

# Effect of Crumb Rubber and Silica Fume in Concrete for Masonry blocks

Athira Radhakrishnan <sup>1</sup>, Aswathy Das <sup>2</sup>, Elson John <sup>3</sup>

P.G. Student, Department of Civil Engineering, KMP College of Engineering, Perumbavoor, Ernakulam, India<sup>1</sup>

Assistant Professor, Department of Civil Engineering, KMP College of Engineering, Perumbavoor, Ernakulam, India<sup>2</sup>

Assistant Professor, Department of Civil Engineering, MA College of Engineering, Kothamangalam, Ernakulam, India<sup>3</sup>

**ABSTRACT:** The increased need for the infrastructure development leads to the increased use of concrete year by year. Consumption of cement and conventional aggregates has to be reduced for sustainability. Applicability of Waste materials as a partial replacement for concrete is studied. Several Literatures were studied about the partial replacement of fine aggregate with crumb rubber. M25 mix was prepared and referred as conventional mix (CM) in this study. Mixes were prepared by replacing with 5% 10% and 15% of fine aggregate with crumb rubber and dosage with better performance were used in the further study. Fresh properties were characterized using slump test. Mechanical properties studied were compressive, flexural and splitting tensile strengths.

**KEYWORDS:** Crumb Rubber, Silica Fume, Compressive Strength, Flexural Strength, Splitting Tensile Strength .

## I. INTRODUCTION

Concrete is the premier construction and one of the most consumed material across the world. It has well-known advantages, such as low cost, general availability, and wide applicability. Its applications in all types civil engineering works, including infrastructure, low and high-rise buildings, environment protection etc. Presently, annual worldwide concrete production is about 12 billion tones. Concrete is essentially consisting of cement, aggregates, water and admixture(s). Presently, it is about 10 billion tons of sand and rock are consuming very year. Traditionally aggregates have been readily available of economic prices and of qualities to suit for all purposes. However, in recent years the wisdom of our continued whole sale extraction and use of aggregates from natural resources results in the lack of availability of natural aggregates

Now, waste materials resulting from various physical and chemical processes are the most important challenge in the industrial and developing countries. Several investigations on wastage recycling are being implemented to control and minimize the environmental damages. In this regard, construction investigators, like other recycling and production industries, have also achieved advances in using these waste materials. One of the non-recyclable materials enters the environment in automotive tires. Investigations show that tires are composed of materials which do not decompose under environmental conditions and cause serious contaminations.

From the last decade, several researches are on the utilization of waste materials as a replacement of anyone of the components. Each material have its own specific effect on the properties of concrete in both fresh and dry state. The proper use of any of the waste material can reduce the pollution and can also improve the performance of concrete. The work in this paper deals with the effect of crumb rubber and silica fume in concrete.

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## II. RELATED WORK

Properties of different materials used are determined and prepared the mix design

Materials used

- i). *Cement*: Ordinary Portland Cement of 53 grade conforming to IS 12269-1987 (Deccan brand) was used in this experiment. Specific Gravity is 3.14, standard consistency is 34%, Initial setting time is 90 minutes and final setting time is 540 minutes .
- ii). *Coarse Aggregate*: Coarse aggregate is chemically stable material in concrete, used in construction, including sand, gravel, crushed stone etc. Coarse aggregate of nominal size 20mm was used. Coarse aggregates which is retained on 4.75mm IS sieve. Specific Gravity is 2.66.
- iii). *Fine Aggregate*: Fine Aggregates are mainly passing through 4.75mm IS sieve. Specific gravity is 2.73.
- iv). *Water*: Portable water in the laboratory confirming to the requirements of water for concreting as per IS 456:2000 was used for casting and curing of specimens.
- v). *Super Plasticizer*: Master Glenium ACE 30 with specific gravity 1.08 was used as super plasticizer. This was obtained from BASF Construction Chemicals (India) Pvt. Ltd.
- vi). *Crumb Rubber*: It is collected from Eastern treads Pvt Ltd Oonukal and was used for replacing fine aggregates with varying percentages. The waste tire crumb rubber particles used to replace fine aggregate in concrete of size passing through 1.18 mm IS sieve and retaining on 600 $\mu$  IS sieve.

## III. EXPERIMENTAL PROCEDURE

Compressive strength of concrete was determined by using cubical specimen of size 150mm x 150mm x 150mm. . The concrete was filled into the mould in different layers. Hand compaction was employed. Specimens were cured for specified period. Tests were done on the compression testing machine and ultimate loads were noted. Specimens were tested after 3, 7 and 28 days. Three specimens were tested at each age and the average values are recorded as compressive strength.

Flexural strength test were used to measure flexural strength of concrete. Sizes of specimens used were 100mm x 100mm x 500mm. Hand compaction was employed. Specimens were cured in curing tank for specified period. For testing third point loading method was used. Ultimate load applied to the specimen during the test was recorded. Specimens were tested for 3, 7 and 28 days.

Splitting tensile strength test is carried out as per IS 5816 :1999. The test is carried out by placing a cylindrical specimen of diameter 150 mm and length 300 mm horizontally between the loading surfaces of a compression testing machine and load is applied until failure of the cylinder along the vertical diameter. It was tested for 3 , 7 and 28 days. Three specimens were tested at each age and the average of the three is expressed as the splitting tensile strength of concrete.

Compressive strength of concrete cube having both crumb rubber and silica fume is also tested.. Compressive strength of this concrete was determined using cubical specimen of size 150mm x 150mm x 150mm.10% crumb rubber is replaced for fine aggregate and 5%, 10% and 15% cement is replaced with silica fume.

Variation of compressive strength of the concrete block in which 10% fine aggregate replaced by crumb rubber and the cement replaced by silica fume at different percentages is studied. For this wooden moulds of dimension 10 inch x 8 inch x 6 inch is prepared. Then concrete is casted using this mould and cured in curing tank for specified period. Specimens were tested after 7 and 28 days.

## IV. EXPERIMENTAL RESULTS

Figures shows the results of the experiments conducted . Figs. 1 (a),(b) and (c) shows 3<sup>rd</sup> day, 7<sup>th</sup> day and 28<sup>th</sup> day compressive strength of crumb rubber concrete. Fig. 2 (a),(b) and (c) shows 3<sup>rd</sup> day, 7<sup>th</sup> day and 28<sup>th</sup> day flexural strength of crumb rubber concrete. Fig. 3 (a),(b) and (c) shows 3<sup>rd</sup> day, 7<sup>th</sup> day and 28<sup>th</sup> day splitting tensile strength of crumb rubber concrete. Fig. 4 (a) and (b) shows 7<sup>th</sup> day and 28<sup>th</sup> day compressive strength of 10CR+SF concrete. Fig. 5 (a) and (b) shows 7<sup>th</sup> day and 28<sup>th</sup> day compressive strength of 10CR+SF concrete

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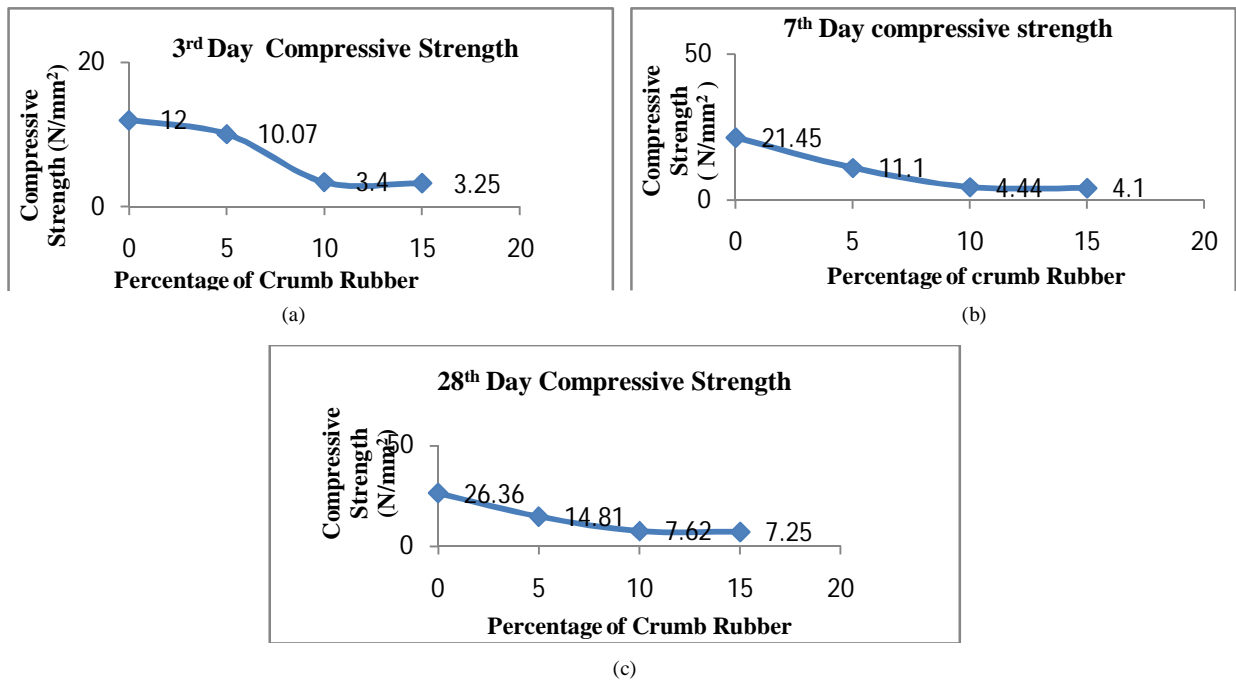


Fig. 1. Compressive Strength of CR Concrete (a) 3<sup>rd</sup> Day Compressive Strength (b) 7<sup>th</sup> Day Compressive Strength (c) 28<sup>th</sup> Day Compressive Strength  
From this graph it was understood that maximum strength obtained at 5% replacement. Compressive strength decreases.

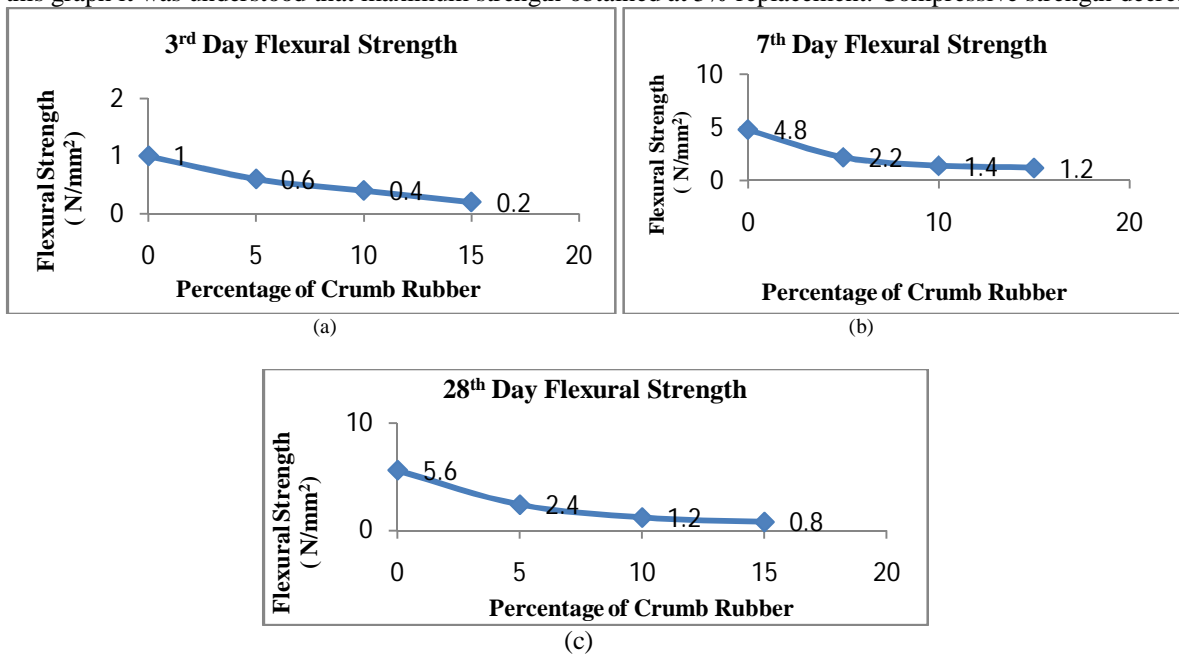


Fig. 2. Flexural Strength of CR Concrete (a) 3<sup>rd</sup> Day Flexural Strength (b) 7<sup>th</sup> Day Flexural Strength (c) 28<sup>th</sup> Day Flexural Strength

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From this graph it was understood that the flexural strength also decreases with increase in the percentage of crumb rubber. Maximum flexural strength of crumb rubber concrete obtained at 5% replacement.

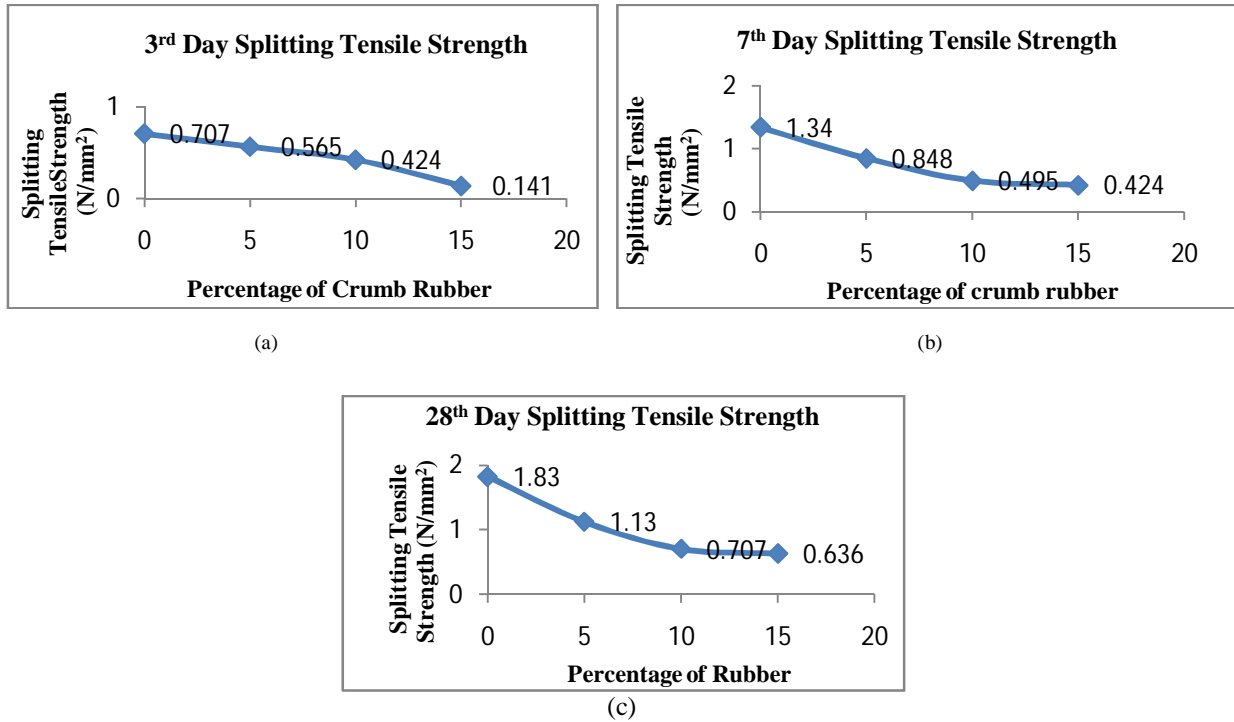


Fig. 3 Splitting Tensile Strength of CR Concrete (a) 3<sup>rd</sup> Day tensile Strength (b) 7<sup>th</sup> Day tensile Strength (c) 28<sup>th</sup> Day tensile Strength

From this graph it is understood that the splitting tensile strength decreases with increase in the percentage of rubber. Maximum strength of crumb rubber concrete was obtained at 5% replacement and its value was 1.13N/mm<sup>2</sup>

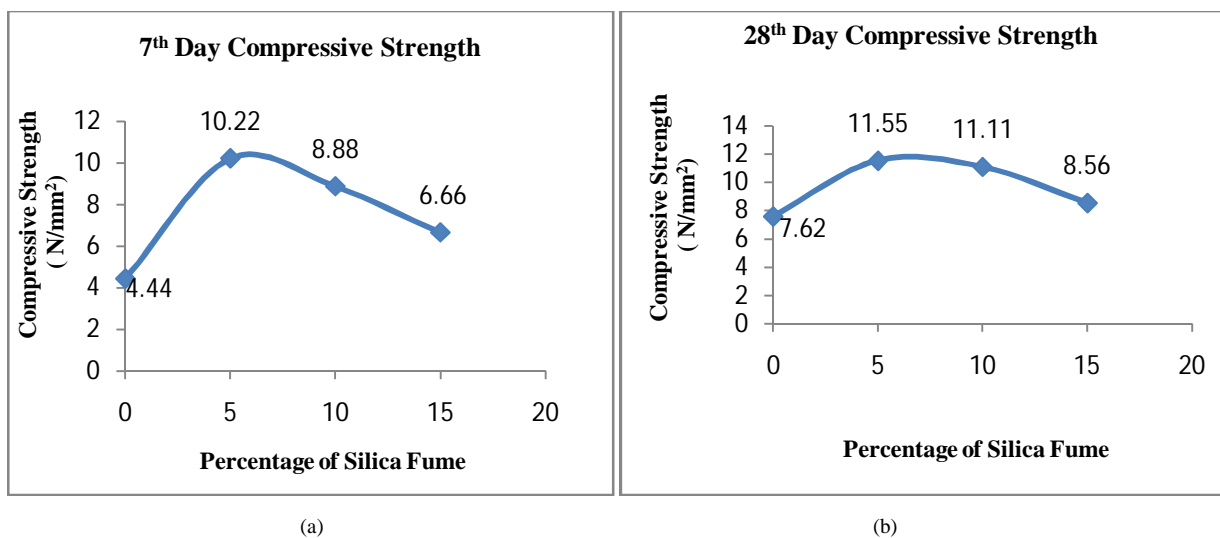


Fig. 4 Compressive Strength of 10 CR + SF Concrete Cubes (a) 7<sup>th</sup> Day Compressive Strength (b) 28<sup>th</sup> Day Compressive Strength

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From this graph it was identified that concrete with silica fume and crumb rubber was more than that of concrete with crumb rubber only.

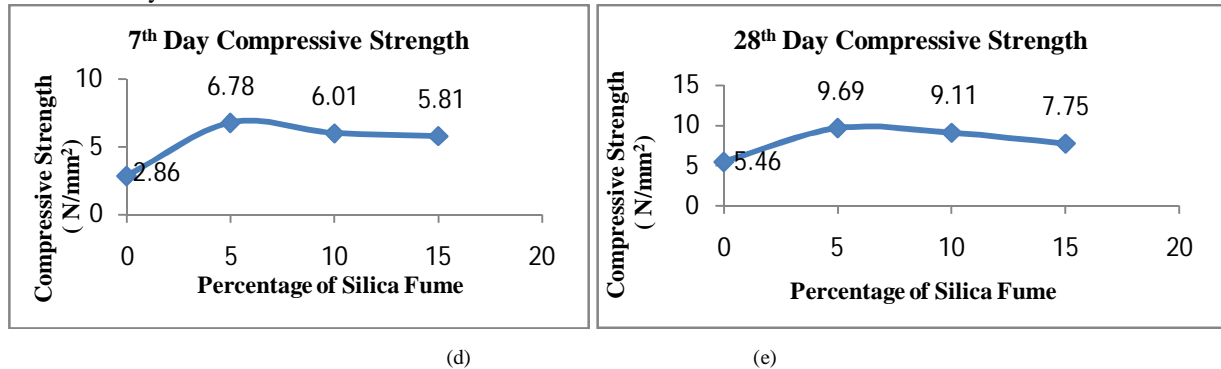


Fig. 5 Compressive Strength of 10 CR + SF Concrete Blocks (a) 7<sup>th</sup> Day Compressive Strength (b) 28<sup>th</sup> Day Compressive Strength

From this graph it was identified that concrete with silica fume and crumb rubber was more than that of concrete with crumb rubber only. Strength of concrete block was less than that of concrete cubes.

### VI. CONCLUSION

Slump tests are used to find the workability of concrete and super plasticizer content in concrete. All mixes prepared show adequate workability (100 mm to 115 mm) by varying the super plasticizer content in small percentage. Mixes are made by replacing fine aggregate with 5%, 10%, and 15% crumb rubber are tested. The compressive strength, flexural strength and splitting tensile strength are studied for 3, 7 and 28 day. Compressive strength, Flexural strength and splitting tensile strength decreases with increase in the percentage of crumb rubber. Maximum values for compressive strength, flexural strength and splitting tensile strength of concrete after the replacement is obtained at 5% which is 14.81 N/mm<sup>2</sup>, and 1.13 N/mm<sup>2</sup> ( 28 day strength)The loss of strength may be due to the lack of adhesive property of crumb rubber. Mixes are made by replacing fine aggregate with 10% crumb rubber and cement with 5%, 10% and 15% silica fume are tested. The compressive strength is studied for 7 and 28 day. From the result it is observed that the strength of concrete increases as compared to the concrete in which 10% fine aggregate is replaced by the crumb rubber. There for the strength increases in crumb rubber silica fume combination rather than the crumb rubber cement combination. The compressive strength obtained for the concrete block is less than that of the concrete cubes for the same mix. Maximum strength is obtained at 5% cement replacement with silica fume and it is 11.55N/mm<sup>2</sup> and that of the concrete block is 9.69N/mm<sup>2</sup>

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