AN EXPERIMENTAL STUDY ON THE SPLIT TENSILE STRENGTH OF RUBBERIZED CONCRETE WITH THE ADDITION OF HAIR AS FIBER

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ABSTRACT: This experimental study is carried out to determine the effect of replacing cement by silica fume, fine aggregate by foundry sand and coarse aggregate by tyre rubber chips on the split tensile strength of concrete. The main aim of this study is to find out alternative sources for construction. The test is conducted to obtain the results by replacing cement by silica fume in 5%, 10% and 15%, fine aggregate by foundry sand in 10% and coarse aggregate by tyre rubber chips in 15%, 25% and 35% and also 2% human hairs were added as a fiber. Specimens were cured for 28 days before testing split tensile strength.

Keywords: rubberized concrete, split tensile strength, tyre rubber chips, conventional concrete, human hairs

INTRODUCTION

Concrete is a construction material consists of cement, fine aggregates (sand) and coarse aggregates mixed with water which hardens with time. Concrete conquers a unique place among modern construction. It gives liberty to mould the structure to any shape. Concrete is also considered as an artificial stone in which the voids of coarse aggregate are filled by the fine aggregates and the voids of fine aggregates are filled with cement. The strength, durability and other characteristics of concrete depend upon the properties of its ingredients, proportions of mix, method of compaction and controls during placing, compaction and curing.

In rubberized concrete the scrap tire rubber is used as a replacement of coarse aggregate. So far concrete was made by using cement, coarse aggregate, fine aggregate and water. The coarse aggregate is obtained by crushing natural stone and fine aggregate is obtained by river bed. With the increasing environmental responsiveness, it has become essential to think about an alternate material for coarse aggregate as well as for fine aggregate. Utilization of waste products has become a smart alternative for coarse aggregate.

OBJECTIVES

The objectives of this study is as follows:

i. To protect environment pollution.
ii. To utilize scrap tyre rubber and human hair.
iii. To study practicability of rubberized concrete.
iv. To estimate the possible advantages of using rubber in concrete specification for structural usage.

MATERIALS USED

- **Cement:** OPC 43 grade cement.
- **Fine Aggregate:** Locally available sand of Zone II
- **Coarse Aggregate:** Locally available aggregate of maximum size of 20mm
- **Silica Fumes:** It was procured from DBS Building Products Pvt. Ltd., Delhi
- **Foundry Sand:** It was taken from local foundries
- **Tyre Rubber Chips:** Procured from Motor Market, Ambala City

CASTING OF SPECIMENS

Cylindrical mould of size 300mm x 150mm was used to prepared concrete specimens to test split tensile strength of concrete as shown in fig. 1

Fig. 1

RESULTS AND DISCUSSIONS

The result of split tensile strength after 28 days of curing of conventional and rubberized concrete is shown in Table 1

Table 1

Cylinder Split Tensile Strength

S.No.	Mix Proportion							Average Load Failure (KN)	Average Split Tensile Strength (MPa)
	Cement (kg)	Percentage of Silica Fume (kg)	Sand (kg)		Aggregate (kg)		Human Hair		
			Sand	Foundry Sand	Stone Aggregate	Rubber Aggregate			
1	22.27	-	45.11	-	74.46	-	-	153.31	2.17
2	21.15	5% (1.11)	45.11	-	74.46	-	-	192.17	2.72
3	20.04	10% (2.23)	45.11	-	74.46	-	-	222.55	3.15
4	18.93	15% (3.34)	45.11	-	74.46	-	-	132.82	1.88
5	21.15	5% (1.11)	40.60	10% (4.51)	67.76	15%(6.70)	2% (2.84)	181.57	2.57
6	21.15	5% (1.11)	40.60	10% (4.51)	63.29	25%(11.17)	2% (2.84)	173.10	2.45
7	21.15	5% (1.11)	40.60	10% (4.51)	58.82	35%(15.64)	2% (2.84)	174.51	2.47
8	20.04	10% (2.23)	40.60	10% (4.51)	67.76	15%(6.70)	2% (2.84)	199.24	2.82
9	20.04	10% (2.23)	40.60	10% (4.51)	63.29	25%(11.17)	2% (2.84)	191.47	2.71
10	20.04	10% (2.23)	40.60	10% (4.51)	58.82	35%(15.64)	2% (2.84)	187.93	2.66
11	18.93	15% (3.34)	40.60	10% (4.51)	67.76	15%(6.70)	2% (2.84)	163.20	2.31
12	18.93	15% (3.34)	40.60	10% (4.51)	63.29	25%(11.17)	2% (2.84)	151.19	2.14
13	18.93	15% (3.34)	40.60	10% (4.51)	58.82	35%(15.64)	2% (2.84)	138.48	1.96

Fig. 2 shows the percentage variation in the split tensile strength of conventional concrete and concrete made by replacing cement by silica fumes as given in Table 1. The results shows that after adding silica to the conventional concrete the split tensile strength increases at 5% and 10% and after that it decreases when 15% silica is added. The percentage increase in split tensile strength of 20% was observed at 28 days when 5% silica is added to concrete.

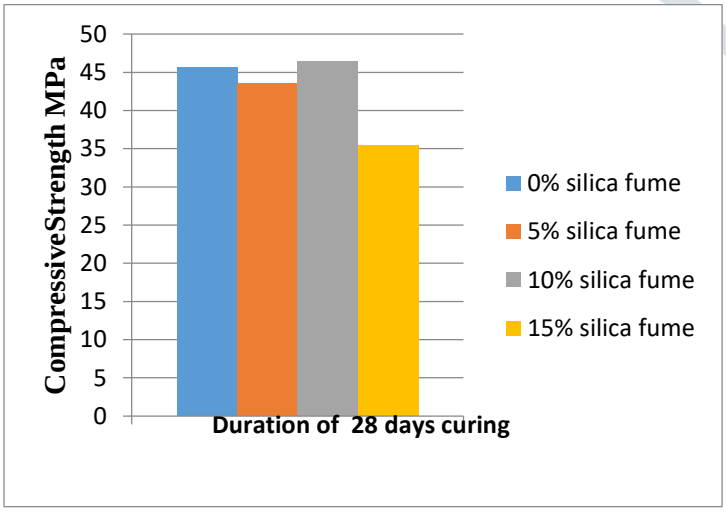

Fig. 2 COMPRESSIVE STRENGTH WITH VARYING PERCENTAGE OF SILICA

Fig. 3 shows the percentage variation in the split tensile strength of conventional concrete and concrete made by adding silica fume, foundry sand, waste tyre rubber and human hair as given in Table 1. The conventional concrete achieve strength of 2.17 N/mm^2 at the age of 28 days while the additional of waste material in concrete achieves the strength of 2.57 N/mm^2 at the age of 28 days i.e. 18.4% higher than conventional concrete. The percentage increase in split tensile strength of 13% was observed for 28 days when 25% tyre rubber chips are added and percentage of silica fumes and foundry sand remains constant. When the percentage of rubber tyre chips increased up to 35% there is increase in the split tensile strength of the concrete i.e. 13.8% at 28 days.

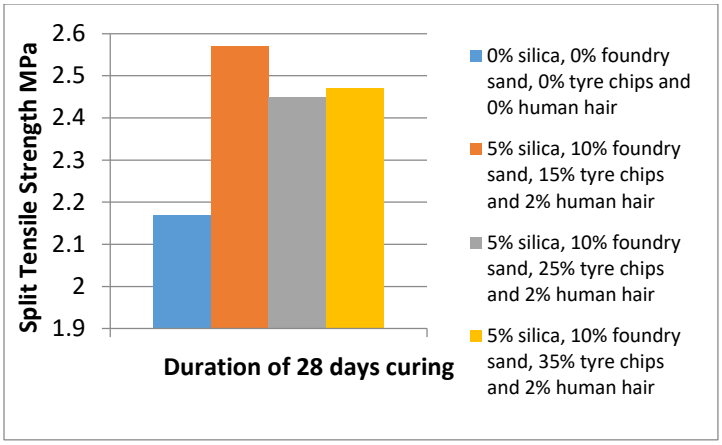

Fig. 3 EFFECT OF FOUNDRY SAND AND TYRE CHIPS ON SPLIT TENSILE STRENGTH WITH HUMAN HAIR

Fig. 4 shows the percentage variation in the split tensile strength of conventional concrete and concrete made by adding silica fume, foundry sand, waste tyre rubber and human hair as given in Table 1. The conventional concrete achieve strength of 2.17 N/mm^2 at the age of 28 days while the partial replacement natural material by waste material, the concrete achieves the strength of 2.82 N/mm^2 at the age of 28 days i.e. 30% higher than conventional concrete. When the percentage of rubber tyre chips increased up to 35% there is increase in the split tensile strength of the concrete i.e. 22.5% at 28 days.

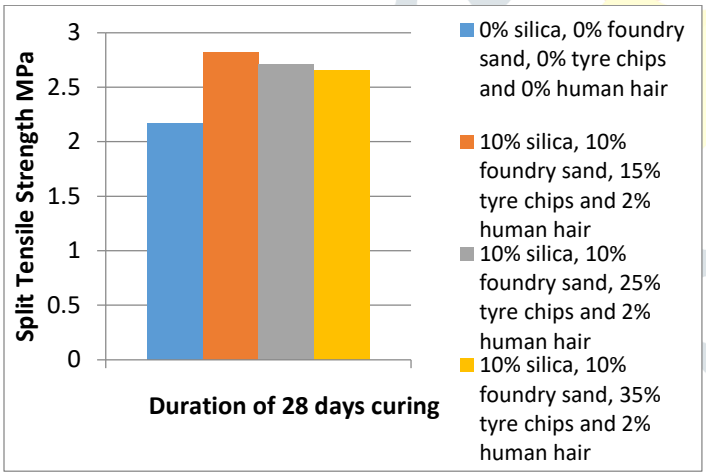

Fig. 4 EFFECT OF FOUNDRY SAND AND TYRE CHIPS ON SPLIT TENSILE STRENGTH WITH HUMAN HAIR

Fig. 5 shows the percentage variation in the split tensile strength of conventional concrete and concrete made by adding silica fume, foundry sand, waste tyre rubber and human hair as given in Table 1. The conventional concrete achieve strength of 2.17 N/mm^2 at the age of 28 days while the partial replacement of all materials by waste materials, the concrete achieves the strength of 2.31 N/mm^2 at the age of 28 days i.e. 6.5% higher than conventional concrete. The percentage decrease in split tensile strength of 1.4% was observed for 28 days when 25% tyre rubber chips are added and percentage of silica fumes and foundry sand remains constant. When the percentage of rubber tyre chips increased up to 35% there is slightly decrease in the split tensile strength of the concrete i.e. 9.7% at 28 days.

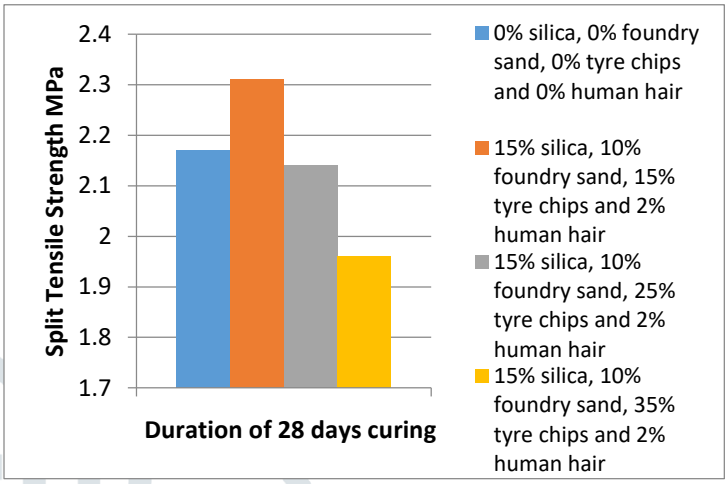

Fig. 5 EFFECT OF FOUNDRY SAND AND TYRE CHIPS ON SPLIT TENSILE STRENGTH WITH HUMAN HAIR

FUTURE SCOPE OF THE STUDY

1. Mechanical properties of the Rubberized Concrete are studied only up to 35% replacement of stone aggregate by waste tyre rubber chips. The effect on strength after 100% replacement yet to be studied.
2. Human hair can be better fiber to be used in concrete as it increases the strength of concrete.
3. Many more tests are yet to be conducted i.e. durability test, modulus of elasticity etc.
4. The effect of freezing, thawing and salt attack on Rubberized Concrete is to be studied.
5. The long term behaviour of Reinforced Rubberized Concrete should be studied.

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