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USE OF RECYCLED MATERIALS IN CONCRETE CONSTRUCTION

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Abstract

Use of recycled aggregate in concrete can be useful for environmental protection. Recycledaggregates are the materials for the future. The application of recycled aggregate has been started in a large number of construction projects of many European, American, Russian and Asian countries.This paper reports the basic properties of recycled fine aggregate & also compares these properties with natural aggregates. Similarly the properties of recycled aggregate concrete are also determined. Basic concrete properties like compressive strength,split tensile strength, flexural strength and workability etc. are explained here for different combinations of recycled aggregate with natural aggregate. The concrete mixes were designed using IS 10262-2009 .fine aggregate is partially replaced with 10%,20%,30% and cement is partially replaced with silicafume of 0%,10%and 15% respectively.

Keywords:

Rubber agregate;
Normal aggregate;
Cement;
Silica fume.

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1. Introduction

Waste materials are common problems in modern living. Waste accumulates from a number of sources including domestic, industrial, commercial and construction. These waste materials have to be eventually disposed of in ways that do not endanger human health. In light of this, waste minimization is increasingly seen as an ecologicallysustainable strategy for alleviating the need for the disposal of wastematerials,which is often costly, time and space consuming, and can also have significant detrimental impacts on the natural environment.The use of recycled materials is often cheaper for the consumers of the end product. Hence, there is also an economic justification for promoting its use.

The use of recycled materials generated from transportation, industrial, municipal and mining processes in

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transportation facilities is an issue of great importance. Recycled concrete aggregates and slag aggregates are being used where appropriate. As the useable sources for natural aggregates for concrete are depleted, utilization of these products will increase. Silica fume is a comparatively expensive product and it is added in smaller quantities in concrete mixture rather than as a cement replacement.

It was also emphasized that the possibility of using solid wastes as aggregates in concrete serves as one promising solution to the escalating solid waste problem. The use of concrete for the disposal of solid wastes has concentrated mostly on aggregates, since they provide the only real potential for using large quantities of waste materials.

Crushed recycled concrete has been used as an aggregate, producing concrete with strength and stiffness equal to about two-thirds of that obtained using natural aggregates. Scrapped tyres have been proposed for use in concretes where high resiliency rather than strength are required.

Particularly among the waste materials in the advancement of civilization are discarded waste tyres. The main reason for this is that the amount of waste tyres is increasing at an alarming rate due to the large number of cars and trucks.

Zaher K.Khatib and Fouad M.Bayomy in (1999), their work concluded thatRubberised PCC mixtures can be made using ground tyre in partial replacement by volume of CA and FA. Based on the workability, an upper level of 50% of the total aggregate volume may be used. Strength data developed in their investigation (compressive and flexural) indicates a systematic reduction in the strength with the increase of rubber content. From a practical viewpoint, rubber content should not exceed 20% of the aggregate volume due to severe reduction in strength. Once the aggregate matrix contains non-traditional components such as polymer additives, fibers, iron slag, and other waste materials, special provisions will be required to design and produce these modified mixes. At present, there are no such guidelines on how to include scrap tyre particles in PCC mixtures.

Mohammad Reza sohrabi, Mohammad karbalaie in (2011), in this work, 5, 10and 15 wt% rubber crumbs with respect to cement is added to the concrete. For increasing the concrete compressive strength, 10 and 15% silica fume, 2 and 3% Nano silica as well as mixtures of Nano silica and silica fume containing 2 and 10%, 3 and 10%, 2 and 15%, and 3 and 15% Nano silica and silica fume were introduced to the rubber- containing concrete. The mixture schemes for measuring the 7- day and 28-day compressive strengths were performed according to ACI standard. 400 Kg/m3 cement and the water to cement ratio of 0.5 were considered. Due to low water to cement ratio, a Superplasticizer called SuperPlast M63 was used. The specimens were kept under standard and completely moist conditions and then their 7- day and 28-day compressive strength were evaluated.

2. Research Method

Figure 1. *Rubber Aggregates Size of 4.12 mm*Figure *2 Concrete Mixing using a Pan Mixer*

2.1 FRESH CONCRETE PROPERTIES

2.1.1 Workability Test

2.2 MECHANICAL PROPERTIES

2.2.1 Compressive Strength

Compressive strength of concrete can be found according to IS: 516-1959. Concrete cubes are loaded uniaxially by using standard testing machine until the specimen fails. The compressive strength is defined as the maximum compressive load divided by cross-sectional area of the specimen.size of cube is 150mmX150mmX150mm.

2.2.2 Split tensile strength Test

The common method of estimating the tensile strength of concrete is through an indirect tension test. The splitting tensile test is carried out on a standard cylinder 100 mm diameter x 300 mm long cylinders.

4.5.3 Flexural strength Tests

Two-point load method was adopted to measure the flexural strength. The beams of 100x100x500 mm adopted. The load was applied without shock and was increased until the specimen failed, and the maximum load applied to the specimen during the test was recorded.

3. Results and Analysis

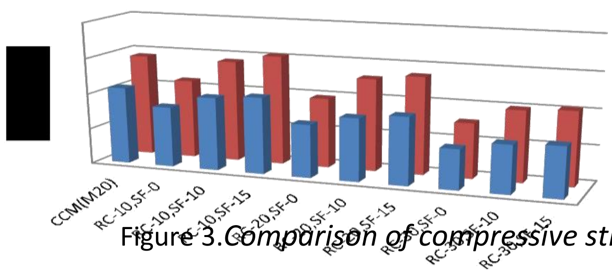

Figure 3.*Comparison of compressive strength*

Table 1: *Compressive Cube Strength at 28 days*

Mix	Compressive strength (MPa)	Change in strength (%)
CCM (M20)	28.56	-
RC-10,SF-0%	22.14	-22.47
RC-10,SF-10%	28.39	0
RC-10,SF-15%	30.64	+10.57
RC-20,SF-0%	19.54	-31.58
RC-20,SF-10%	25.86	-9.4
RC-20,SF-15%	27.32	-4.34
RC-30,SF-0%	15.47	-45.83
RC-30,SF-10%	19.93	-30.21
RC-30,SF-15%	20.68	-27.59

Table 2: *Split tensile Strength at 28 days*

Mix	Split tensile strength (MPa)	Change in strength (%)
CCM (M20)	3.41	-
RC-10,SF-0%	2.24	-34.90
RC-10,SF-10%	3.01	-11.73
RC-10,SF-15%	3.48	0
RC-20,SF-0%	1.86	-49.5
RC-20,SF-10%	2.58	-24.3
RC-20,SF-15%	2.82	-17.36
RC-30,SF-0%	1.68	-50.73
RC-30,SF-10%	2.12	-37.86

Table 3: *Flexural Strength at 28 days*

Mix	Flexural strength (MPa)	Change in strength (%)
CCM (M20)	6.8	-
RC-10,SF-0%	6.21	-8.67
RC-10,SF-10%	7.14	+5.0
RC-10,SF-15%	7.35	+8.08
RC-20,SF-0%	5.43	-20.14
RC-20,SF-10%	5.9	-13.23
RC-20,SF-15%	6.16	-9.41
RC-30,SF-0%	4.87	-28.32
RC-30,SF-10%	5.26	-22.64
RC-30,SF-15%	5.39	-20.73

4. Conclusion

Based on the experimental investigations carried out, the following conclusions are drawn

1. The introduction of recycled rubber tyres into concrete significantly increased the slump and workability.
2. For rubberized concrete, the test results show that the addition of rubber aggregate resulted in a Significant reduction in concrete compressive strength compared with the conventional concrete.
3. This reduction increased with increasing percentage of rubber aggregate. Reduction of compressive Strength ranging from 4.34 % to 45.83 % were observed.
4. The results of the splitting tensile strength tests show that, there is a decrease in strength with increasing Rubber aggregate content like the reduction observed in the compressive strength tests.
5. The reductions in splitting tensile strength ranging from 11.73 % to 50.53 % were observed.
6. A significant advantage of increase in flexural strength was achieved in the replacement amount of 10 % of the fine aggregate with rubber aggregate contents as 20 and 30 % flexural strength reduction was observed compared to the conventional mixes.
7. The reduction ranging of flexural strength is 8.67 % to 28.32 %. When compared to compressive and split tensile strength the reduction is less.
8. The addition of silica fume increasing in the strength the concrete specimens in the variation is 0 to 15 %.the increment is higher in 0 to 10 % compare to 10 to 15 %.
9. The overall results of this study show that it is possible to use recycled rubber tyres in concrete construction as a partial replacement of fine aggregates. However, the percentage replacement should be limited to specified amounts

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