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A STUDY ON USAGE OF WASTE IN CONCRETE WITH PARTIAL REPLACEMENT OF COARSE AGGREGATE BY CHOPPED SCRAP TYRE AND FINE AGGREGATE BY CRUSHED CERAMIC TILE

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Abstract - *As, we are entering into the modern era of innovative construction techniques, we parallel experience most successful results and also heavy amounts of construction waste at the same time. Studies show that, tyres take up more landfill while the land is becoming more scarce. As, India accounts for 6 to 7 % of tyre waste globally, which ends up with unhealthy factors like sudden ignition, tyre fires which are difficult to extinguish and last for months generating toxic air and oils. Similarly, India produces 200 million tons ceramic every year leaving a massive 15-30% of waste. If, observed clearly it is durable, hard and highly resistant against several degradation forces. To manage such solid waste we need to come up with a clear idea of using them effectively in the process of construction. In an attempt to reduce scarcity of natural aggregates for making concrete, one of the most proper way is to replace the aggregates with the so called obtained solid waste.*

Hence, in this project concrete was prepared with natural aggregates including tyres and ceramic waste individually and jointly. So, that It would be more economical compared to the standard mix. This paper presents Chopped Scrap Tyre and Crushed Ceramic Tile which are used as a replacement to the coarse aggregates and fine aggregate. Chopped Scrap Tyre (5%, 7.5% & 10%) is partially replaced in place of coarse aggregates and Crushed Ceramic Tile (10%, 15% & 20%) is partially replaced in the place of fine aggregates. Design mix of M25 is adopted and tested . In this we have observed strength aspects like compressive, flexural, split tensile strength & flow properties.

Key Words*: *Chopped Scrap Tyre, Crushed Ceramic Tile, coarse aggregates replacement, fine aggregate replacement, Strength Characteristics.

1. INTRODUCTION

With the growing population and expansion of urban centres, the levels of construction industry have increased. So, there is a need to keep an eye on the utilization of waste. The wastes which are produced were dumped at nearby ponds, rivers and outskirts of our cities which are accumulating day by day. These wastes cannot be recycled easily like other materials. So, there is a necessity to recycle these Industrial wastes in specular manner by regulating the min the utilization of construction. In this manner, the economical view of the construction decreases and reduces the environmental pollution too. As India is on its way, from being a developing country to a developed country. In the last five fiscal years i.e. 2010 to 2015, the tyre industry in India has shown a growth of about 12%. According to economy of Nation and Industrialisation view this growth is very significant. But taking the environmental aspect into consideration; it was seen as a challenge and an emerging threat. About 15-30% of waste is produced from total 100 million tons of tile production in India. Ceramic products are part of the essential construction materials used in many buildings. Some common manufactured ceramics like wall tiles, floor tiles, sanitary ware, household ceramics and technical ceramics. They are mostly produced using natural materials that contain high amount of clay minerals. Concrete is a composite material which mainly contains water, aggregates, and cement. Concrete plays a vital role in construction of buildings, highways and other infrastructure. This leads to utilization of large quantity of concrete. As cost of concrete is attributed to the cost if its ingredients which is expensive, this leads to usage of economically alternative materials in its production. To manage such solid waste we need to come up with a clear idea of using them effectively in the process of construction. In an attempt to reduce scarcity of natural aggregates for making concrete, one of the most proper way is to replace the aggregates with the so called obtained solid waste. Concrete, which have been incorporated with Chopped Scrap Tyre & Crushed Ceramic Tile.

2. LITERATURE REVIEW

El-Gammal et al. (2010) The natural aggregates were replaced by tyre rubber aggregates and produced a resultant concrete mix on which further studies are continued. By making a clear observation, it is found that there was a rapid decrease in the percentage of compressive strength. Similarly, while performing the compressive strength test, the observations are, the specimen has taken a good amount of energy under the loads of compression. After attaining the failure point by the specimen, it was almost the same even though it failed under the ultimate load. So finally, we can draw the conclusion that the concrete has increased its ductility property.

Akinwonmi, Seckley et al. (2013) In this research study, both fine and coarse aggregates are replaced by shredded and crumb rubber respectively. After performing certain tests on the concrete blocks which were possessing shredded and crumb rubber separately, it was found that the concrete blocks in which the replacement was done by level of 2.5% by shredded tyre, the compressive strength was slightly increased. But the usage of crumb rubber have produced quiet negative results and not recommended after the research.

TOPÇU AND M. CANBAZ (2010) The totally produced tile waste can be used as a partial replacement in the concrete components. The usage of tile waste as the replacement was environment friendly as well as economical. Using the tile aggregates, hence the concrete reducing its self-weight by 4% by making the process of construction economical. Considering the aspects of strength, negative results were produced while considering the tile waste as partial replacement in the concrete. In this research it was studied that maximum replacements of tile waste were also further divided into different percentages which are small and can be usable in concrete with desired.

Hemanth Kumar Ch, Ananda Ramakrishna K, Sateesh Babu K, Guravaiah T, Naveen N, Jani Sk (2015) In this paper it is studied regarding the stability of concrete possessing tile waste. In this study, various cubes are casted with different mixes, coarse aggregate was partially replaced by waste crushed tile by 20% and fine aggregate was partially replaced by tile powder in both 10 and 20 percentages respectively. Waste materials are used as partial replacement of both fine and coarse aggregates. Workability and compressive strength for all 9 types of castings are taken for 7 and 28 days and found that, if tile powder is increased parallelly both strength and workability was also increased, just like Ready Mix Concrete (RMC).

3. MATERIAL AND PROPERTIES

3.1 Water

Water which is used for both Mixing and Curing of Concrete should be free from dirt particles and pollutants, As per the IS: 456-2000 specifications.

3.2 Cement

Ordinary Portland Cement is used in this experimental study, conforming to IS: 8112-1989.

3.3 Coarse Aggregate

Crushed aggregates which were of minimum size 20mm were used, they are collected from the local crushing plant. The aggregates which are exclusively passing through 40mm sieve size and retaining on 20mm sieve are selected. Some tests like fineness modulus, gradation, specific gravity are done to know the physical properties of aggregates in accordance with IS: 2386-1963. The individual aggregates were mixed to induce the required grading taken in combination.

3.4 Fine Aggregate

Natural river sand is used in the place of fine aggregate for the preparation of normal concrete in this research which is confirmed to grading zone-III as per IS: 383-1970 with specific gravity 2.62 and having fineness modulus as 2.54. The maximum size of FA can be considered as 4.75 mm. The sand is tested as per IS: 2386 –1963.

3.5 Crushed Ceramic Tile

Ceramic waste is collected from various constructing buildings in this study as shown in the fig-1. Surface treatment is done by distilled water & dried at open space. The waste tiles were crushed into small pieces manually using hammer. The Crushed Ceramic Tile which passes through 4.75mm sieve are used as a partial replacement to fine aggregate. Ceramic Crushed Tiles were partially replaced in place of fine aggregate by the percentages of 10%, 15% and20% respectively.

Figure-1

3.6 Chopped Scrap Tyre

The scrap tyres were taken from nearby automobile shops and were cut down into pieces using chisel and other cutting equipment. We have used 20mm and 16mm size pieces as both maximum and minimum sizes respectively as shown in Figure-1. The pieces are treated on the surface with soap water and rinsed with distilled water. Later, they are dried under the sun in open place and were rubbed with wire brush on their both sides in order to make them rough and bind easily. Chopped Scrap Tyre were partially replaced in place of coarse aggregate by the percentages of 5%, 7.5% and10% respectively.

Figure-2

4. DESIGN MIX

Mix design is used for the preparation of desired concrete by selecting suitable ingredients. The object of mix design is to make a concrete of certain minimum strength and durability as economically as possible. The mix proportion for M25 grade concrete is calculated by following the guidelines given in IS: 10262-2009.

Table -1: Mix Proportion & Quantity of Materials in concrete for M25 mix

CEMENT (Kg/m³)	F.A (Kg/m³)	C.A (Kg/m³)	WATER (Lit)
428.04	515.60	1194.30	188.34
1	1.34	2.91	0.45

Table -2: Percentage of Mix ratio proportion

S.NO	Concrete Mix	Mix Proportion
1	M0	M25
2	M1	M25+5% CST
3	M2	M25+7.5% CST
4	M3	M25+10% CST
5	N1	M25+7.5% CST+10% CCT
6	N2	M25+7.5% CST+15% CCT
7	N3	M25+7.5% CST+20% CCT

M0 = Conventional Concrete, CST = Chopped Scrap Tyre, CCT = Crushed Ceramic Tile

5. RESULTS AND DISCUSSIONS

The following are the test results of material properties and strength evaluated by replacement of coarse aggregate with Chopped Scrap Tyre and also with the replacement of fine aggregate with Crushed Ceramic Tile. We are discussing here the comparison of material properties and strengths how they varied.

Table -3: Tests on Hardened properties of Concrete

MIX	Compressive Strength (N/mm²)		Split-Tensile Strength (N/mm²)	Flexural Strength (N/mm²)
	7 days	28 days		
M0	20.47	31.08	2.84	4.9
M1	20.88	28.32	1.32	2.54
M2	23.96	28.89	2.86	3.81
M3	22.55	28.75	2.72	3.36
N1	23.74	30.24	2.21	3.68
N2	27.13	34.46	3.05	4.98
N3	25.58	31.89	2.75	4.54

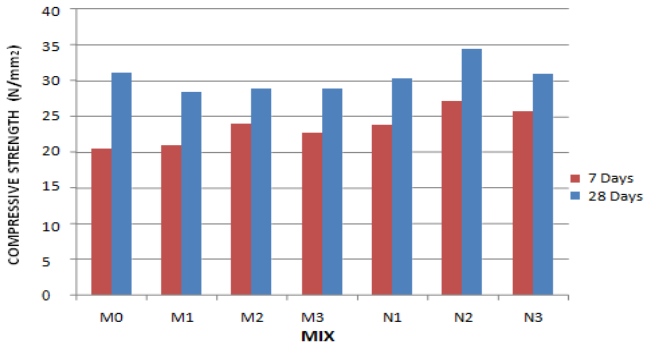

Chart -1: Comparisons of compressive strength (7 & 28days) at different % of CST & CCT

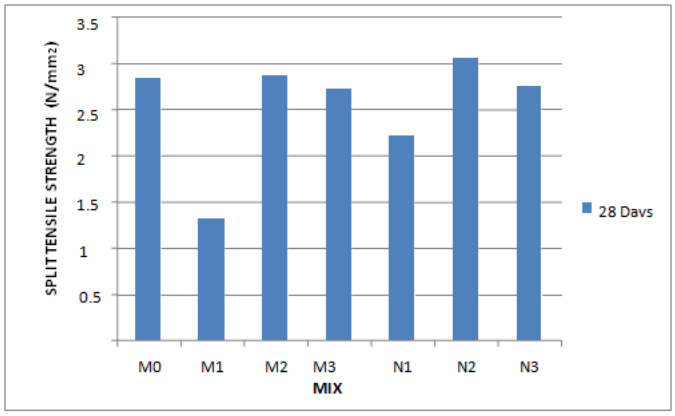

Chart -2: Shows variation of split tensile strength (28days) at different % of CST & CCT

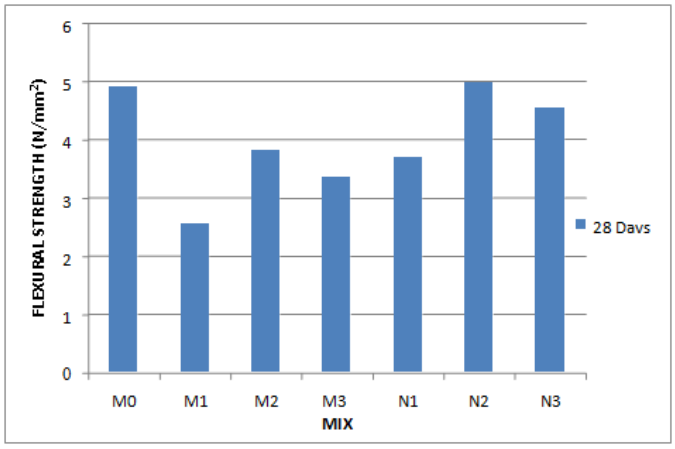

Chart -3: Shows variation of flexural strength (28days) at different % of CST CCT

6. CONCLUSIONS

1. The main objective of the study is to prepare a concrete which is quiet better in both stability and durability than the nominal mix of concrete by replacing the fine aggregates and course aggregates in various trails.

2. Based on the work, the coarse aggregate was replaced by Chopped Scrap Tyre in the percentages of 5%, 7.5% and 10% giving the M1, M2 & M3 mixes respectively.

3. After performing few tests like compressive strengths after both 7 and 28 days along with split tensile strength and flexural strength, it is found that the mix M2 has produced good results like 23.96 N/mm^2, 28.89 N/mm^2, 2.86 N/mm^2 and 3.81 N/mm^2 respectively according to the order of tests mentioned above. Hence the first phase of the project was completed.

4. As the mix M2 has produced desired results the same percentage of coarse aggregate was carried and adopted in the second phase too.

5. But in the second phase along with the replacement of 7.5% of coarse aggregate by CST, the fine aggregate was replaced by CCT in various percentages of 10%, 15% and 20% respectively giving the N1, N2 & N3 mixes respectively.

6. It was found that N2 mix (M25+7.5% CST+15%CCT) has produced better results as a 28 days of compressive strength is 34.46 N/mm^2, 28 days of split tensile strength is 3.05 $N/mm^2$and 28 days of flexural strength is 4.98 N/mm^2, which is better than the other mixes N1 &N3. Finally N2 mix (M25+7.5%CST+15%CCT) has produced better results.

7. As we exceed the percentages of replacing the coarse aggregate with Chopped scrap tyre by 7.5 % and the crushed ceramic tile with fine aggregate by 15 % the strength is observed to be decreasing.

8. So using the waste materials in the form of aggregates while preparing the concrete not only increases the strength but also reduces the cost and manages the left out solid waste.

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