Experimental Study on Mechanical Properties of Concrete Partial Replacement of Fine Aggregate with Crumb Rubber

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Abstract: This paper shows the experimental study on the consumption of refuse tyre crumb rubber in concrete in replacement for fine aggregate in different percentage along with the use of silica fumes as mineral admixture to alter the bonding properties of the rubberized concrete in a positive way. The use of waste rubber tyre leads to the protection of environment and also it aids in preserving the natural aggregates. In this study the waste tyre crumb rubber was used as a replacement for natural fine aggregates and was tested for the mechanical properties of M25 grade concrete as per IS 10262-2009. Three different properties of rubberized concrete were tested namely compressive strength, flexural strength and split tensile strength. According to the test result it was noticed that there is decrease in the compressive strength, split tensile strength and flexural strength when the percentage of rubber cement is increased as compared to the nominal mix. The percentage replacement of natural fine aggregate with crumb rubber was 5%, 10% and 15%.

KEYWORDS:Crumb rubber, Fine aggregate, Mechanical properties, Waste tyre.

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I. INTRODUCTION

The dumping of waste material is one of the key issues in the whole tyres is a major matter because this material is very difficult to degrade even after a long time. Waste rubber is also used as raw material for rubber goods. Concrete is made by means of the composition of cement, coarse aggregate and fine aggregate. Among all kinds of construction material concrete is the most frequently used material. Due to which there is decrease in the natural aggregates. There are several techniques which were proposed for consumption of waste tyre, one of them is the use of crumb rubber in the concrete as full or partial replacement of coarse aggregates or fine aggregates, But only limited researches have been done till now on the use of waste tyre crumb rubber in concrete.

Alteration of building material has an important role in the building sector. Various numbers of attempts have been thus made in the construction material field to get into use refused waste products like damaged used tyres, into valuable and gainful items. Success in this case will have a great contribution towards the decline of waste material dumping problems by utilization of the waste materials as a raw matter for other construction requirements. As dumping and burning of waste and discarded rubber tyres in a very difficult and pollution producing process.

Cement mixture consisted of rubber may be proved sensible to use for basic and non-structural purpose, for example, lightweight concrete dividers, building exteriors and compositional parts. The use of crumb rubber in flimsy concrete is viewed as conceivably critical road. The use of crumb rubber will be advancement in the structuring of the wall as it will work as shock as well as sound absorber.

1.2 Scope and Need of work

In the developmental procedures a lot of waste is being produced in which, there lies two categories degradable and non degradable. While the rubber tyres falls in the non degradable category thus they cannot be decomposed easily. People however try to decompose this material by dumping them in the ground but this method works only for a limited duration as after sometime they come out of the landfills and get on the top of the surface of land while some people try to decompose them by burning which is even worst as they emit a lot of carbon while burning which results in the increased air pollution. So it is better to put them for the reuse, one of the best way to reuse them is by using them in construction industries as a building material .They can be mixed with concrete to build various structures which will make the disposal of rubber tyres easy as well as productive.

1.3 Objective of the work

The process requires a broad laboratory for studying the proportion of rubberized concrete. The motive of the study was to known the strength behaviour that is change in compressive, flexural strength and split tensile strength of rubberized concrete with different percentage of crumb rubber along with the use silica fume as a mineral admixture parameters have varying varied in investigation as shown below:

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- To study the compressive strength of concrete under different mixes of 7,14,28 days comparing the results of conventional concrete.
- To study the compressive strength and split tensile strength value of different mixes.
- To know the optimum percentage of crumb rubber for replacement of fine aggregate with crumb rubber.

II. LITERATURE REVIEW

. **A Mohd Al-Bakri, S.A.Fadli, M.D.AboBakar and K.W. Leong (2007)** carry out two different type of concrete which are rubberized concrete and rubber filler in concrete. In rubberized concrete, rubbers were used to replace fine aggregate and coarse aggregate. Furthermore, in rubber filler in concrete, crushed stone was used as coarse aggregate and river sand as fine aggregate. Coarse aggregate usually gravel or crushed stone and shredded rubber as filler in concrete. The design of mixture concrete is 15Mpa for 7-days and water ratio are 0.4, 0.5, 0.7. Lastly, the compression cube test will be test on 7- days. The properties of the aggregate will compared.

. **Osama A. Abaza (2007)** utilization of waste crumb tires in varies portlande cement concrete categories for the production of non-structuralportlande cement concrete N.J.Azmi, B.S. mohammed and H.M.AL-Mattarneh(2008) carry out to develop information about to develop information about the mechanical properties of rubberized concrete with three different water cement ratio (0.41, 0.57and 0.68).The

results revealed slump values increased as the crumb rubber content increase from 0%to30%

Goulias and Ali (1997), on premise of test outcomes utilizing diverse parameters, it was discovered that dynamic moduli of inflexibility diminished with an expansion of the rubber substance, demonstrating that a less concrete and less fragile material was acquired. The damping limit of cement (a measure of the capacity of the material to diminish the adequancy of free vibrations in its body) appeared to diminish with an expansion of the rubber substance16.

Biel and Lee (1996), reported that the failure of plane concrete cylinders resulted in explosive chemical separations of cylinders, leveling the specimen in several pieces. As the amount of rubber in concrete was increased, the severity and explosiveness of the failures decreased. Failure of concrete specimens with 30, 45 and 60% replacement of fine aggregate with rubber particles occurred as a gradual shear that resulted in a diagonal failure plane

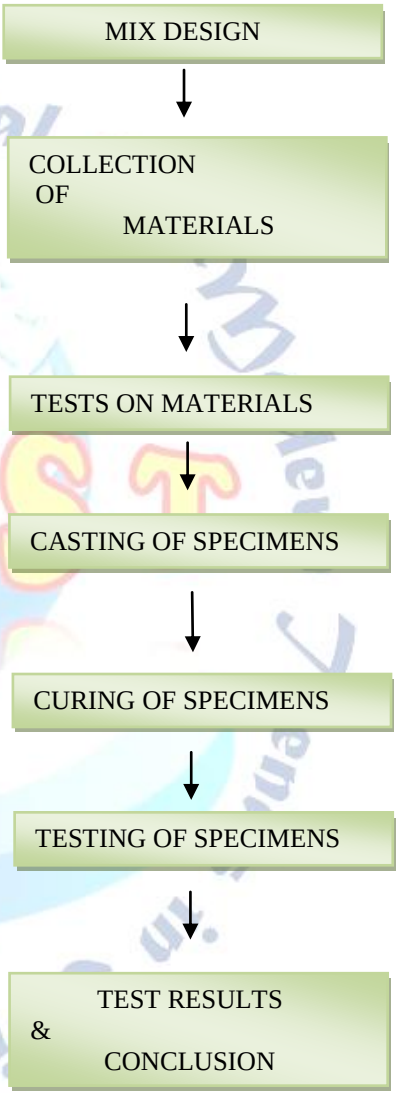
D.Fedroff (1996),the air content increased in rubberized mixtures with increased amount of ground tyre rubber. Although the air entraining agent was used in rubberized mixtures, higher air contents were measured as compared to control mixtures made with an AEA. The higher air contents of rubberized mixtures may be due to non polar nature of the rubber particles and their ability to entrap air in their jagged surface structure.

Topcu (1995), investigated the consequences of pressure test led on normal and rubber treated concrete. He also observed that the acquired from barrel tests. In any case, the outcomes regarding rubber treated cements of rubber treated mixture is extraordinarily influenced with the size, extent, surface of rubber particles and the sort of concrete utilized as a part of such mixture.

Eldin and senouci (1993), on the premise of experimental outcomes, demonstrated that there was around 85% reduction in compressive strength and half reduction in rigidity when the total course was completely replaced by coarse rubber chips. In any case, example lost up to 65% of their compressive strength and up to half of their rubberity.

Neil N.Eldin (1993)[13], broke down the after effects of compressive and part rigid qualities in rubber treated cement following 7 and 28 days curing and watched that there was slightest change in the compressive and rubber qualities between the 7th and 28th day, when the coarse total were supplanted by rubber chips with an expansive volume that is for the examples carrying 75% and 100% tire chips. The decrease of up to 85% of compressive and half of rubberity has been observed when the coarse total was supplanted by rubber. A little decrease was observed when sand was supplanted with piece rubber.

III. METHODOLOGY



3.1 Crumb rubber

Crumb rubber is recycled rubber produced from automotive and truck scrap tires. During the recycling process, steel and tire cord are removed, leaving tire rubber with a granular consistency. Continued processing with a granulator or cracker mill.Crumb rubber usually consists of particles ranging in size from 4.75mm(no.4 sieve) to less than 0.075mm (no.200 sieve)

3.2 Cement

In this project OPC43 grade is used

3.3 Coarse aggregate

20mm size of coarse aggregate was used

3.4 fine aggregate

IV. TESTS CONDUCTED

COMPRESSION STRENGTH TEST:

Out of many test applied to the concrete, this is the utmost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether concreting has been done properly or not. That test has been shown in the below figure

Compression strength =load / area

SPILT TENSILE STRENGTH TEST:

The tensile strength of concrete is one of the basic and important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength ofconcrete.

Spilt tensile strengthTsp = 2P /π DL

FLEXURAL STRENGTH TEST:

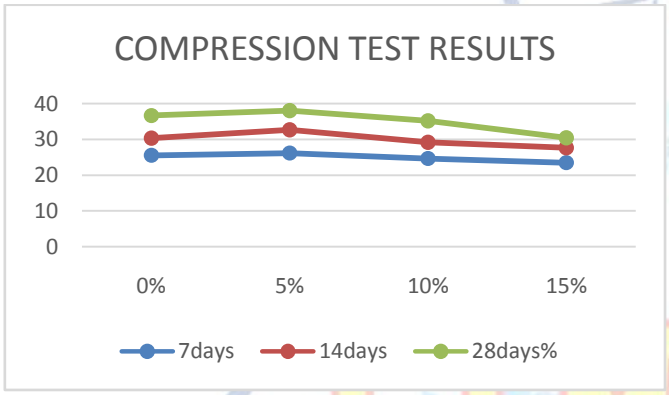
The test has been carried out to determine the flexural strength of beams. The size of the specimen used.The specimen is tested on Universal testing machine. The specimen shall be placed in the machine in such a manner the load shall be applied to the upper most surface as cast in the mouldalong two lines spacing 13.3 cm apart.

Flexural strength (fb) = P×L / b×d2

V. RESULTS AND DISCUSSION

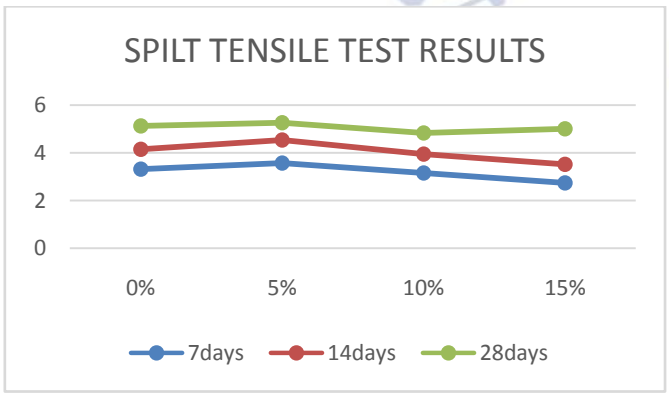
COMPRESSION STRENGTH TEST (N/mm²):

S.no	%Crumb rubber	COMPRESSION STRENGTH VALUES		
		7days	14days	28days
1.	0%	25.52	30.36	36.63
2.	5%	26.16	32.64	38.02
3.	10%	24.61	29.19	35.14
4.	15%	23.47	27.67	30.38



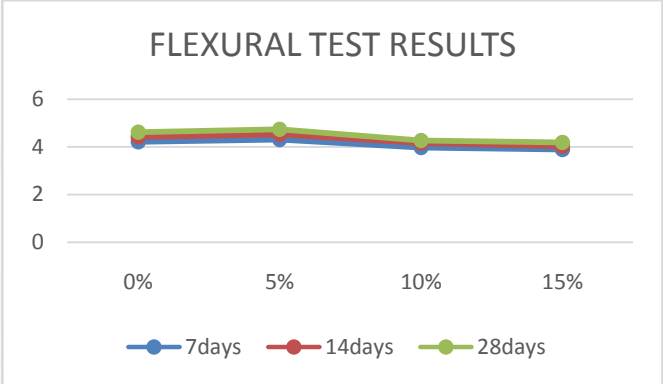
SPILT TENSILE STRENGTH TEST(N/mm²)

s.no	%crumb rubber	Spilt tensile strength values		
		7days	14days	28days
1.	0%	3.31	4.15	5.12
2.	5%	3.57	4.54	5.26
3.	10%	3.16	3.95	4.83
4.	15%	2.74	3.52	4.27



FLEXURAL STRENGTH TEST(N/mm²):

S.NO	% crumb rubber	Flexural strength values		
		7days	14days	28days
1.	0%	4.21	4.41	4.62
2.	5%	4.31	4.52	4.74
3.	10%	3.97	4.15	4.27
4.	15%	3.89	4.02	4.419



VI. CONCLUSION

- The compression strength as achieved its maximum strength at 5% and later it was decreased
- The spilt tensile strength as achieved its maximum strength at 5% and later it was decreased
- The flexural strength as achieved its maximum strength at 5% and later it was decreased
- For the results it has concluded that the strength of the concrete has been decreases with increases crumb rubber ratio
- Since crumb rubber causes environment pollution ,it can used in concrete upto some extent

VII. FUTURE SCOPE

- For the extent of this study you can also partial replacement of coarse aggregate with crumb rubber
- Increases the tests conducted for concrete
- Or increase the percentage of crumb rubber which we are used fine aggeregate

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