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ISSN: 2277-9655
[Mandal * *et al.*, 6(7): July, 2017] Impact Factor: 4.116
IC™ Value: 3.00 CODEN: IJESS7

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

STUDIES ON DURABILITY OF WASTE RUBBER MIXED CONCRETE

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DOI: 10.5281/zenodo.829807

ABSTRACT

Concrete is one of the most widely used construction material in the world. The construction industries are looking for making concrete more "greener" by reducing its ecological effects on environment and they are in need of finding cost effective materials for increasing the strength of concrete structures. Cement and aggregate, which are the 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. Parallel to the need for the utilization of the natural resources emerges a growing concern for protecting the environment and need to preserve natural resources (such as aggregate) by using alternative materials which are recycled or waste materials. In this project, a study was carried out on the use of recycled rubber tires as a partial replacement for fine aggregates in concrete construction using locally available waste tires. The work was carried out by conducting tests on the raw materials to determine their properties and suitability for the experiment. Concrete mix designs are prepare using IS method for M20 grade of concrete. The specimens were cast with percentage replacements of the fine aggregate by 5,10,15 and 20% of rubber as fine aggregate. Workability, compressive strength, heat and durability against acid is testedThe main findings of this investigation revealed that the rubber materials could be used successfully as an addition to concrete composites. Due to exceptionally low density, recycled modified rubber concrete blocks or rubber mixture can be used in non-load bearing structures where lightweight materials recommended.

KEYWORDS: concrete, crumb rubber, Rubber reinforced concrete, recycled material concrete.

I. INTRODUCTION

Currently, waste materials resulting from various physical and chemical process are the most important challenge in the industrial and developing countries. Extensive investigations on wastage recycling are being implemented to minimize the environmental damages. In this regard, construction investigators, like other recycling and production industries, have also achieved advanced in using these waste materials.

One of the non-recyclable materials enters the environment in automotive used tires. Investigations show that used tires are composed of materials which do not decompose under environment conditions and cause serious contaminations.

Impact of Rubber

Rubber pollution involves the accumulation of plastic products in the environment that adversely affects wildlife, wildlife habitat, or humans. The rapid growth of the use of rubber generates large quantities of effluents coming from its processing operations which is really a big problem because of its wastewater contains high BOD and ammonia.

High concentration of BOD, COD & SS

These characteristics vary from country to country due to difference in raw latex and applied technique in the process. The main source of the pollutants is the coagulation serum. These compounds are readily biodegradable and this will result in high oxygen consumption upon discharge of waste water in receiving surface water.

Acidic effluent

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Different extents of acid usage in the different factories attribute to PH variation of different effluent. The effluent comprises mainly of carbonaceous organic materials, nitrogen and sulfate.

High concentration of ammonia and nitrogen compounds
The high concentration of ammonia presents in the latex concentrate effluent posed another serious threat to the environment. Most of the factories in south eastern Asia discharge treated wastewater that contains high level of nitrogen & ammonia to nearby ocean leading to a water pollution problem.

It is estimated that 235 million tires are discharge annually in India and only 20%(48 million) and 305 million tires are discharge annually in the united states and only 35%(107 million) are currently being used or recycled. The remaining contribute to already alarming environmental wasteproblem. Based on examinations, another ay is used the tires in concrete. This results in the improvement of such mechanical and dynamical properties as energy absorption, ductility and resistance to cracking. The replacement of fine aggregate with rubber particles may significantly comprise the compressive strength characteristic of concrete, localizing stresses and bonding problems between the rubber particles and the cement matrix.

II. MATERIALS AND METHODS

Materials Used

a) Cements & aggregates

53 grade Ordinary Portland cement conforming to IS12269:1987 with specific gravity 3.15 was used. Riversand and the locally available blue granite crushed stoneaggregates of size 20mm were used as fine aggregatesand coarse aggregates respectively in the presentinvestigation. Their physical properties (Table 1) like specific gravity, bulk density, percentage of waterabsorption and fineness modulus were tested inconcurrence with IS: 2386:1963.

Type	Fine aggregate	Coarse aggregate
Specific gravity(SSD)	2.67	2.64
Fineness modulus	2.8	3.6
Water absorption (%)	0.5	1.21
Bulk density(SSD), kg/m^3	1628	1562

b) Water

Potable water was adopted as the liquid for mixing andcuring of specimens throughout the experimentation.

c) Crumb Rubber

the tire rubber used in the experiments was applied in the following two size grading and it was obtained from nearest rubber factory, Kolkata. Crumb rubber for the replacement of fine aggregate in concrete. The size of the crumb rubber used is 20 meshes.

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Experimental Programmed

In order to prepare the recycled crumb rubber concrete specimens, fine aggregates were replaced by waste material of crumb rubber in several percentages (0%, 5%, 10%, 15%, and 20%) in separate concrete mixes. The sand used was cleaned from all inorganic impurities and passed through 2.36 mm

Sieve and retained on 150 microns. For each mix, cubes of 150 x 150 x 150 mm were prepared. All specimens were fabricated and then cured in 28 days in accordance with Indian standard 10262-2009

Mix Ingredients

The proportion of mix ingredients for $1m^3$ of concrete are tabulated below.

Table: proportions of Mix Ingredients (for $1m^3$ of concrete)

Crumb rubber Replacement (%)	Cement (kg)	Crumb Rubber (kg)	Fine aggregate (kg)	Coarse aggregate (kg)
0	2.724	0	4.148	8.838
5	2.724	0.205	3.950	8.838
10	2.724	0.411	3.741	8.838
15	2.724	0.631	3.505	8.838
20	2.724	0.848	3.227	8.838

Test for Mechanical Properties

Slump test

Slump test is determining the workability of fresh concrete. Slump test as per IS:1199 is followed. The apparatus used for doing slump test are slump cone and tamping rod.

Compressive Strength

Compressive Strength test was performed in a universal testing machine of 2000 KN capacity at the age of 7 and 28 days respectively as per IS:516-1959 [9] and IS: 5816-1999 [10].

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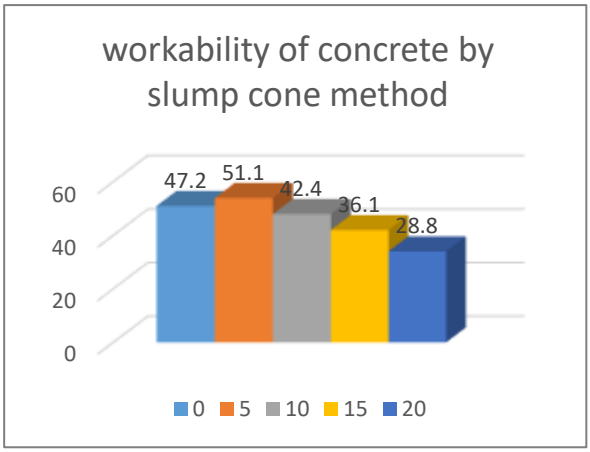
III. RESULTS & DISCUSSION

Slump test



Compressive Strength Test

Table: Results of M20 Grade Concrete Average Compressive Strength

Cube Notation (%)	Compressive strength (N/mm^2)	Compressive strength (N/mm^2)
	7 Days	28 Days
0	26.83	35.20
5	18.92	27.60
10	14.59	23.28
15	12.25	21.26
20	9.27	16.86

Heat Test

Compressive test after heating the specimen after 28days + 48 hours at 110^0 of control concrete and 5%, 10%, 15% and 20% rubber concrete found to be 33.15% N/mm^2,26.61 N/mm^2,19.87 N/mm^2,14.21 N/mm^2,11.88 N/mm^2 respectively.

Table: Results of M20 Grade Concrete Average Compressive Strength

Cube Notation (%)	Compressive strength (N/mm^2)
	28 days + 48 hours heat
0	33.15
5	26.61
10	19.87
15	14.21
20	11.88

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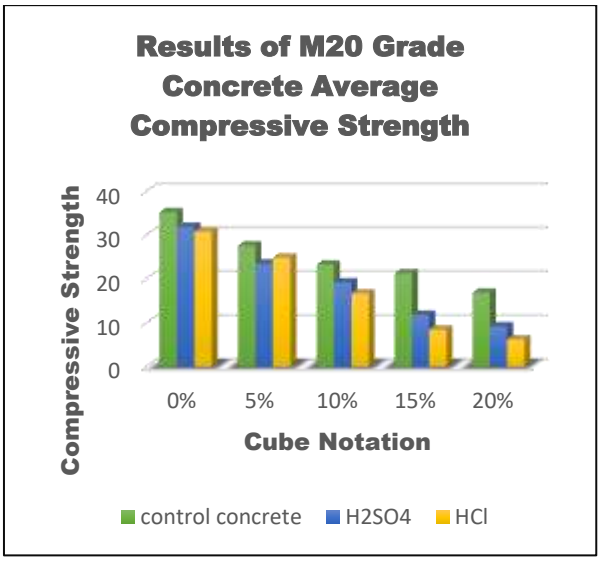
Durability in acid

Compressive Strength after submerged the specimen in 10-liter water + 100 ml acid (H_2SO_4, HCL)of control concrete and replacement of 5%,10%,15% and 20% rubber concrete found to at below table.

Table: Result of M20 Grade Concrete Average Compressive Strength		
Cube Notation (%)	Compressive Strength N/mm^2	
	28 days + 7days	
	H_2SO_4	**HCL**
0	31.84	30.76
5	23.48	24.88
10	19.21	16.67
15	11.84	8.47
20	9.17	6.23



A gradual reduction of compressive strength can be observed. This was cause by the increased porosity or weakness points in the concrete mix. Due to a lack of bonding between rubber particles and the cement paste applied tresses are not uniformly distributed in the paste. As cement paste containing rubber particles surrounding the aggregates is much softer than hardened cement paste. Without rubber particles during loading and causing rupture in the concrete. Effect of acid in the concrete mixture causes rupture very much with the increased of percentage of rubber it decreased the compressive strength very rapidly. Particularly the effect of HCL is very much high with respect to H2SO4. Because chemical reaction of HCL is greater than H2SO4.
Acid reduce the compressive strength 9% to 60% respectively.

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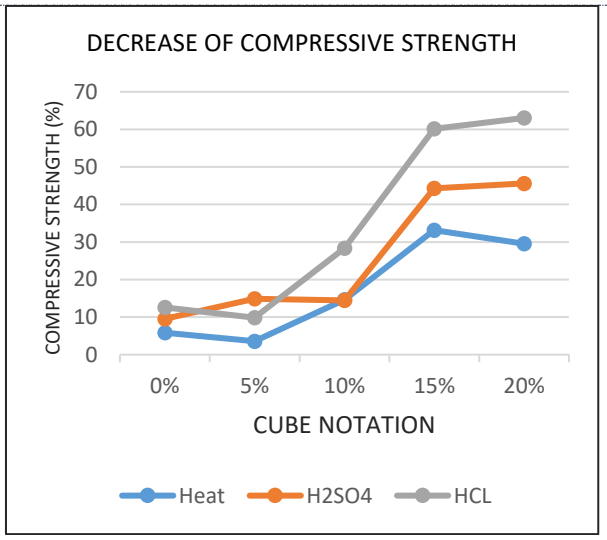

IV. CONCLUSION

1. The use of rubber particles in concrete mixtures has not only paved way for its safe disposal method, but also it has enhanced the mechanical properties of concrete.
2. The compressive strength of M20 grade rubber concrete prepared from damage rubber tire to form an eco-friendly concrete.
3. Compressive strength decreases when the percentage of replacement of crumb rubber increases.
4. 5% replacement of crumb rubber proves exceptionally well in compression strength and follow the curvature of the conventional specimens all the tests in M20 grade of concrete.
5. Effect of heat decreases, the compressive strength of the concrete by 5% to 29%.
6. Effect of acid (H_2SO_4 and HCL) to the compressive strength of concrete is very high. It decreased the value of compressive strength very rapidly. Particularly the effect of HCl is greater than H_2SO_4 Effect of acid decreases, the compressive strength 9% to 63%.
7. It decreases the dead load.
8. Can be used in structure where load is not major criteria.

V. ACKNOWLWEGMENTS & REFERENCES

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CITE AN ARTICLE

Mandal, Aritra , Kushal Chakraborty, and Atanu Samanta. "STUDIES ON DURABILITY OF WASTE RUBBER MIXED CONCRETE." ***INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY*** **6.7 (2017): 635-41. Web. 15 July 2017.**