Partial Replacement of fine Aggregate in Self-Compacting Concrete using Crumb Rubber

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***Abstract*—In the past few decades, due to the exponential increase of the world's population, the number of discarded waste tires has become a serious ecological and environmental problem. Decomposition of waste tire rubber can take longer than 50 years, and every year the number of discarded tires is rapidly going. In this project crumb rubber is added by partially replacing fine aggregate. Crumb rubber is added 15% and 20% by volume of fine aggregate. This study enhances the understanding of the material properties of Self-compacting concrete through laboratory testing, to suggest the best size and proportion of crumb rubber that can increase the properties of self-compacting concrete. The compressive strength and flexural strength of the specimens were analyzed. The compressive strength decreases with the increase in percentage of crumb rubber but flexural strength increases with the increase in percentage of crumb rubber.**

Keywords—Self-Compacting Concrete; Crumb rubber; Compressive Strength; Flexural Strength

I. INTRODUCTION

The number of unusable waste tires from different kinds of vehicles is rapidly growing and is in fact turning out as one of the major ecological and environmental problems of the present day. Nearly one-billion waste tires are discarded each year and are predicted to be almost 1.2 billion per year by 2030. Common ways of disposing of the scrap tires, such as land-filling and burning may cause grave ecological problems, either because of the fast depletion of the site or air pollution, respectively. From an ecological point of view, by implementing rubber derived from waste tires in concrete, the amount of disposed waste tires would become smaller and provide a source of eco-friendly concrete. From an engineering point of view, adding waste tire rubber into concrete could produce a material with improved dynamic and durability properties, such as ductility, damping capacity, chloride-ion penetration resistance, carbonation resistance, etc.

Similar to traditional concrete, self-compacting rubberized concrete however has lower levels of emitted radiation and thus safer to building users. Because of its high ductility, improved impact resistance, and energy dissipation properties, rubberized concrete has been used in several applications so far, i.e., road barriers, sidewalks, and pavement. Before this can be accomplished, it is suggested that experimental investigation on self-compacting rubberized concrete needs to be carried out. The fact that fine and coarse aggregate makes approximately 50% of weight of the self-compacting concrete can be used as a motivation to thoroughly study the influence of partially replacing natural aggregate with waste tire rubber to provide lightweight self-compacting concrete (SCC). Mixing Procedure and Rubber Aggregate Properties Currently, there is no standardized methodology to design mixes of self-compacting rubberized concrete. However, there are several mixture design methods for self-compacting concrete.

II. METHODOLOGY FOR EXPERIMENTATION

A. *Materials and its testing*

The various materials used are crumb rubber, cement, fine aggregates, coarse aggregates, water, ceraplast200 (super plasticizer). The various experimental results of the materials are shown below:

TABLE I TEST RESULTS OF MATERIALS

Sl.no	Title Of The Experiment	Result
1	Standard consistency of cement paste	33
2	Initial and final setting time	70min&300min
3	Fineness of cement	7%
4	Bulk density of fine aggregate	1.74 kg/lit
5	Specific gravity of fine aggregate	2.706
6	Sieve analysis	Fineness modulus =2.83
7	Bulk density of coarse aggregate	1.29 kg/lit
8	Specific gravity of coarse aggregate	Specific gravity = 2.72

B. *Casting of Conventional Self-Compacting Concrete*

1 cube of 150x150mmx150mm and 1 cylinder of 300mm height and 150mm diameter was casted.

C. *Casting of SCC with crumb rubber*

3 cubes of 150mmx150mmx150mm and two cylinders of 300mm height and 150mm diameters were casted both for 15%and 20%. The mix proportion was found out after trial and error methods and fixed as 1:1.44:2.34

D. *Experimental study*

The specimens were tested in the compression testing machine. After the curing period of 7 days' results were obtained.

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III. RESULTS

TABLE II SLUMP TEST RESULT OF COVENTIONAL SCC AND SCC WITH CRUMB RUBBER

% Of CR in The Mix	0%	15%	20%
Slump (cm)	63	70	72

TABLE III COMPRESSIVE STRENGTH TEST RESULTS OF CONVENTIONAL SCC AND SCC WITH CRUMB RUBBER

% of crumb rubber	0%	15%	20%
Average compressive strength after 7 days in MPa	16	23	16
Average compressive strength after 28 days in MPa	19	25	20

TABLE IV FLEXURAL STRENGTH TEST RESULTS OF CONVENTIONAL SCC AND SCC WITH CRUMB RUBBER

% of crumb rubber	0%	15%	20%
Average compressive strength after 28 days in MPa	3.5	4.9	4.2

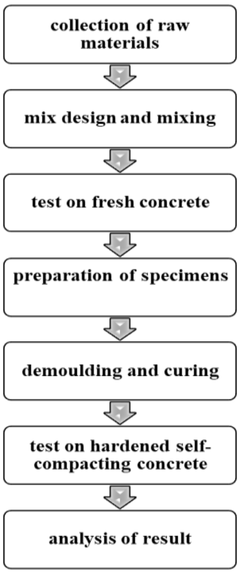

Fig. 1. Schematic Representation of Stages of the Project

Fig. 2. Crumb rubber

Fig. 3. Ceraplast 200 (*Superplasticizer*)

Fig. 3. Mixing Stage Before Addition of Water

Fig. 4. Moulded cylinders

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Fig. 5. Moulded cubes

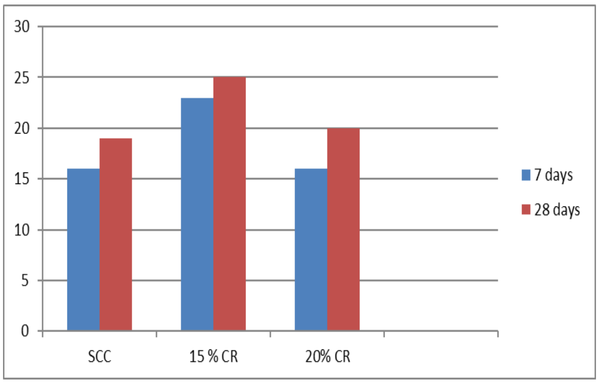

Fig.8. Variation of Compressive Strength with % Replacement of crumb rubber

Fig. 6. Cured Specimens

Fig. 9. Flexural Strength Test for Concrete Cylinder

Fig. 7. Compressive Strength Test of Concrete Cube

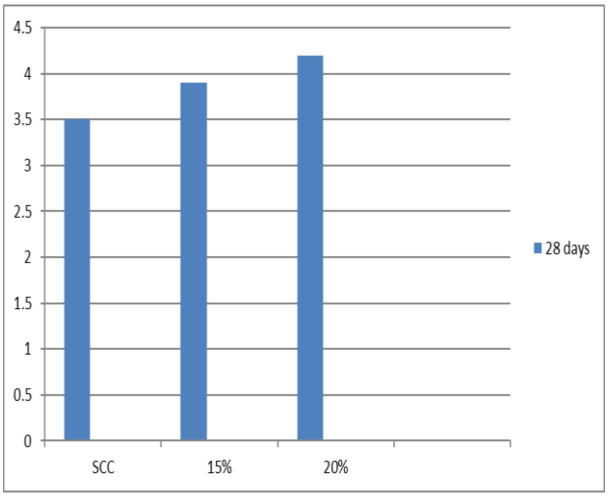

Fig. 10. Variation of Flexural Strength with % Replacement of crumb rubber

IV. CONCLUSIONS

The conclusion of our study are the following:

1. As the percentage of waste rubber increases, flexural strength increases.
2. So that we can use rubber mixed SCC for casting beams.
3. Compressive strength decreases as the % of waste rubber increases.
4. Rubber mixed SCC can be used for non-load bearing components.
5. Waste rubber is expensive to store and is a hazard, can be reused in SCC.

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