Study on Egg Shell Concrete

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***Abstract*—This paper presents the partial replacement of cement by egg shell powder. In present world, increased accumulation of carbon dioxide content in atmosphere is creating environmental pollution and global warming. In every tons of cement manufacturing produces equal amount of carbon dioxide. In order to reduce the impact of carbon dioxide emission and to protect the environment, cement is been replaced by egg shell powder. This study represents the influence in properties of concrete when cement is replaced by 5%, 10% and 15% of egg shell powder . Properties are experimentally investigated based on compressive strength, split tensile strength and flexural strength of concrete. Compressive ,tensile and flexural strength up to 7 days of age were compared with conventional concrete; from the results obtained, it is found that egg shell powder can be used as cement replacement material.**

Keywords—Compressive strength;split tensile strengt;,flexural strength; egg shell powder

I. INTRODUCTION

Concrete is one of the world's most construction material due to its versatility, durability and economy. During the manufacturing of concrete tons of CO2 are produced which imparts an impact in the ecological balance of the environment. Today many researchers are ongoing into the use of Portland cement replacement using supplementary cementitous materials like fly ash ,steel slag etc.

A.Egg shell powder

Eggshell known as a smooth surface that is desirable compared rough eggshells fracture more easily. Most good quality eggshells of commercial layers contain approximately 2.2 grams of calcium in the form of calcium carbonate. About 95% of the dry eggshell is calcium carbonate weighing 5.5 grams.The average eggshell contains about 0.3% of magnesium, phosphorous, and traces of sodium, zinc, potassium, iron, copper and manganese. There are many factor influences in quality of eggshell which is nutrient adequacy, flock health problem, environmental condition and breeding. Apart from that, the controlling rate of egg weight also contributes to a good quality of eggshell and it is not depends on the thick eggshell mean strong. Sometimes, thinner eggshell is stronger than thicker eggshell. This fact is due to shape and organization of organic and inorganic component of the shell.

Eggshell waste can be used as fertilizer, animal feed ingredients and other such uses. However, majority of the eggshell waste is deposited as landfills. Eggshell waste in landfills attracts vermin due to attached membrane and causes problems associated with human health and environment. The aim of this review is to spread awareness of egg shell powder as a constructional material.

Fig.1.Egg shell powder sieved through 90 micron sieve

II OBJECTIVES OF STUDY

The main objective of this study is to experimentally investigate the suitability of egg shell powder used as a partial replacement of cement in concrete and compared it with conventional concrete. The followings were also considered.

- To study the structural behavior of replaced concrete
- To determine the percentage which gives the maximum strength when compared to conventional concrete.
- To examine the possibility of egg shell powder as a partial replacement of cement.

III.EXPERIMENTAL PROCEDURE

A. Materials used

Ordinary Portland cement of 53 grade confirming to is used in this study. M sand confirming to grading zone II of IS 383-1970 is used as fine aggregate. Crushed stones were used as coarse aggregate. The maximum aggregate size of coarse aggregate was 20 mm. Coarse aggregate was in surface saturated dry condition. Egg shell are cleaned in normal water and sun dried for 5 days approximately at a temperature range of 25 to 300 C. The shells then hand crushed grinded and sieved through 90 micron sieve. The water shall be clean an free from deleterious matter. Impurities in the water may affect setting time, strength and promotes corrosion reinforcement .It shall meet the requirements stipulated in is 456:2000.

TABLE I
PHYSICAL PROPERTIES OF CEMENT

SL NO	Properties	Test Value
1	Standard consistency	34%
2	Initial setting time	48 min
3	Final setting time	600 min
4	Fineness	3%

TABLE II
PHYSICAL PROPERTIES OF FINE AGGREGATE

Slno:	Properties	Test values
1	Specific gravity	2.7
2	Fineness Modulus	4.72
3	Bulking of fine aggregate	52%

TABLE III
PHYSICAL PROPERTIES OF COARSE AGGREGATE

Sl no	Properties	Test values
1	Specific gravity	2.67
2	Fineness modulus	4.75
3	Aggregate impact value	24.48%
4	Flakiness index	12.56%
5	Elongation index	42.24%

TABLE IV
PHYSICAL PROPERTIES OF EGG SHELL POWDER

SL NO	Properties	Test value
1	Specific gravity	2.44
2	Standard consistency	39%
3	Initial setting time	48 min

TABLE V
CHEMICAL PROPERTIES OF CEMENT AND EGG SHELL POWDER

Composition	Cement (%)	ESP(%)
SiO2	21.8	0.08
Al2O3	6.6	0.03
Fe2O3	4.1	0.02
CaO	60.1	52.1
MgO	2.1	0.01
Na2O	0.4	0.15
K2O	0.4	-
SO3	2.2	0.62
Others	-	0.62
LOI	2.4	45.42

B. Mix proportion

The mix proportioning for M30 grade concrete used in the present work. It is designed as per IS 10262:2009 standards. Specimens are prepared according to the mix proportion and by replacing cement with egg shell powder of different proportion .

TABLE VI
MIX PROPORTION

Cement	Fine aggregate	Coarse aggregate	Water
437.8	772.6	1009	197
1	1.76	2.3	0.45

C.Experimental work

Determination of strength for M30 grade concrete, using Ordinary Portland cement (OPC) with 0%,5% and 10% of egg shell powder. All the cast specimens are de-moulded after 24 hours and were placed in curing tank for a period of 7 to 28 days. The cubes of 150 x 150 x150 mm size , beam of 100 x 100 x 500 mm and cylinder of 150mm diameter and 300mm height were tested.

The concrete specimens will be tested for following strengths:

- Compressive strength for 7 and 28 days curing using standard cube specimen
- Flexural strength after 7 and 28 days curing using standard beam specimen
- Split tensile and compressive strength for 7 and 28 days curing using standard cylinder specimen.

IV RESULTS AND DISCUSSION

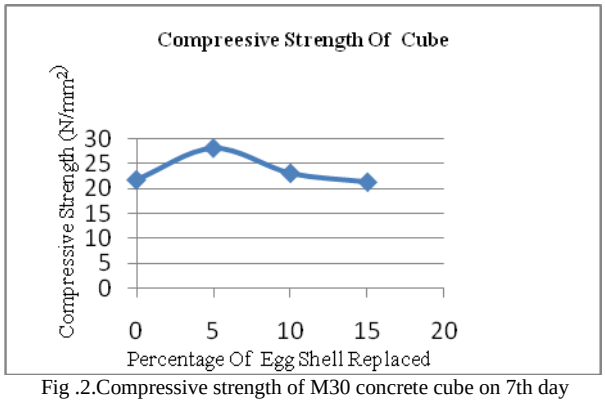

Fig .2.Compressive strength of M30 concrete cube on 7th day

Fig.3.Test setup for compressive strength

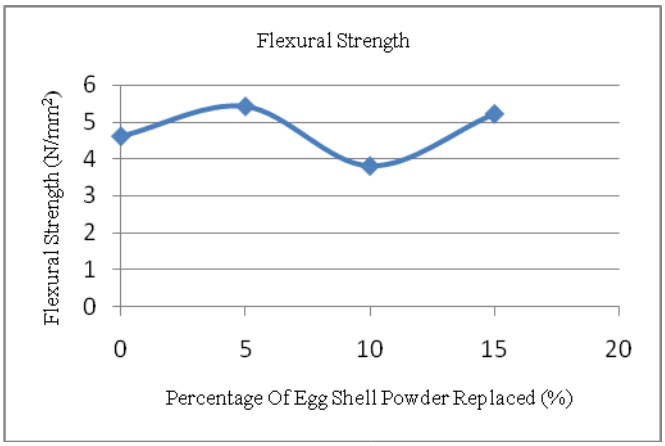

Fig 5. Flexural strength of beam in 7th day

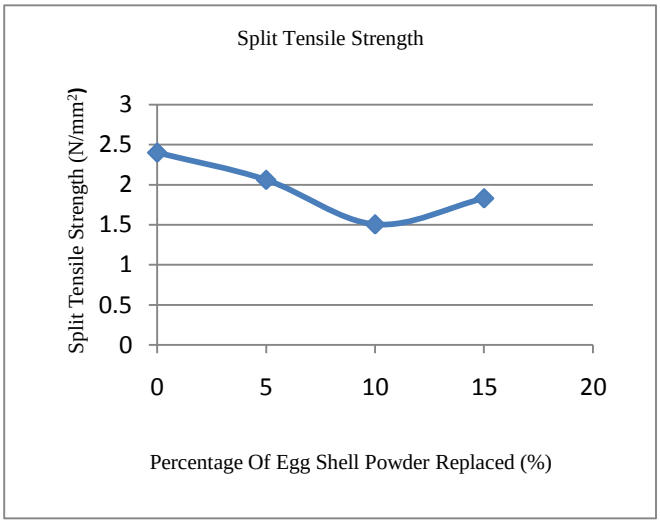

Fig .6. Split tensile strength of cylinder in 7th day

Fig.7.Test setup for split tensile strength of cylinder

V.CONCLUSION

- Compressive strength was higher than control concrete for 5 % ESP replacement at 7 days of curing ages. ESP replacements greater than 10 % had lower strength than control concrete
- Egg shell concrete gives greater split tensile and compared to concrete without egg shell powder
- Optimum replacement of cement is up to 5%.
- Further strength can be improved in addition of fly ash

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