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AN EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF COARSE AGGREGATE BY WASTE RUBBER

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Abstract:

In recent days availability of natural resources are scarcely available and disposal of the used materials becomes a great challenge. As a result of industrialization and urbanization the usage of rubber tyre has increased drastically. The disposal of such used rubbers creates lot of environmental issues. The aim of this study is achieved to use of rubber waste as partialreplacement of coarse aggregate to produce rubberize concrete in M20 mix. The strength of concrete with partial replacement of waste tyre rubber chips at various percentages had been investigated. Compression and split tensile tests were carried out for three different percentages of rubber chips say, 10%, 20%, 30% and 40% at 7 days and 28 days curing period.

INTRODUCTION

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. In its simplest form, concrete is a mixture of paste and aggregates. The paste, composed of Portland cement and water, coats the surface of the fine and coarse aggregates. Through a chemical reaction called hydration, the paste hardens and gains strength to form the rock-like mass known as concrete. Concrete is the world's most important construction material. The quality and performance of concrete plays a key role for most of the infrastructures including commercial, industrial, residential and military structures, dams, power plants and transportation systems.

The use of recycled rubber as partial aggregate in concrete has great potential to positively affect the properties of concrete in a wide spectrum. Concrete is one of the most popular construction materials. Due to this fact, the construction industry is always trying to increase its uses and applications and improving its properties, while reducing cost. In general, concrete has low tensile strength, low ductility, and low energy absorption. Concrete also tends to shrink and crack during the hardening and curing process. These limitations are constantly being tested with hopes of improvement by the introduction of new admixtures and aggregates used in the mix. One such method may be the introduction of rubber to the concrete mix. It is a perfect way to modify the properties of concrete and recycle rubber tires flaps at the same time.

Rubberised Concrete

About one crore 10 lakhs all type flaps of new vehicles are added each year to the Indian roads. Theincrease of about three crores discarded tire flaps each year pose a potential threat to the environment.

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Largequantities of scrap tires flaps are generated each year globally. This is dangerous not only due to potentialenvironmental threat, but also from fire hazards and provide breeding grounds for rats, mice, vermin‟s andmosquitoes, Over the years, disposal of tire flaps has become one of the serious problems in environments.Land filling is becoming unacceptable because of the rapid depletion of available sites for waste disposal. Inorder to prevent the environmental problem from growing, recycling tire is an innovative idea or way in thiscase. Recycling tire is the processes of recycling vehicles tires that are no longer suitable for use on vehiclesdue to wear or irreparable damage.

So, the research has already been conducted on the use of waste tyre flap asaggregate replacement in concrete showing that a concrete with enhanced toughness and sound insulationproperties can be achieved It has been reported that the addition of rubber to structural high strength concreteslabs improved fire resistance, reducing the spalling damage concluded in their research that rubberizedconcrete can successfully be used in secondary structural components such as culverts, crash barriers,sidewalks, running tracks, sound absorbers, etc. However, most of the developing third world countries have yetto raise their awareness regarding recycling of waste materials and have not developed effective legislation withrespect to the local reuse of waste materials. Building on previous research carried out internationally, this studymay provide the echnical information necessary to improve local awareness of the reuse of flap rubber as asubstitute for natural aggregates in the production of concrete. The proposed work presents an experimentalstudy of effect of use of solid waste material in concrete by volume variation of rubber. One of the objectives ofthis paper is to make these data regarding the basic properties of modified concrete using flap rubber in theconcrete mix available to aid in the development of preliminary guidelines for the use of flap rubber in concrete.

EXPERIMENTAL WORK

Materials Cement:

Cement graded confirming to IS 1489 (Part 1): 1991. In this experimental analysis 53 grade of Portland Pozzolana Cement (PPC) is used for all Mixes.

Fine aggregate:

As per IS 383:1970 zone III, the fine aggregate had been collected. Specific gravity for the sample is 2.61.

Coarse aggregate:

As per IS 383:1970 the nominal size of coarse aggregate used for pavers is 10-12 mm size. Specific gravity for the sample is 2.71.

Rubber chips:

The scrap tyre are collected and cut into small pieces. The rubber chips are sieved through 12 mm and retained in 10 mm for the replacement of coarse aggregate as shown in Fig. 1.

Casting of control specimen:

Cubes specimens of size 150 X 150 X 150 mm and cylinder specimens of diameter 150 mm & height 300 mm (as per IS 10086:1982) are used. Mix proportion for the control specimen was cast as per the ration given below.

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Casting of rubber concrete

The casting of rubber concrete contains waste tyre rubber chips of 10 mm with partial replacement of coarse aggregate at various percentages like10%, 20%, 30%&40%.

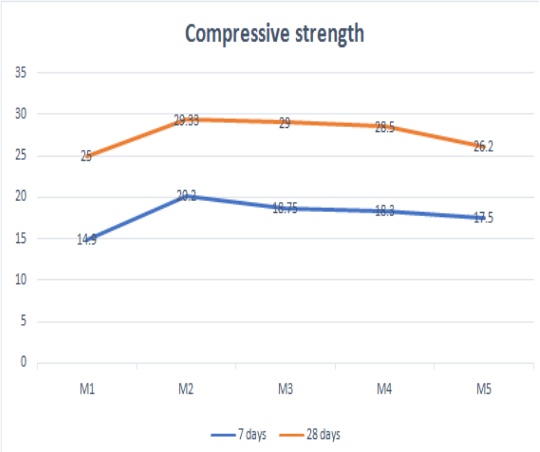
MIX NAMES	PROPORTIONS
M1	0% Rubber + 100% Coarse Aggregate
M2	10% Rubber + 90% Coarse Aggregate
M3	20% Rubber + 80% Coarse Aggregate
M4	30% Rubber + 70% Coarse Aggregate
M5	40% Rubber + 60% Coarse Aggregate

RESULTS AND DISCUSSIONS

Compressive strength test

The compressive test as shown in below figure., was carried out as per IS: 516-1959. The compressive load results of the control specimen and the rubber replaced concrete was calculated for 7 and 28 days.

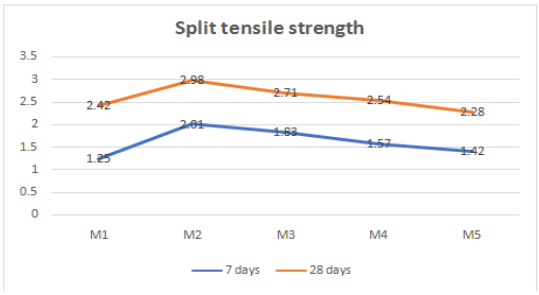
MIX NAMES	Compressive strength (MPa)	
	7 days	28 days
M1	14.9	25
M2	20.2	29.33
M3	18.75	29
M4	18.3	28.5
M5	17.5	26.2



Split tensile strength test:

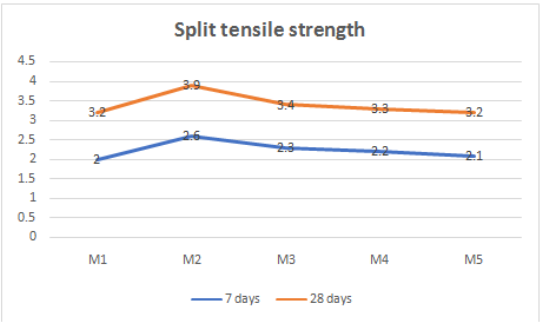
The test was carried out in CTM as shown in Fig. 4.2 as per IS: 5816-1999. The Split tensile strength had been calculated for 7days and 28 days for the control specimen as well as for therubber replaced concrete

MIX NAMES	Split tensile strength (MPa)	
	7 days	28 days
M1	1.25	2.42
M2	2.01	2.98
M3	1.83	2.71
M4	1.57	2.54
M5	1.42	2.28



Flexural strength test

MIX NAMES	Flexural strength (MPa)	
	7 days	28 days
M1	2	3.2
M2	2.6	3.9
M3	2.3	3.4
M4	2.2	3.3
M5	2.1	3.2



Conclusion:

- The use of rubber aggregates from recycled tires addresses many issues. These include; reduction of the environmental threats caused by waste tires, introduction of an alternative source to aggregates in concrete, enhancing of the weak

properties of concrete by the introduction of different ingredients other than the conventionally used natural aggregates and ultimately leading to the conservation of natural resources. In addition to meeting recycling and sustainability objectives, it aims is to produce products with enhanced properties in specific applications.

- The test results of this study indicate that there is great potential for the utilization of waste tyres in concrete mixes in several percentages, ranging from 10 to 40 percent.
- From this present study it has been concluded that maximum strength is obtained by 10% replacement of coarse aggregate even 40 percent of replacement of coarse aggregate give more strength than the nominal concrete.
- Concrete with higher percentage of flap rubber possess high toughness From the present experimental study, Rubberized concrete strength may be improved by improving the bond properties of rubber aggregates.
- A reduced compressive strength of concrete due to the inclusion of rubber aggregates limitsits use in some structural applications.

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