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Experimental Study on Rubberized Concrete

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ABSTRACT
Modifications of construction materials have an important bearing on the building sector. Several attempts have been therefore made in the building material industry to put to use waste material products, e.g., worn-out tyres, into useful and cost-effective items. Success in this regard will contribute to the reduction of waste material dumping problems by utilizing the waste materials as raw material for other products. The present proposal involves a comprehensive laboratory study for the newer application of this waste material in the preparation of fibrous concrete. The primary objective of investigation is to study the strength behavior i.e. compressive strength, impact resistance of rubberized concrete with rubber chips. Volume variation of rubber chips with replacement to course aggregate. The proposed work is aimed to study the effect of volume of rubber chips on the compressive strength.
Keywords— Rubber chips, rubberized concrete, compressive strength, light weight concrete.

I. INTRODUCTION:

About one crore 10 lakhs all types of new vehicles are added each year to the Indian roads. The increase of about three crores discarded tyres each year pose a potential threat to the environment. Hazardous materials can be classified as chemical, toxic or non-decaying material accumulating with time. The accumulation of rubber and plastic can be considered non-decaying materials that disturb the surrounding environment. However, a positive method for disposing of this non-decaying material, such as reuse in concrete mixes, would have a beneficial effect. One of the major environmental challenges facing municipalities around the world is the disposal of worn out automobile tyres. Most discarded tyres are buried in the landfills. Only fewer are used as fuel or as raw materials for the manufacture of rubber goods. Burying scrap tyres in landfills is both wasteful and costly. Disposal of whole tyres has been banned in the most landfills because they are bulky and tend to flow to the surface with time, so tyres are often shredded.

If tyres are reused as a construction material instead of being burnt, the unique properties of tyres can once again be exploited in a beneficial manner. In this context, the use of tyre chips in lightweight concrete is considered a potentially significant avenue. Thus, the use of scrap tyres in concrete manufacturing is a necessity than a desire. The use of scrap tyres in concrete is a concept applied extensively over the world. The use of scrap tyres rubber in normal strength concrete is a new dimension in concrete mix design and if applied on a large scale would revolutionize the construction industry, by economizing the construction cost and increasing the worn outtyre disposal. It is with this intension, an experimental study is proposed to be conducted by using crumb rubber as sand in cement concrete.

II. AIM & OBJECTIVE

Aim:- To determine the compressive strength of concrete when it is replaced with aggregate in various percentage i.e. 5%, 10% & 15%.

Objective :-

- To make proper use of waste rubber.
- To help environment from harmful gases which emits after burning of rubber.
- To reduce the cost of concrete and used in light weight traffic.

III. LITERATURE REVIEW

Sulagno Banerjee, Aritra Mandal, Dr.Jessy Robby:-The aim of their investigation was studies on mechanical properties of tyre rubber concrete. In their study they made a concrete of M25 grade by replacing 5%, 10%, 15%, 20% and 25% of tyre concrete with coarse aggregate and compared with regular M25 grade concrete. The properties of fresh concrete and flexural strength of hardened concrete were identified. So they concluded that flexural strength decreases in concrete. In 7 days' flexure strength, there is not much variation seen between conventional and rubberized concrete. So

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there was not much difference in strength of rubberized and conventional concrete.

Khatib and Bayomy (1999):- Investigated the workability of Rubberized concrete. They observed a decrease in slump with increased rubber aggregate content by total aggregate volume. Their results show that for rubber aggregate contents of 40% by total aggregate volume, the slump was close to zero and the concrete was not workable by hand. Such mixtures had to be compacted using a mechanical vibrator. Mixtures containing fine crumb rubber were, however, more workable than mixtures containing either coarse rubber aggregate or a combination of crumb rubber and tire chips.

Siddique and Naik (2004) and Senthil Kumaran et al (2008):- presented an overview of some of the research published regarding the use of scrap tires in the manufacture of concrete. Studies indicate that good workable concrete mixtures can be made with scrap-tire rubber.

Eldin and Senouci (1992):-Reported that, in general the Rubberized concrete batches showed acceptable performance in terms of ease of handling, placement and finishing. However, they found that increasing the size or percentage of rubber aggregate decreased the workability of the mix and subsequently caused a reduction in the slump values obtained. They also observed that the size of the rubber aggregate and its shape (mechanical grinding produces long angular particles) affected the measured slump. The slump values of mixes containing long, angular rubber aggregate were lower than those for mixes containing round rubber aggregate. Round rubber aggregate has a lower surface/volume ratio. Therefore less mortar will be needed to coat the aggregates, leaving more to provide workability. They suggested that the angular rubber aggregates form an interlocking structure resisting the normal flow of concrete under its own weight; hence these mixes show less fluidity. It is also possible that the presence of the steel wires protruding from the tire chips also contributed to the reduction in the workability of the mix.

Topcu (1995):-Included low volumes of rubber aggregate during the preparation of the concrete, while Rostami et al (1993) appeared to use larger volumes of rubber aggregate. Their results indicated that concrete densities were reduced to 87% and 77% of their original values, respectively, when the maximumamounts of rubber aggregate were used in the investigations.

Ali et al. (1993):-Reported that when rubber aggregate was added to the concrete, the air content increased considerably (up to 14%). 8) Fedroff et al (1996) and Khatib and Bayomy (1999) observed that the air content increased in Rubberized concrete mixtures with increasing amounts of rubber aggregate.The higher air content of Rubberized concrete mixtures may be due to the nonpolar nature of rubber aggregates and their ability to entrap air in their jagged surface texture. This increase in air voids content would certainly produce a reduction in concrete strength, as does the presence of air voids in plain concrete (Benazzouk et al 2007). Since rubber has a specific gravity of 1.14, it can be expected to sink rather than float in the fresh concrete mix. However, if air gets trapped in the jagged surface of the rubber aggregates, it could cause them to float (Nagdi 1993). This segregation of rubber aggregate particles has been observed in practice.

IV. MATERIAL PROPERTIES

1-Cement – Confirming to IS 8112-1989 OPC of grade 43 was used in this experiment. Cement is a binding material use in construction to bind other materials like coarse and fine aggregate.

2-Fine Aggregate- When the aggregate is pass through the 4.75mm sieve, it is called fine aggregate. Fine aggregate use as an inert material and also fill the voids of concrete and improve the workability.

3-Coarse Aggregate- The aggregate that retain on 4.75mm sieve, it is called coarse aggregate. It reduces shrinkage and occupies the 70-80% volume of concrete.

4- Crumb Rubber- Crumb rubber is recycle rubber, produce from automotive and truck scrap. Crumb rubber is often used in artificial turf as cushioning.

5-Water- Water is use as a lubricant, cleaning agent, sealant, heat transfer medium, as a solvent, and air pollution control medium.

PREPARATIO OF SPECIMENS:

Batching: All cement, sand, coarse aggregate and coconut shell measured with digital balance. Water is measuring cylinder of capacity 1 lit and measuring jar of capacity 100 ml and 200 ml..

Mixing of concrete: The ingredients are thoroughly mixed in concrete mixer. The sand, cement and aggregate are measured accurately.

Moulds:

Concrete mould sare cubes (150 mm x 150 mm x 150 mm), cleaned first and oiled for easy stripping. The moulds for conducting tests on fresh concrete were made ready and inner surface was oiled.

Placing and Compaction: To avoid the bond formation between moulds and concrete just clean and oil the moulds before pouring concrete. Place the fresh concrete and tamp each surface 25 time . Clean the mounds and apply grease. Fill the concrete in the moulds in 3 equal layer

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Demoulding:
After leveling the fresh concrete in the mould, it was allowed to set for 24 hours. The identification marks of concrete specimens were done with permanent markers and the specimens were removed from the mould. The moulds were cleaned and kept ready for next batch of concrete mix.

Curing:
Curing is an important process to prevent the concrete specimens from losing their moisture while they are gaining their required strength. Inadequate curing is also the cause of unexpected cracks on the surface of concrete specimen.

COMPRESSIVE TEST RESULT:

%Replaced by Rubber	Days	Cubes	0 %	5%	10%	15%
Compressive Strength (N/mm2)	7 Days	C1	21.87	20.42	19.34	17.43
		C2	21.60	19.76	19.92	17.78
		C3	21.35	20	19.50	17.55
		Avg	21.60	20.06	19.58	17.58

Table No.1 Result of compressive Strength of Rubberized concrete after 7 days (N/mm2)

% Replaced by Rubber	Days	Cubes	0%	5%	10%	15%
Compressive Strength (N/mm2	14 Days	C4	25.75	23.10	21.67	19.87
		C5	25.78	23.01	21.35	19.54
		C6	25.33	23.18	22	19.77
		Avg	25.62	23.09	22	19.72

Table No.2 Result of compressive Strength of Rubberized concrete after 14 days (N/mm2)

%Replaced by Rubber	Days	Cubes	0 %	5%	10%	15%
Compressive Strength (N/mm2)	28 Days	C7	31.60	27.56	24.34	22.68
		C8	31.55	27.98	24.45	22.45
		C9	31.40	28.40	24.37	21.77
		Avg	31.57	27.98	24.38	22.3

Table No.3 Result of compressive Strength of Rubberized concrete after 28 days (N/mm2)

%Replaced by Rubber	Days	Cubes	0 %	5%	10%	15%

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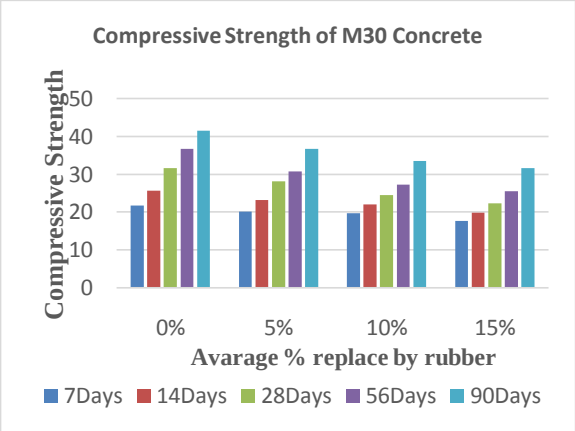
Compressive Strength (N/mm2)	56 Days	C7	36.74	30.78	27.55	24.88
		C8	36.70	29.98	27.12	25.86
		C9	36.60	31.39	27	25.75
		Avg	36.68	30.71	27.22	25.49

Table No.4Result of compressive Strengthof Rubberized concrete after 56 days (N/mm2)

%Replaced by Rubber	Days	Cubes	0 %	5%	10%	15%
Compressive Strength (N/mm2)	56 Days	C7	41.66	36.66	33.23	31.14
		C8	41.34	36.87	33.10	31.94
		C9	41.20	36.55	33.77	31.32
		Avg	41.4	36.69	33.36	31.47

Table No.5 Result of compressive Strength of Rubberized concrete after 90 days (N/mm2)



Graph No: 1 Compressive strength Vs Average % replacement of rubber to aggregate.

V. RESULT

By the study of different experiments following results are achieved.

1. Slump value is decreased as the percentage of scrap tyre rubber increased, so it decreases the workability of concrete.
2. The result obtained by the compressive strength test of concrete represent that the compressive strength decreases with the increasing percentage of rubber crumb in the concrete.
3. At 5% replacement of rubber chip to aggregate gives maximum strength as compare to 10% & 15%.
4. Due to replacement of the aggregates by rubber particles, the weight was reduced.

VI. CONCLUSION

- This research indicate that there is a great potential for utilization of waste tyres rubber in concrete mix in different percentages varying from 5% to 10%&15%.
- This experiment shows that 5% replacement of aggregate by rubber gives better result than 10% &15%.

- Rubber waste can be used with non-structural concrete such as light weight concrete or fill concrete.
- This research was done by preparing single graded rubber aggregate of size 20mm. The effect of different sizes should be study in future.

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