An Experimental Study on the Compressive Strength of Rubberized Concrete by using Waste Material with the Addition of Human Hair as Fiber

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Abstract- **The present experimental study is carried out to estimate the effect of replacing cement by silica fume, fine aggregate by foundry sand and coarse aggregate by waste tyre rubber chips on the compressive strength of concrete. The main objective of this study is to find out alternative sources so that the natural resources can be saved. In the present study 5%, 10%, 15% cement was replaced by silica fumes, 10% fine aggregate was replaced by foundry sand and 15%, 25%, 35% coarse aggregate by tyre rubber chips and also 2% human hairs were used as fiber.**

Keywords: Compressive strength; rubberized concrete; tyre rubber chips;foundry sand;silica fumes

I. INTRODUCTION

Concrete is most widely used man-made construction material in the world, and is second only to water as the most utilized substance on the planet. Concrete is primarily made up of four fundamental ingredients, i.e. coarse aggregate, fine aggregate (i.e. sand), cement and water. The concrete grows stronger with age. Concrete may also be considered as an artificial stone in which the voids of larger particles i.e. coarse aggregate are filled by the smaller particles i.e. fine aggregates and the voids of fine aggregates are filled with cement. The concrete mixed with waste rubber in different volume proportions is called rubberized concrete and it is an infant technology. The rubberized concrete is affordable, cost effective and can withstand more pressure, impact and temperature when compare with conventional concrete. It is observed that the rubberized concrete is very weak in compressive and tensile strength. But they have better water resistance with low absorption, low shrinkage, improved acid resistance, high impact resistance, and excellent sound and thermal insulation. Moreover the unique qualities of rubberized concrete will find usage in new areas of highway constructions as a shock absorber, in sound barriers as a sound absorber and also in buildings as an earthquake shock-wave absorber. it reduces plastic shrinkage cracking and vulnerability of concrete to catastrophic failure. It may also used in runways and taxiways in the airport, industrial floorings and even as structural member. In recent years, much attention has been attracted towards using silica fumes in concrete to increase the strength of the concrete. By adding silica fume and super plasticizers in the concrete compressive strength can be increased.

II. OBJECTIVES OF PRESENT STUDY

The objective of this experimental study is to utilize the waste rubber tires in concrete as a replacement to coarse aggregate and study its effects on the compressive strength of concrete. The objective of this study is as follows:

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

In the present study, an attempt has been made to study the compressive strength of rubberized concrete by partially replacing fine aggregate by foundry sand and by using human hair as fiber.

III. MATERIAL INVESTIGATION

A. CEMENT

Ordinary Portland cement (OPC) 43 Grade from single batch was used for all concrete mixes. It was fresh and without any lumps. Specific Gravity of Cement is 3.15.

B. Fine Aggregate

In this experimental study, locally available sand has been used and conformed to Indian Standard Specifications IS: 383-1970. Sand used was river sand with specific gravity 2.5 the fine aggregate was in zone II. The water absorption of fine aggregate is 3.425%.

C. Coarse Aggregate

The coarse aggregate was crushed angular with a maximum size of 20mm. The specific gravity of coarse aggregate is 2.53. Water absorption of coarse aggregate is 0.6%.

D. Silica Fume

Silica fume used in this experimental study was procured from DBS Building Products Pvt. Ltd., Delhi.

E. Foundry Sand

Foundry Sand used was taken from the foundries. The specific gravity of foundry sand f is 2.36. Water absorption of coarseDeletion: Delete the author and affiliation lines for the second affiliation.

F. Tyre Rubber Chips

Tyre Rubber chips were procured from Motor Market, Ambala City. It is used to partially replace the coarse aggregate and having the dimension of about 20 mm. The particle shape of the rubber aggregate was irregular and rough.

IV. CASTING OF SPECIMENS

Standard cubical mould of size 150mm x 150mm x 150mm was used to prepared concrete specimens to test compressive strength of concrete. Cylindrical mould of size 300mm x 150mm was used to prepared concrete specimens to test split tensile strength of concrete. To test flexure strength beams of size 500mm x 100mm x 100mm were used to prepare concrete specimens.

V. RESULTS AND DISSCUSSION

COMPRESSIVE STRENGTH

The concrete structure is mainly designed for its compressive strength as it is weak in tension and strong in compression. Hence to compare the conventional concrete and rubberized concrete made with waste tyre rubber, the compressive strength has been observed by moulding concrete cube specimen, beam specimen and cylindrical specimen.

Table shows the compressive strength of concrete cube specimens' having different mix proportions.

S.NO.	MIX PROPORTION							Average load failure (KN)	Compressive Strength (MPa)
	Cement (Kg)	Percentage of Silica Fumes (kg)	Sand (kg)		Aggregate (kg)		Human Hair (kg)		
			Sand	Foundry Sand	Stone Aggregate	Rubber Aggregate			
1	3.54	-	7.18	-	11.85	-	-	1027	45.64
2	3.37	5% (0.18)	7.18	-	11.85	-	-	980	43.56
3	3.19	10% (0.35)	7.18	-	11.85	-	-	1044	46.40
4	3.01	15% (0.53)	7.18	-	11.85	-	-	797	35.42
5	3.37	5% (0.18)	6.46	10% (0.72)	11.85	15%(1.07)	-	594	26.40
6	3.37	5% (0.18)	6.46	10% (0.72)	11.85	25%(1.78)	-	344	15.29
7	3.37	5% (0.18)	6.46	10% (0.72)	11.85	35%(2.49)	-	204	9.07
8	3.19	10% (0.35)	6.46	10% (0.72)	10.79	15%(1.07)	-	644	28.62
9	3.19	10% (0.35)	6.46	10% (0.72)	10.08	25%(1.78)	-	270	12.00
10	3.19	10% (0.35)	6.46	10% (0.72)	9.36	35%(2.49)	-	424	18.84
11	3.01	15% (0.53)	6.46	10% (0.72)	10.79	15%(1.07)	-	474	21.07
12	3.01	15% (0.53)	6.46	10% (0.72)	10.08	25%(1.78)	-	164	7.29
13	3.01	15% (0.53)	6.46	10% (0.72)	9.36	35%(2.49)	-	239	10.62
14	3.37	5% (0.18)	6.46	10% (0.72)	11.85	15%(1.07)	2% (0.48)	644	28.63
15	3.37	5% (0.18)	6.46	10% (0.72)	11.85	25%(1.78)	2% (0.48)	437	19.42
16	3.37	5% (0.18)	6.46	10% (0.72)	11.85	35%(2.49)	2% (0.48)	275	12.23
17	3.19	10% (0.35)	6.46	10% (0.72)	10.79	15%(1.07)	2% (0.48)	664	29.50
18	3.19	10% (0.35)	6.46	10% (0.72)	10.08	25%(1.78)	2% (0.48)	495	22.01
19	3.19	10% (0.35)	6.46	10% (0.72)	9.36	35%(2.49)	2% (0.48)	531	23.61
20	3.01	15% (0.53)	6.46	10% (0.72)	10.79	15%(1.07)	2% (0.48)	518	23.00
21	3.01	15% (0.53)	6.46	10% (0.72)	10.08	25%(1.78)	2% (0.48)	285	12.68
22	3.01	15% (0.53)	6.46	10% (0.72)	9.36	35%(2.49)	2% (0.48)	425	18.91

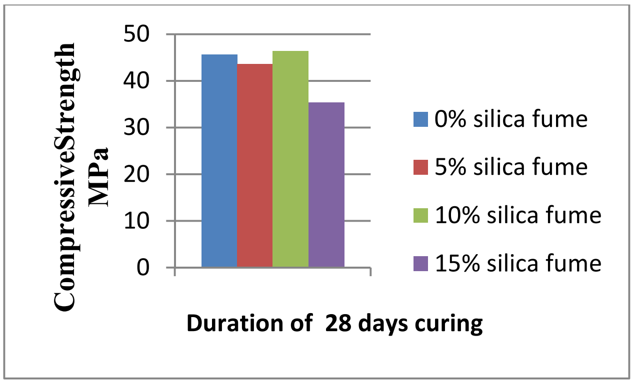

Fig 1: Compressive strength with varying percentage of silica fume

Fig. 1 represents the compressive strength of convectional concrete by using varying percentage of silica fumes. Compressive strength increases by adding 10% and after that strength decreases.

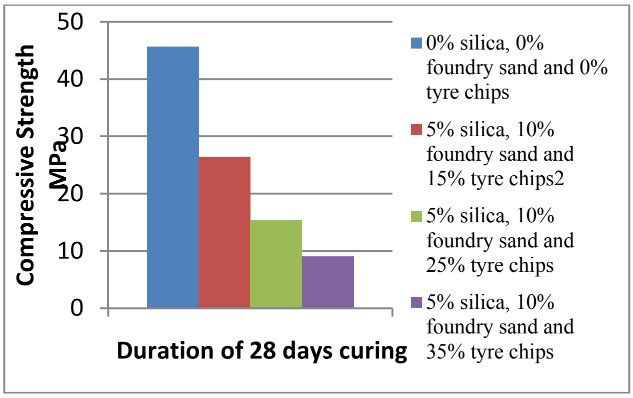

Fig 2: Effect of foundry sand and tyre chips on compressive strength

Fig. 2 represents the compressive strength of convectional concrete by using varying percentage of silica fumes, foundry sand and tyre chips. Compressive strength decreases by adding varying percentage of silica fume. Foundry sand and tyre chips

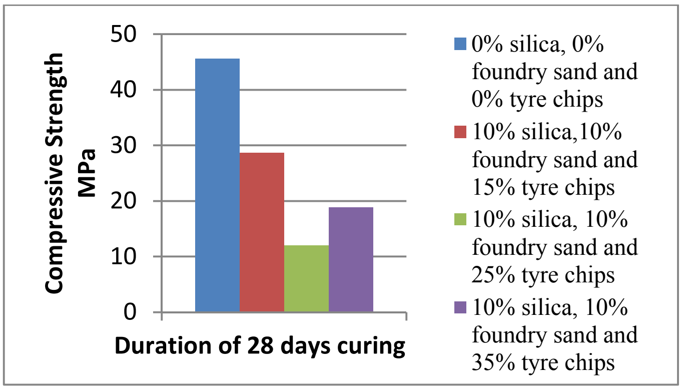

Fig 3: Effect of foundry sand and tyre chips on compressive strength

Fig. 3 represents the compressive strength of convectional concrete by using varying percentage of silica fumes, foundry sand and tyre chips. Compressive strength decreases by adding varying percentage of silica fume. Foundry sand and tyre chips and increases by adding 10% silica fumes, 10% foundry sand and 35% tyre chips

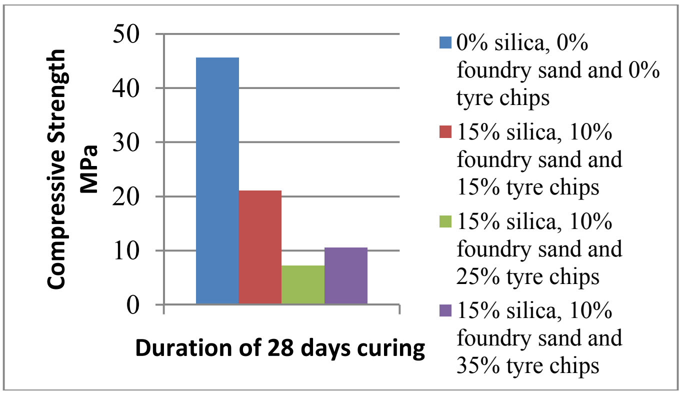

Fig 4: Effect of foundry sand and tyre chips on compressive strength

Fig. 4 represents the compressive strength of convectional concrete by using varying percentage of silica fumes, foundry sand and tyre chips. Compressive strength decreases by adding varying percentage of silica fume. Foundry sand and tyre chips and increases by adding 15% silica fumes, 10% foundry sand and 35% tyre chips.

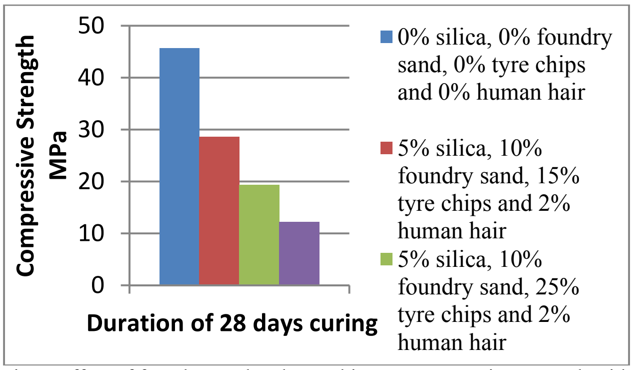

Fig 5: Effect of foundry sand and tyre chips on compressive strength with human hair

Fig. 5 represents the compressive strength of convectional concrete by using varying percentage of silica fumes, foundry sand, tyre chips and human hair. Compressive strength decreases by adding varying percentage of silica fume. Foundry sand, tyre chips and human hair

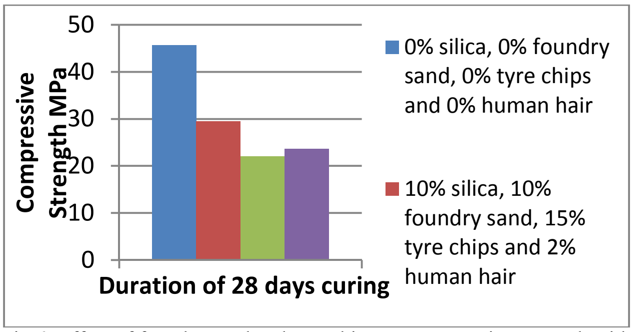

Fig 6: Effect of foundry sand and tyre chips on compressive strength with human hair

Fig. 6 represents the compressive strength of convectional concrete by using varying percentage of silica fumes, foundry sand, tyre chips and human hair. Compressive strength decreases by adding varying percentage of silica fume, Foundry sand, tyre chips and human hair and increases by adding 10% silica fumes, 10% foundry sand, 35% tyre chips and 2% human hair.

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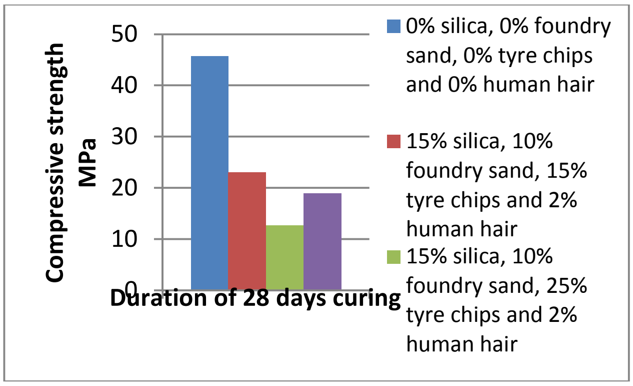

Fig 7: Effect of foundry sand and tyre chips on compressive strength with human hair

Fig. 7 represents the compressive strength of convectional concrete by using varying percentage of silica fumes, foundry sand, tyre chips and human hair. Compressive strength decreases by adding varying percentage of silica fume, Foundry sand, tyre chips and human hair and increases by adding 15% silica fumes, 10% foundry sand, 35% tyre chips and 2% human hair.

VI. CONCLUSIONS

i. The Compressive Strength of the concrete is highest when 10% cement is replaced by silica fume which is 1.67% as compared to conventional concrete. After replacing more than 10% cement by silica fume the compressive strength decreases.
ii. The Compressive Strength of the Rubberized Concrete made by replacing cement by silica fume, sand by foundry sand and aggregate by varying percentage waste tyre rubber is lesser than the Conventional Concrete which is approximately 42% lesser.
iii. The Compressive Strength of the Rubberized Concrete made by adding human hair is high as compared to the Rubberized Concrete made without adding human hair which is 8% high but 37% lesser than the Conventional Concrete.

VII. REFERENCES

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