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RUBCRETE: REPLACEMENT OF AGGREGATE BY WASTE TIRE RUBBER

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ABSTRACT

Waste tire are one of the most serious environmental problem, it causes dumping problem and also show various hazardous affect to the environment, it pollutes our surrounding due to its non bio-degradable nature. On the other hand Concrete aggregate require some replacement due to its excessive use in construction. As the construction industry grows it require more concrete which results excessive excavation of natural aggregate, which also affect our environment adversely, due to excessive use of natural aggregate we need a replacement for it and in this research paper we are looking for tire rubber as its alternative. In this we are replacing our concrete mix by shredded rubber and crump rubber, shredded rubber & crump rubber are being use to replace course aggregate and fine aggregate respectively.

I. INTRODUCTION

Concrete is a composite material, composed of coarse aggregate embedded in a hard matrix of cement 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 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 foremost of the infrastructures including commercial, industrial, residential and military structures, dams, power plants and transportation systems.

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. Shredded or crumbed rubber is waste being of non-biodegradable and poses severe fire, environmental and health risks.

II. OBJECTIVE

The objective of this study is to test the properties of concrete when shredded or crumbed rubber used as aggregate by partial replacement of natural aggregates. The parameters of this investigation include the compressive strength of concrete specimens. Cubes of 150 X 150 X 150mm size for compressive strength, cubes are casted for the testing of concrete. The concrete having compressive strength of 15N/mm2(M15), 20N/mm2 (M20) & 25N/mm2(M25) are being used and percentages of rubber aggregates are 0, 10, 25 and 50% of normal aggregates. We also tested the concrete for 100% replacement of normal aggregate. The strength performance of modified concrete specimens was compared with the conventional concrete.

Material

The basic material of concrete e.g. cement, sand, aggregate and scrap TIRE rubber are used.

Scrap Tire Rubber

TIRE may be divided into two types – car and truck TIREs. Car TIREs are different from truck TIREs with regard to constituent materials (e.g- natural and synthetic rubber). Usually three main categories of discarded TIRE rubber have been considered such as chipped, crumb and ground rubber. Chipped or shredded rubber is used to replace the gravel. To produce this rubber, in first stage the rubber has length of 300 – 430 mm long and width of 100 -230 mm wide. In the second stage its dimension changes to 100 -150 mm by cutting. If the shredding is further continued particles of about 13 – 76 mm in dimension are produced. Crumb rubber is used to replace the sand. This rubber is manufactured by special mills where big rubbers change into smaller particles. In this procedure particles of about0.425 - 4.75 mm in dimension are produced.

CEMENT

The cement type used in this research Ordinary Portland cement. The main reason for using Ordinary Portland Cement in this study is that, this is by far the most common cement in use andis highly suitable for use in general concrete construction when there is no exposure to sulphates in soil.

AGGREGATES

The relevant tests to identify the properties of the aggregates that were intended to be used in this research were carried out. After that, corrective measures were taken in advance before proceeding to the mix proportioning. In general, aggregates should be hard and strong, free of undesirable impurities, and chemically stable. Soft, porous rock can limit strength and wear resistance; it may also break down during mixing and adversely affect workability by increasing the amount of fines. Aggregates should also be free from impurities: silt, clay, dirt or organic matter. If these materials coat the surfaces of the Aggregate, they will isolate the aggregate particles from the surrounding concrete, causing reduction in strength. Silt, clay, and other fine materials will also increase the water requirements of the concrete, and organic matter may interfere with cement hydration.

WATER

The quality of the water plays a significant role in concrete production. Impurities in water may interfere with the setting of the cement, may adversely affect the strength of the concrete or cause staining of its surface, and may also lead to corrosion of the reinforcement. For these reasons, the suitability of water for mixing and curing purposes.

III. TESTING ARRANGEMENT

The following tests were performed on the different concrete samples produced in this study.
1) Slump test for workability
2) Compressive strength test
3) Flexural strength test

1) SLUMP TEST

SN	Specimen	Grade	% Rubber	Slump(mm)
1	M15A	M15	0	30
2	M15B		10	34
3	M15C		25	40
4	M15D		50	45
5	M20A	M20	0	10
6	M20B		10	18
7	M20C		25	31
8	M20D		50	15
9	M25A	M25	0	8
10	M25B		10	15
11	M25C		25	22
12	M25D		50	45

2) COMPRESSIVE STRENGTH TEST

SN	Specimen	Grade	% Rubber	07 Days	28 Days
1	M15A	M15	0	13.75	21.15
2	M15B		10	12.55	19.3
3	M15C		25	9.82	15.1
4	M15D		50	6.50	10
5	M20A	M20	0	26.65	41
6	M20B		10	22.95	35.3
7	M20C		25	18.72	28.8
8	M20D		50	9.88	15.2
9	M25A	M25	0	32.60	50.15
10	M25B		10	26.52	40.8
11	M25C		25	20.48	31.5
12	M25D		50	13.39	20.6

3) FLEXURAL STRENGTH TEST

SN	Specimen	Grade	% Rubber	Failure Load	Flexural Strength	% Strength Loss
1	M15A	M15	0	9.35	9.35	0
2	M15B		10	9.60	9.60	-2.67
3	M15C		25	6.70	6.70	28.34
4	M15D		50	7.15	7.15	23.53
5	M20A	M20	0	12.15	12.15	0.00
6	M20B		10	12.60	12.60	-3.70
7	M20C		25	11.15	11.15	8.23
8	M20D		50	7.20	7.20	40.74
9	M25A	M25	0	12.80	12.80	0.00
10	M25B		10	11.60	11.60	9.38
11	M25C		25	10.00	10.00	21.88
12	M25D		50	7.60	7.60	40.63

IV. CONCLUSION

From the test results of the samples, as compared to the respective conventional concrete properties, the following conclusions are drawn out.

The introduction of recycled rubber tires into concrete significantly increased the slump and workability. It was noted that the slump has increased as the percentage of rubber was increased in all samples.

The results show that the flexural strength increased compared to the control mix for rubber aggregate content of 10 % and for the low strength concrete classes (i.e. M15B and M20B).In these two categories of concretes, for rubber aggregate content of 25% and 50% a flexural strength reduction was observed as compared to the control mix. This indicates that improvements in flexural strength are limited to relatively small rubber aggregate contents. On the other part for mix (M25) a reduction in flexural strength is seen in all concrete samples containing the rubber aggregate. The observed percentage losses in mix M25 are 9.38, 21.88 and40.63% for a rubber content of 10, 25 and 50% respectively. From the results obtained, it can be concluded that as the amount of rubber content increases, the reduction in the flexural strength also increases with a concrete of medium and high strength compressive values. Nevertheless, a good advantage of increase in flexural strength can be achieved with a lower strength concretesM15 and M20 and by limiting the replacement value to only 10 % of the coarse aggregate.

A reduced compressive strength of concrete due to the inclusion of rubber aggregates limits its use in some structural applications. Nevertheless, it has few desirable characteristics such as lower density, higher impact and toughness resistance, enhanced ductility, and as light increase in flexural strength in the lower strength concretes.

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.

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