EXPERIMENTAL INVESTIGATION ON MECHANICAL AND DURABILITY PROPERTIES OF HIGH STRENGTH FIBER REINFORCED CONCRETE INCORPORATING EGG SHELL POWDER

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ABSTRACT

The imagination of a world without concrete is impossible. It is a soul of infrastructures. Concrete is necessary to gain strength in structures. Conventional concrete, which is the mixture of cement, fine aggregate, coarse aggregate and water, needs curing to achieve strength. Concrete is a counterfeit material in which the totals both fine and coarse are reinforced together by the bond when blended with water. The solid has turned out to be so prominent and essential in view of its natural, concrete acquired an upheaval uses of cement. Concrete has boundless open doors for creative applications, plan and development methods. Its extraordinary adaptability and relative economy in filling extensive variety of necessities has made it is exceptionally focused building material.

This project focuses on concrete, keeping importance to this, an attempt has been made to develop strength in concrete incorporating egg shell powder . As part of the project cement partially replaced with egg shall powder and using glass fiber and steel fibers as partial replacement in coarse aggregate.Comparative studies were carried out for compressive strength, tensile strength and flexural test and curing done for 7,14,28,56 days.

I. INTRODUCTION

In India, the manufacturing of Portland cement was commenced around the year 1912. The beginning was not very promising and growth of cement industry was very slow. At the time of independence in 1947, the installed capacity of cement plants in India was approximately 4.5 million tons and actual production around 3.2 million tons per year. The large construction activity undertaken during the various 5 years plans mainly during the necessitated the growth of cement industry. However, the five year plans envisaged for Multi-purpose projects and also for rapid industrial growth remained stinted due to the complete control exercised by the Government over the cement industry. As the infra-structure sector was developing during 1980s prompted the various industrial organizations were interested for setup new cement plants in the country. The full liberalization on cement industry in 1988 further provided rapid expansion for the growth.

- Concrete is the most commonly used construction material; its usage by the communitiesacross the globe is second only to water. Customarily, concrete is produced by using the Ordinary Portland Cement (OPC) as the binder. The usage of OPC is on the increase to meet infrastructure developments. The world-wide demand for OPC would increase further in the future. It is well-known that cement production depletes significant amount of natural resources and releases large volumes of carbon-dioxide. Cement production is also highly energy-intensive, after steel and aluminium. On the other hand, coal burning power generation plants produce huge quantities of egg shell powder and Fiber reinforced concrete can be defined as a composite material consisting of mixtures of cement, mortar or concrete and discontinues, discrete, uniformly dispersed suitable fibers. And fiber is a small piece of reinforcing material possessing certain characteristics properties.
- They can be circular or flat the fiber is often described by the parameter aspect ratio which is ratio of fiber length to its diameter. Typical aspect ratio varies from 20 to 150.

The use of fibers to reinforce a brittle material was done first by Egyptians they used straw to reinforce sun baked bricks and horsehair was used to reinforce plaster

OBJECTIVES

1) To study the relative strength development with age of egg shell powder 5% as partial replacement in cement and steel fibers and carbon fibers in fine aggregate.
2) To study the comparative strength development with age of (Steel Fibers +ESP) concrete.
3) To study the comparative strength development

with age of (Carbon Fibers +ESP) concrete.
4) To conduct Experimental test on Steel Fibers (0,5%,10%,15%,20%) +ESP(5%) and Carbon Fibers (0,5%,10%,15%,20%) +ESP(5%) with ordinary concrete
5) To protect the environment by utilizing waste properly.

EXPERIMENTAL PROGRAM

This investigation focuses on the following pattern of work

- partial replacement of cement with Egg shell powder as partial replacement in cement and steel fibers and carbon fibers as fine aggregate partial replacement.
- Curing was done at the ages of 7,14,28 and 56 days were tested i.e. compression, split tensile strength and flexural strength test.

II LITERATURE REVIEW

AMARNATH YERRAMALA eggshell powder was used to study the properties of concrete in instead of cement. In order to incorporate chicken waste into concrete, eggshell powder (ESP) was developed, as is discussed in this study. A variety of ESP concretes were created by substituting 5–15% of the ESP for cement.
. Greater than 10% ESP replacements had weaker concrete than control concrete. It was discovered that the addition of steel fibres increased the compressive strength of ESP concrete, resulting in substantially less wastage from the egg shell powder used in the concrete.

D.GOWSIKA ET AL Egg shell powder as a Partial Replacement for Cement in Concrete has been experimentally examined. This study evaluated the use of egg shell powder from the egg production business as a partial replacement for regular Portland cement in cement mortar. Egg shell powder is used in a cement mortar with a mix ratio of 1:3 to replace 5%, 10%, 15%, 20%, 25%, and 30% of the cement by weight. At a 28-day curing age, the compressive strength was measured. Beyond 5% egg shell powder replacement, compressive strength significantly decreased.

LAU YIH BLING investigated egg albumen and reported that foamed concrete was made using egg albumen, which decreased project cost and time. The egg albumen concentrations employed were 1% and 5%. According to the experiment, 5% of EAFC has an unstable compressive strength and a stronger flexural strength with increased density, compared to 64% and 35% of control foamed concrete, respectively. In this work, it is demonstrated that Egg Albumen Foamed Concrete (EAFC) may provide lightweight concrete with better characteristics and a more favourable environmental impact.

III MATERIALS AND METHODOLOGY

Materials:

- Cement
- Fine aggregate (sand)
- Coarse aggregate
- Water
- Egg shell powder
- Steel fibers
- Carbon fibers

In the present study from the above mix design we have choosen the following cases for casting

Mix proportion for m50 grade concrete

Cement	Fine aggregate	Coarse aggregate	Water
450	430	1425	153
1	0.95	3.16	0.34

As Per the design and based on mix proportion following quantities are required for 1m3

mix	ESP	steel fibers	carbon fibers	cement 450 kg	fa	ca	water
1	5%	0%	0%	432	430	1425	153
2	5%	5%	5%	432	430	1282.51	153
3	5%	10%	10%	432	430	1140	153
4	5%	15%	15%	432	430	997.5	153
5	5%	20%	20%	432	430	855	153

IV EXPERIMENTAL INVESTIGATION

The following are the strength tests which was conducted in the project and specimens are casted and cured for 7, 14,28,56 days.

- Compressive strength test
- Split tensile strength test
- Flexural strength test

V EXPERIMENTAL RESULTS AND DISCUSSION

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COMPRESSION TEST RESULTS

Table 5.1: COMPRESSION TEST RESULT ESP 5% & CARBON FIBRES (0%,5%,10%,15%,20%)

MIX	CF	ESP	7 DAYS	14 DAYS	28 DAYS	56 DAYS
1	0	5%	28.4	36.8	53.5	58.5
2	5	5%	29.2	38.9	54.9	60.2
3	10	5%	29.8	40.1	56.75	62.5
4	**15**	**5%**	**30.2**	**41.8**	**59.5**	**66.5**
5	20	5%	35.3	43.5	58.1	63.5

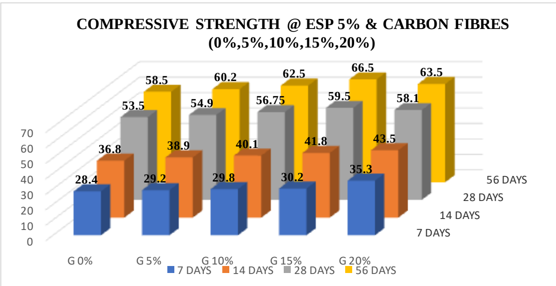

FIG.5.1. COMPRESSION TEST RESULT BAR CHART

Table 5.2: COMPRESSION TEST RESULT ESP 5% & STEEL FIBRES (0%,5%,10%,15%,20%)

MIX	SF	ESP	7 DAYS	14 DAYS	28 DAYS	56 DAYS
1	0	5%	32.2	36.8	53.5	58.5
2	5	5%	33.6	37.8	53.8	60.12
3	10	5%	33.8	39.2	54.86	61.8
4	**15**	**5%**	**35.2**	**42.8**	**56.72**	**63.4**
5	20	5%	33.1	40.01	53.8	62.1

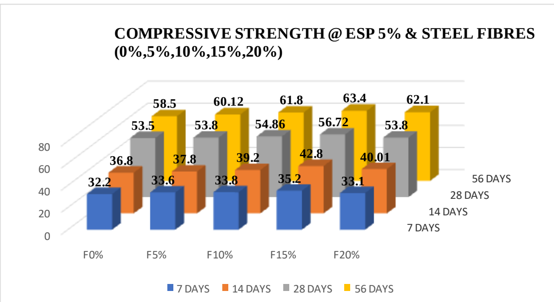

FIG.: 5.2 COMPRESSIVE STRENGTH BAR CHART @ ESP 5% & STEEL FIBRES (0%,5%,10%,15%,20%)

Table 5.3.: SPLIT TENSILE STRENGTH TEST RESULT ESP 5% & CARBON FIBRES (0%,5%,10%,15%,20%)

MIX	CF	ESP	7 DAYS	14 DAYS	28 DAYS	56 DAYS
1	0	5%	3.85	4.09	4.8	5.1
2	5	5%	4.11	4.35	5.32	5.4
3	10	5%	4.54	4.56	5.87	5.92
4	15	5%	4.86	4.98	6.48	6.5
5	20	5%	4.35	4.48	5.98	6.01

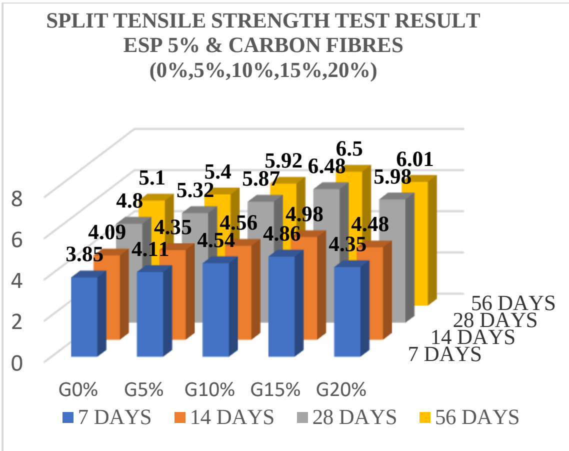

Fig.5.3: SPLIT TENSILE STRENGTH TESTBAR CHART RESULT ESP 5% & CARBON FIBRES (0%,5%,10%,15%,20%)

Table 5.4.: STRENGTH TEST RESULT ESP 5% & STEEL FIBRES (0%,5%,10%,15%,20%)

MIX	SF	ESP	7 DAYS	14 DAYS	28 DAYS	56 DAYS
1	0	5%	3.85	4.20	4.8	5.1
2	5	5%	4.25	4.39	5.48	5.6
3	10	5%	4.68	4.63	5.92	6.01
4	15	5%	4.98	5.01	6.82	6.98
5	20	5%	4.26	4.45	5.86	6.21

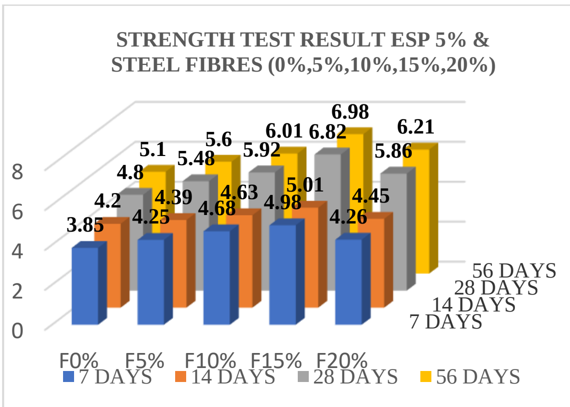

Fig.5.4: STRENGTH TEST RESULT ESP 5% & STEEL FIBRES (0%,5%,10%,15%,20%)

Table 5.5.: FLEXURAL STRENGTH TEST RESULT ESP 5% & CARBON FIBRES (0%,5%,10%,15%,20%)

MIX	CF	ESP	7 DAYS	14 DAYS	28 DAYS	56 DAYS
1	0	5%	3.85	4.09	4.8	5.2
2	5	5%	4.28	4.45	5.45	5.52
3	10	5%	4.62	4.8	5.95	6.01
4	15	5%	4.98	5.12	6.69	6.75
5	20	5%	4.57	4.98	6.01	6.21

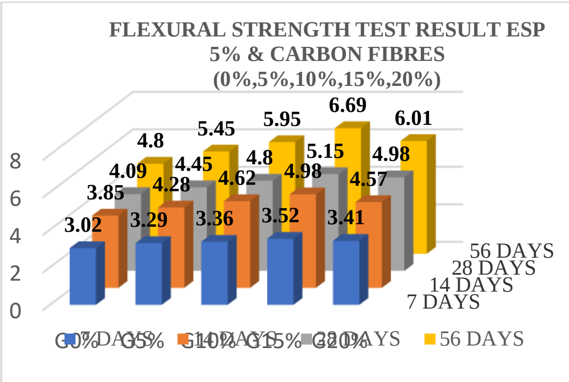

Fig.5.5: FLEXURAL STRENGTH TEST BAR CHART RESULT ESP 5% & CARBON FIBRES (0%,5%,10%,15%,20%)

Table 5.6.: FLEXURAL STRENGTH TEST RESULT ESP 5% & STEEL FIBRES (0%,5%,10%,15%,20%)

MIX	SF	ESP	7 DAYS	14 DAYS	28 DAYS	56 DAYS
1	0	5%	3.85	4.09	4.8	5.01
2	5	5%	4.11	4.35	5.32	5.38
3	10	5%	4.46	4.56	5.87	5.92
4	15	5%	4.86	4.98	6.48	6.58
5	20	5%	4.58	4.48	5.98	6.01

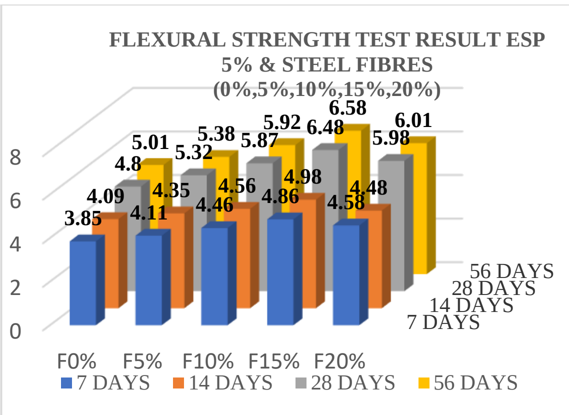

FIG.5.6: FLEXURAL STRENGTH BAR CHART TEST

RESULTS

DURABILITY TESTS:

Table 5.7.: SORPTIVITY TEST RESULT @ ESP 5% & CARBON FIBRES (0%,5%,10%,15%,20%)

Mix ID	% Carbon Fibers	EGG SHELL POWDER	% GGBS	Dry wt. in grams (W1)	Dry wt. in grams (W1)	Sorptivity value in 10^{-5} mm/min $^{0.5}$
1	0	5%	0	979	980	2.32
2	5	5%	5	948.5	950	3.48
3	10	5%	10	908.5	910.35	4.07
4	15	5%	15	909.0	911.01	4.09
5	20	5%	20	918	920.25	5.23

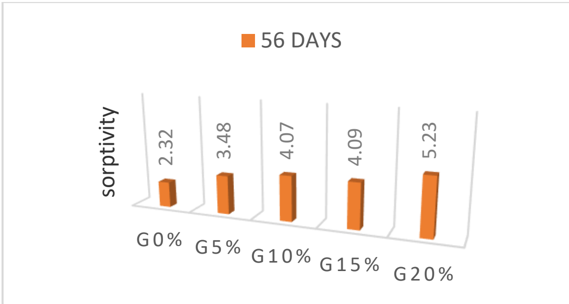

FIG.5.8: SORPTIVITY BAR CHART TEST RESULTS

SORPTIVITY TEST RESULT @ ESP 5% & STEEL FIBRES (0%,5%,10%,15%,20%)

Mix ID	% STEEL Fibers	EGG SHELL POWDER	% GGBS	Dry wt. in grams (W1)	Dry wt. in grams (W1)	Sorptivity value in 10^{-5} mm/min $^{0.5}$
1	0	5%	0	983	987	2.37
2	5	5%	5	954.5	956	3.54
3	10	5%	10	911.5	912.5	4.4
4	15	5%	15	911.0	913.01	4.29
5	20	5%	20	920	923.25	5.29

RCPT (RAPID CHLORIDE PERMEABILITY TEST) TEST RESULTS

MIX ID	% CARBON FIBERS	% ESP	CHARGE PASSED (COULOMBS	
1	0	5%	1552.5	1186.7
2	5	5%	1450.5	1026.8
3	10	5%	1359.2	997.2

4	15	5%	1056.8	954.9
5	20	5%	998.5	726.2

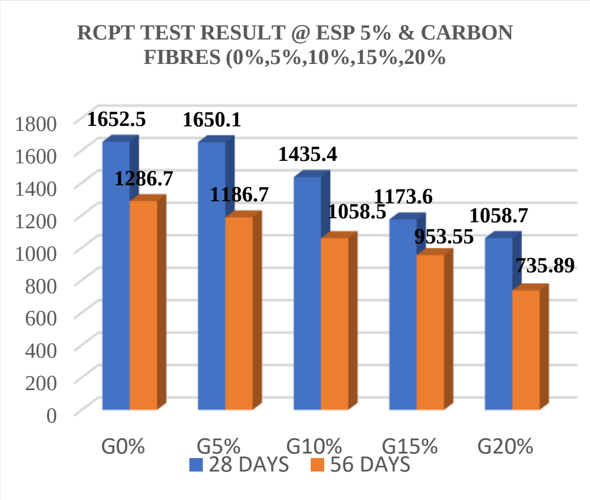

Fig.5.8: RCPT BAR CHART TEST RESULTS

MIX ID	% STEEL FIBERS	% ESP	CHARGE PASSED (COULOMBS	
1	0	5%	1552.5	1186.7
2	5	5%	1450.5	1026.8
3	10	5%	1359.2	997.2
4	15	5%	1056.8	954.9
5	20	5%	998.5	726.2

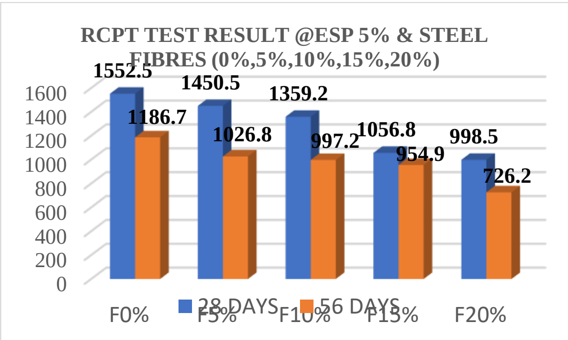

Fig.5.8: RCPT BAR CHART TEST RESULTS

VI CONCLUSION

All the experimental data shows that the addition of the cementious materials and improves the physical and mechanical properties. The results are of great importance because of this king of innovative concrete. partial replacement of cement along with Egg Shell Powder. Compressive strength of specimens are as follows:

After studying the various experimental done by various authors, following conclusions are drawn:

Usage of cement produces carbon dioxide by manufacturing process

The present paper is about experimental study on carbon fibers and steel fibers along with with egg shell powder.

the egg shells as a useful material instead of a waste material (harm to the environment) that they were hurled in many hundred tons annually had been use in an engineering application.

compressive strength increases with increase of percentage of carbon fibers in concrete along with ESP constant proportions of ESP is added for the specimens (5%)

Compressive strength increases with increase of percentage of Steel Fibers in concrete along with ESP constant proportions of ESP is added for the specimens (5%)

Better mechanical properties of concrete Specimens can be obtained with the replacement of cement with carbon fibers and steel fibers along egg shell powder in mix.

compressive strength the mix increases with increases in carbon fibers by weight in concrete up to 20%

compressive strength the mix increases with increases in percentage of steel FIBERS in concrete by weight in concrete up to 15% then after it starts decreases.

6.2. SUGGESTIONS FOR FUTURE WORK

In spite of a long-term recognition of the problem of Sulphur acid corrosion in concrete sewer pipes this issue has not been satisfactorily resolved. Cementious material as binders have been reported as being acid resistant and thus are a promising and alternative binder for sewer pipe manufacture

Experimental study on concrete with different cementious materials may be carried out

Experimental studies on UPV and non- destructive tests may be carried out

Experiments can be conducted for short Term /Long Term Properties of Reinforced concrete with partial replacement of respective percentages

Experiments can be conducted on long term properties durability test.

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