials which are recycled or waste materials. Disposal of rubber has before a major environmental issue. Every year millions of tones of rubber discharge and it cause a serious threat to ecology. Most of the rubber waste discharge to landfill or garbage without any treatment. The increasing annual production of rubber is one of the major sources of environmental pollution. This study focuses on the effective utilization of these wastes in cement concrete which leads to an overall sustainable development in the field of concrete. The specimens were cast with percentage replacements of the fine aggregate by 5, 10, 15, 20 and 25% of rubber as coarse aggregate. The experiments were carried out to determine Compressive strength of waste tyre crumb rubber concrete cubes on 7 and 28 days and The results of using waste tyre rubber aggregates in concrete as compared to normal concrete are analysed.

I. INTRODUCTION

The major significance of the research work is to ascertain the replacement of natural stone aggregate, sand etc. because they are depleting very fast with the increase in construction activities. At present environment quantity of tyres are already stockpiled or land filled. Tyre land filling is responsible for Serious ecological threats such as reduction of biodiversity.

Out of 1.2 billion waste tyre rubber produced globally per year. It's estimated that 11% of post consumer tyre are exported and 27% are send to land fill, stockpiled or dumped illegally and only 4% is used for civil engineering projects.

Hence, efforts have been taken to identify the potential application of waste tyre in civil engineering. We have tried to find the optimum percentage of waste rubber which can be added in concrete considering economy factors and improve properties like compressive strength and workability. Some of the current uses for used tyres in India include tyre rethreading applications, tyre derived fuel for making bricks, making belts for running shafts and making gaskets. This consumes only a fraction of the total tyres discarded every year. The previous common practice of use as fuel is now prohibited by the Indian Government as it causes serious environmental degradation.

The major significance of this research work is to ascertain the replacement of the natural stone aggregate as good quality conventional natural resources like sand, gravel, aggregates etc are depleting very fast with the increase in construction activities in the country and a ban on new quarries are inevitable due to environmental problem. As such, there is a growing search for alternative materials.

Keeping in view of the aforesaid reason, a comprehensive experimental investigation was carried out to study the properties of fresh rubberized concrete which in turn provide a useful guideline for its use. With the development of modern society's aftermath of Industrial revolution, the mobility within automobile sector got Momentum.

II. LITERATURE REVIEW

Pravesh Shukla[1] It was studied nominal mix and rubberized concrete mix has prepared. Dimensions of 150*150*150mm moulds were used to prepare cubes for compressive strength tests and 150mm diameter and 300mm length cylindrical specimens were used for split tensile strength tests. Compressive, split tensile strength was measured in concrete specimens with 10%, 15% substitution of natural aggregate by junk tyre rubber shreds. The cube specimens were tested for compressive strength at the end of 3,7,14 & 28 days. The compressive strength is increased with decreased percentage of scrap tyre rubber Compressive strength of 40.89N/mm2, split tensile strength of 2.83N/mm2, and flexural strength of 6.33N/mm2 at 28days is achieved for M30.It is clearly seen that the 20% cost of cement can be save with better strength than control concrete.

Umang Patel[3] It was studied M30 mix. Different partial replacements of crumb rubber (0, 5, 10, 15 and 20%) by volume of fine aggregate are cast and test for compressive strength, but slump values increase as the crumb rubber content increase from 0% to 20%. Meaning that crumb rubber mixture is more workable compare to normal concrete and also it is useful in making light weight concrete. A total of fifteen main mixtures were cast as solid bricks with 0% replacement as control then followed by 5%, 7.5%, 10%, 12.5%, 15%, 17.5%, 20% separately for both shred and crumb rubber materials. The results of the compressive test show that by replacing the aggregate by 2.5 % shredded tyre, the compressive strength increased by about 8.5% but at 5% replacement and beyond, the compressive strength decreased. For the Crumb tyre aggregates, the compressive strength decreased generally as the percentage replacement increase.

Sanjay Kumar[4] It was studied From the results of the compressive strength test, for water-cement ratios of 0.4, 0.45 and 0.5, the compressive strength showed a decreasing trend when the percentage of crumb rubber is increased. When the water–cement ratio is 0.4, the strength above 30 N/mm2 has been obtained up to 12.5 % of crumb rubber replacement and up to 7.5 % replacement when the water–cement ratio was 0.45 and 5 % replacement when the water–cement ratio is and 5 % replacement when the water-cement ratio is 0.5. The compressive strength showed a decrease up to 50 % in all the three water–cement ratios when the percentage of crumb rubber reached 20 % of fine aggregates.

III. SCOPE AND OBJECTIVE

- Large quantity of rubber can be utilized in concrete. By doing this we can reduce the cost of concrete and also we got utilize big amount of waste rubber.
- We will design M25 grade concrete and will carry out test for compressive strength, workability and flexure for the specimens of M25 grade concrete.
- The replacement of coarse aggregate and fine aggregate by different optimum percentage.
- Mix design of concrete M25 grade then perform sieve analysis after then prepare a specimen of size 150x150x150 mm.
- Find out compressive strength of concrete.

- Replacement of coarse aggregate by rubber to various percentages and then carried out compressive strength test on it.
- Find out the optimum percentage of rubber add in concrete.

IV. MATERIAL USED

Cement Ordinary Portland cement of 53 grade is been used. Conplast super plasticizer is added by 1% of cement weight. Specific gravity of cement is 3.15.

Sand passing through 4.75mm IS sieve is being used. Specific gravity of sand is 2.64.

Aggregate of size 15-20mm is used. Specific gravity of aggregate is 2.84.

Rubber aggregate Rubber of discarded tyre is used. Size of rubber aggregate is 12-16mm.

Here, Fig. 1 Shows that Rubber aggregate was having 12-16mm size.

Figure 1: Rubber aggregate

V. AGGREGATE WATER ABSORPTION TEST

First, we dried the samples in oven for 24 hours at 105° C. after that, we put four samples each of same mass samples in the water for 48 hours and weights all the samples before and after putting in water.

Calculation:

W1 = weight of aggregate and basket in water = 2000g
W2 = weight of basket in water = 900g
W3 = weight of saturated dry aggregate = 1740g
W4 = weight of oven dried in air = 1710g

Specific Gravity = dry weight of aggregate / weight of equal volume of water

= W3 / W3-(W1-W2)
= 1740g/1740g - (2000g - 900g)
= 2.64

Water absorption = percent by weight of water absorb in terms oven dried wt. of aggregate

= 1740g – (1710g / 1710g) × 100
= 1%

VI.METHODOLOGY

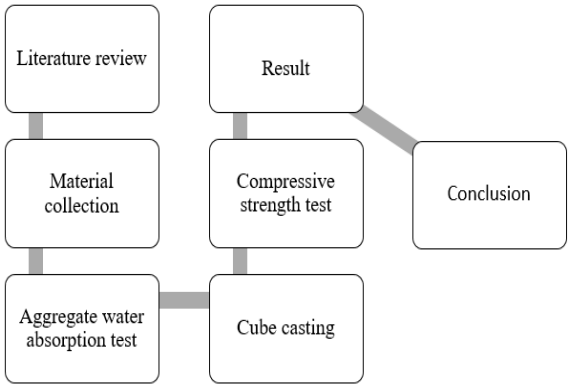

Figure 2: Methodology adopted

VII. MIX DESIGN PROPORTION

Mix Design was prepared based on IS: 10262-2007. After preparing mix design we got mix proportion as shown in table I.

TABLE I

CEMENT	SAND	COARSE AGGREGATE	WATER
1	2.1	3	0.42

1) First trial Concrete Mix proportions for Trial Mix 1:-

Cement = 378.74 kg/m³

Water = 162 kg/m³

Fine aggregates = 805.18 kg/m³

Coarse aggregate = 1136.56 kg/m³

W/c ratio = 0.43

VIII. RESULT ANALYSIS

Compressive strength: We casted the 6 cubes of 150*150*150mm, using aggregates and nominal mix of M25 and tested them at 7 days and 28days simultaneously without curing. Testing results are given in a below result table.

TABLE III

DAY	CUBES NO.	STRENGTH (N/MM²)	DATE
7	1	19.2	27/9/2017
	2	19.5	
	3	18.8	
28	1	26.2	18/10/2017
	2	27.8	
	3	27.2	

We casted the 12 cubes of 150*150*150mm, using aggregates and rubber mix of M25 and tested them at 7 days and 28days simultaneously curing. Testing results are given in a below result table.

TABLE IIIII

% OF RUBBER	DAY	NO. OF CUBE	STRENGTH	AVG. (N/MM²
REPLACE-MENT		S	(N/MM²)	)
5%	7	1	17.2	18.2
		2	18.2	
		3	19.2	
	28	1	28.2	28.7
		2	29.1	
		3	28.8	
10%	7	1	17.8	19.03
		2	19.2	
		3	20.1	
	28	1	27.8	28.96
		2	29.2	
		3	29.9	

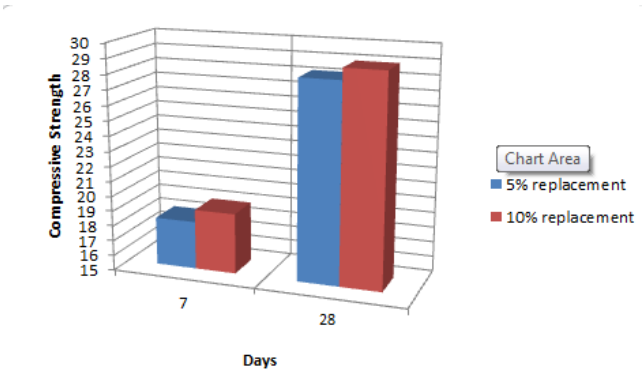

Figure 3: Compressive strength vs. days

Workability: we find workability of normal concrete 85mm and find workability of rubber concrete 80mm.

Figure 4: Slump test

X. CONCLUSION

- This experiment shows rubber concrete in increase compressive strength and also workability result improve.
- rubber could be used in applications that demand concrete, characteristics associated with rubberized concrete then disposal of used tire could be reduced to a large extend.

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