Study and Experimental Investigation of Partial Replacement of Eggshell Powder as Cement in Concrete

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Abstract

Though out the world, concrete is being widely used for the construction of most of the buildings, bridges etc. The huge quantity of concrete is used for rapid infrastructure development. unfortunately, India is not self sufficient in the production of cement and its very costlier too. Therefore the suitable solution is the various waste material is partially replace with the cement. Since several replacement experiments are done for coarse and fine aggregates. It may lightly minimise the construction cost.So, in our concept of the project is partial replacing the cement with eggshell powder .our project describes the effect of replacement of eggshell powder for cement in proportion such as 5%,10% and 15%of ESP. The results outcome were found to be successful.

Keywords*: Eggshell powder, cement, compressive strength, flexural strength.*

I. INTRODUCTION

All the waste products are seriously polluting the environment. There are many types of waste disposal systems are possible. Such as land filling, open burning and river fill definitely indicate the solid waste.[1] Nowadays, waste products are used in construction industry and maximize the profit and reducing the amount of waste. The construction industry are searching for alternative products that can reduce the construction cost.[2] The eggshell have good characteristics when mixed with concrete and it has a good strength durability.[3] Most of the eggshell waste is commonly disposed in landfills without any pretreatment because it is traditionally useless.Eggshell has a cellulosic structure. Eggshell consists of several mutally growing layer of caco3, the inner most layer maxillary 3 layer grows on the outermost egg membrane and creates the base on which palisade layer constitutes the thickest part of the eggshell. The eggshell primary contains calcium, magnesium carbonate (lime) and protein.[4]The main ingredient in eggshell is calcium carbonate in the range of 95% and the remaining 5% includes magnesium, copper, ironic acid, silica acid aluminium, phosphorous, sodium potassium, zinc, and iron. Eggshell are waste materials from hatcheries, homes and fast food industries and can be really collected in plenty.[6].The study conducted for partial replacement of cement with GGBS upto25 to 40% .With 25% of GGBS the compressive strength at the end of 7,14 and 28 days 32.1, 39.94 and 47.56N/mm2 respectively. 2. The compressive strength at the end of 28 days decreases when the GGBS percentage is increased beyond 40% [10]

II. MATERIALS AND METHODOLOGY

FLOW CHART

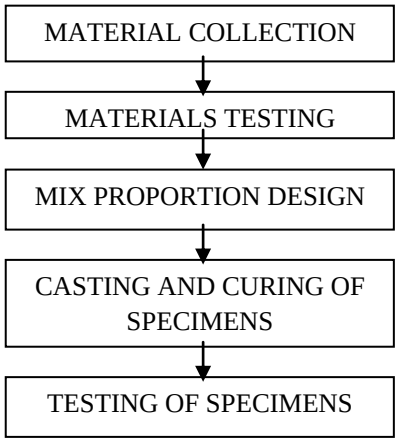

Fig.1.Methodology Flowchart.

A. Material

Generally, the quality of concrete produced depends on the quality of raw materials only. Such as cement, aggregate, and water. If the raw materials used are of low quality, then the resulting concrete will have low standards and the result of the concrete is not strong.

1) Cement

The choice of the cement content depends on the strength requirements. The cement used for this study is ordinary Portland cement of 53- grade.

Fig.2. Cement

2) ***Sand***

The fine aggregate are playing an important role in the concrete mixture. It consists of natural resources and manufactured from gravel.Sand has been sieve in 4.75mm

Fig.3. Sand

3) ***Coarse Aggregate***

The coarse aggregates that are used for the concrete are 20mm of maximum size and they should be angular and well graded. The diameter of the aggregate is 9.5mm to 37.5 mm.The selection of aggregate is very important to the concrete mixture.

Fig.4. Coarse Aggregate

4) ***Eggshell Powder***

The chemical composition of eggshell powder and cement were found to be similar. The main component of eggshell powder was calcium carbonate around 51%.. The following procedure was carried to prepare the Egg shell powder by material collection, Grinding, powdering, sieving and mixing

Fig.5. EGGSHELL POWDER

B. Mix Design Procedure:

The process of mixing is define by measuring concrete mix ingredients either by volume or by mass and introducing them into the mixture. The batching is done by volume but most specifications require that batching be done by mass rather than volume..M25 Grade Of Concrete Was Used For Casting Specimens With The Following Details

1) ***Preparation of Specimens Using Materials***

Cement **:** ordinary Portland cement

Aggregate **:** natural sand (river sand)

Coarse aggregate: crushed aggregate (angular) maximum size of 20mm

Water **:** tap water

Replacement material: Eggshell powder

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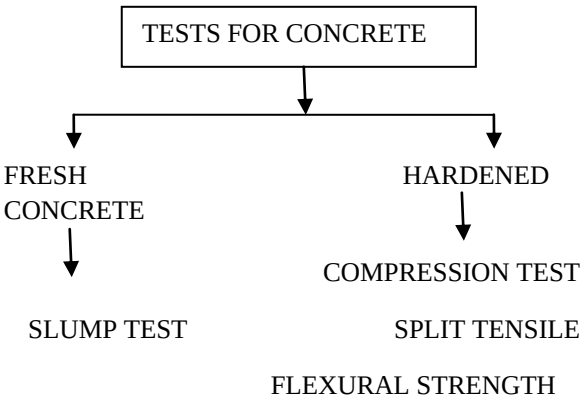

Fig.6.Tests for Fresh and Hardened Concrete

C. ***Procedure For Slump Test***

The mould for the slump test is a frustum of cone 300mm of height. The base is 200mm and the top is 100mm in diameter.The base is placed on a smooth surface and the container is filled with concrete in three layers whose workability is to be

tested. Each layer is tamped 23 times with a standard 1mm diameter steel rod rounded at the end.When the mould is completed filled with concrete and it.The cone is slowly and carefully lifted vertically an unsupported concrete will now slump.The decrease in the height of the center of the slumped concrete is called slump.The decrease in the height of concrete to the mould is measured with scale.

D. Procedure for Cube Compression Test

We are preparing the M25 mix design with the help of properties of their materials. Then, we are preparing the eggshell up to 30% . for each and every proportion, we are making the cubes. After we are testing the cubes at 7day,14 day and 28 day. Before testing the cubes all are weighted. Compressive strength was calculated for the all proportion of cubes by using compressive strength formula with help of their resisting loads.

Volume of cube = a^3

$$=150x150x150 = 3.375x10^6 mm^3$$

E. Procedure for Spliting Tensile Strength Test

We are preparing the M25 mix design with the help of properties of their materials. Then, we are preparing the eggshell up to 30% . for each and every proportion, we are making the cylinder. After we are testing the cylinder at 7day,14 day and 28 day. Before testing the cylinders all are weighted. The tensile strength was calculated by using the formula with help of their resisting loads.Volume of cylinder $= \pi r^2 h = \pi x75^2 x300 = 5.30x10^6 mm^3$

F. Procedure for Flexural Strength Test

We are preparing the M25 mix design with the help of properties of their materials. Then, we are preparing the eggshell up to 30% . for each and every proportion, we are making the beams. After we are testing the beam at 7day,14 day and 28 day. Before testing the beams all are weighted. The flexural strength was calculated by using the formula with help of their resisting loads.

Volume of beam = l x b x h

$$= 500 \times 100 \times 100 = 5x10^6 m^3$$

III. RESULT AND DISCUSSION

A. Test Result for Cement

Specific gravity of cement (G):
G= W2-w1/(w2-w1)-(w3-w4)0.79=**3.18**
Initial setting time of the sample = **32min**
Final setting time of the sample = **8hrs**

Table.1.PROPERTIES OF CEMENT, AGGREGATE AND ESP

S. NO	MATERIALS	SPECIFIC GRAVITY	BULK DENSITY Kg/m^3	MOISTURE CONTENT
1	Cement	3.18	1300	-
2	Fine aggregate	2.54	1560	1.50
3	Coarse aggregate (20 mm)	2.71	1027	1.20
4	ESP	0.85	0.8	1.18

B. Test Result for Aggregate

Specific gravity of fine aggregate:
G = (w2-w1)/(w4-w1)-(w3-w2) = **2.54**
Specific gravity of coarse aggregate:
G= W2-w1/(w2-w1)-(w3-w4) = **2.707**

C. Compressive Strength

The Average Compressive Strength For Cube At Different Percentages (0%, 5%, 15%) at age of 7, 14,28 days. The following shows the ductile failure of cube specimens

Fig.7.COMPRESSIVE STRENGTH OF CUBE

Table.2. Test Results for Cubes

S.NO	CURING DAYS	5%	10%	15%
1	7	23.12	24.86	27.30
2	14	25.90	28.32	32.97
3	28	40.67	44.47	44.59

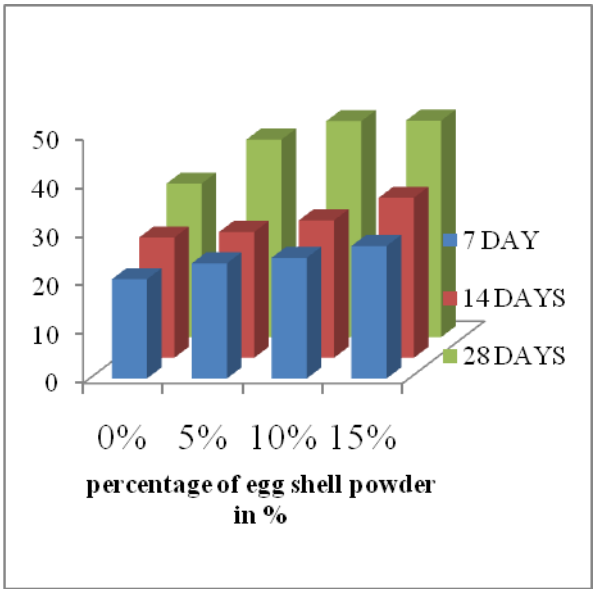

Fig.8. Comparison of Compressive Strength of Cubes

D. Split Tensile Strength

The average Split Tensile strength for cylinder at different percentages (0%, 5%, 10% and 15%) at age 7,14 and 28 days . The fig shows the ductile failure of cube specimens. The graphical representation shows the Split Tensile strength of egg shell powder.

Table 3. Test Result For Cylinder

S.NO	CURING DAYS	5%	10%	15%
1	7	2.41	2.54	2.89
2	14	2.61	2.78	3.15
3	28	3.29	3.32	3.54

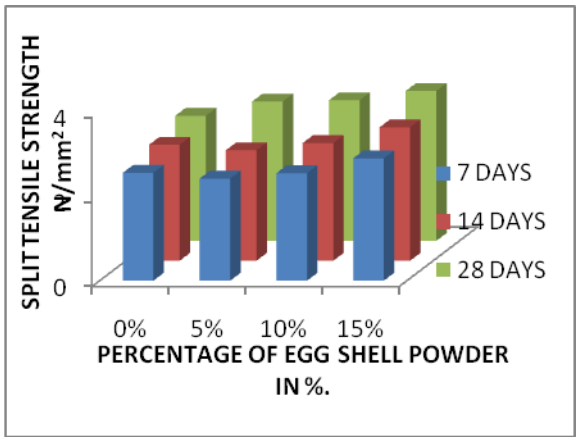

Fig.9.Comparison of Split Tensile Strength of Cylinder

E. Flexural Strength

The average flexural strength for beam at different percentages (0%, 5%, 10% and 15%) at age 7,28 days .The graphical representation shows the flexural strength of egg shell powder.

Fig.10.Flexural Strength of Beam

Table 4 Test Results For Beam

S.NO	CURING DAYS	5%	10%	15%
1	7	2.78	2.85	3.05
3	28	5.61	6.53	6.81

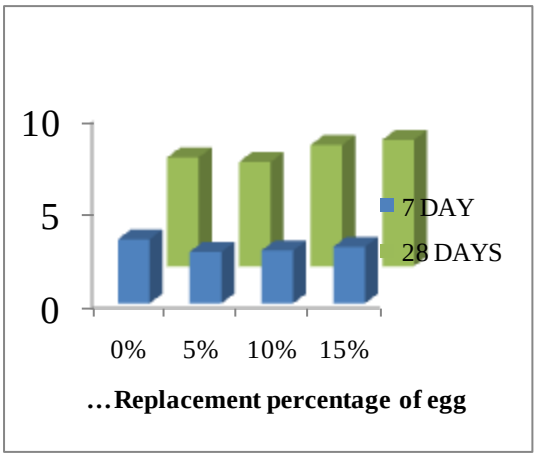

Fig 11 . Comparison of Flexural Strength of Beam

IV. CONCLUSION

The concrete was prepared for the M_{25} grade concrete with partial replacement of cement by egg shell powder with various percentages of 0%, 5%, 10% and 15%. The specimens were casted for 7days, 14 days and 28 days then tested. The results are presented below.The maximum flexural strength for partial replacement of cement with egg shell powder be achieved by 15% is found to be greater than the conventional concrete. It achieved maximum compressive strength when there is partial replacement of cement with egg shell powder (15%). So the optimum percentage of replacement of egg shell powder is 15%. The result indicate the eggshell powder is partially replaced for cement.

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