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Experimental Study on Compressive Strength of Cement Concrete Cubes by Partial Replacement of Cement with Egg Shell Powder

Balimidi Harinath
Civil Engineering Department,
Rgmcet, Nandyal, Kurnool District

Paladin Durga Varaprasad
Civil Engineering Department,
Rgmcet, Nandyal, Kurnool Distric

Utti Lakshmi Kanth;
Civil Engineering Department,
Rgmcet, Nandyal, Kurnool District

Yerrapureddi Harikumar Reddy
Civil Engineering Department,
Rgmcet, Nandyal, Kurnool District

Abstract **- The cost of cement used in concrete works is increasing day by day. Since the population is growing rapidly, need for housing also increasing. . Waste materials like eggshells are used for this purpose.. The chemical composition of eggshell powder and cement were found to be similar. The main component of eggshell was calcium carbonate (around 51%). Eggshell waste is evolved from poultry farms, restaurants and hotels. These wastes are used in animal feeds and in many countries they are thrown un used. . Such waste is collected and implemented in our project. In this study the results of experiments evaluating the use of eggshell powder from egg production industry as partial replacement for ordinary portland cement. The cement concrete cubes of mix 30 grade were casted in which cement is partially replaced with eggshell powder as 0%, 5%, 10%, 15%, 20% , by weight of cement. The compressive strength of cement concrete cubes are determined at curing ages 3, 7, 28 days.**

Keywords: Eggshell powder, Compressive Strength, Cement Concrete.

1. INTRODUCTION

1.1General

The raw materials from which it is prepared; cement and aggregates. Cement owes its unique position as the structural material in the preparation of concrete since it is economically highly resistant to water and earth quakes. In the recent times its use in construction has been increased considerably thus the cities and towns are virtually becoming cement jungles. The demand is likely to increase in the future to match the growing population, housing, transportation and other works in which concrete will be more advantageous. Aggregate is as important as cement to form a cement mortar that is very useful in construction of buildings. The aggregate is usually derived on natural sources. Calcium rich egg shell is a poultry waste with chemical composition nearly same as that of lime stone. Use of eggshell waste may be used to replace cement which will improve the overall performance. This experimental study aims to investigate the suitability of egg shell powder as partial replacement for cement (OPC53) in the production of low cost concrete. This study investigates the performance of cement concrete in terms of compressive strength for 3 days, 7 days and 28 days at replacement levels of OPC by eggshell powder as by weight of cement. Water-binder ratio was kept constant at all cases. These cement concrete specimen were deep cured in water under normal atmospheric temperature. On the basis of result that partial replacement of cement by eggshell powder found to increase in compressive strength.

1.2 Cement

Cement is a binding material that sets and hardens independently, and can bind other materials together..

1.3 Ordinary Portland Cement

the most commonly used type of cement. Portland cement is a basic ingredient of concrete and mortar.

Aggregates

Aggregate properties greatly influence the behavior of cement mortar cube, since they occupy about more volume of the total volume of cement mortar cube. The aggregates are classified as fine aggregate and coarse aggregate.

Fine Aggregate

Fine aggregate are material passing through an IS sieve that is less than 4.75 mm gauge. The most important function of the aggregate is to provide workability and uniformity in the mixture. The aggregate also helps the cement paste to hold the coarse aggregate particle.

Coarse Aggregate.

The aggregate strength is an important factor in the selection of aggregate.

Water

- It should be free from oils, acids, alkaline materials or other organic or inorganic impurities.
- It should be free from iron, vegetable matter or other any type of substances, which likely to have adverse effects on concrete or reinforcement.

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Eggshell Powder
The eggshell consists of traces of calcium. Eggshell comprises 93.70% calcium carbonate, 4.20% organic matter, 1.30% magnesium carbonate, and 0.8% calcium phosphate.

Super Plasticizer : Master Glenium SKY 8630
Mix Design for M30 Grade of Concrete
Step-1: Stipulations for Proportioning

- Grade Designation :M30
- Type of cement : OPC 53 grade
- Max. nominal size of coarse aggregate : 20 mm
- Min. Cement content :320kg=m3(From IS: 456-2000 table5
- Max. Water - Cement ratio : 0.45 (From IS: 456-2000 Table5)
- Workability : 25-50 mm Slump
- Exposure condition : Severe
- Method of concrete placing : Manual
- Max. Cement content : 450kg=m3(From Is-10262:2009)
- Chemical admixtures : Master Glenium SKY 8630
- Type of aggregates : Crushed angular aggregates
- Degree of supervision : Good

Step-2: Tests data for Materials

a)Cement used : OPC 53 grade

b)Specific gravity of cement : 3.06

c)Chemical admixture : Master Glenium SKY 8630

d)Specific gravity of

I) Coarse aggregate : 2.87

II) Fine aggregate : 2.538

Step-3: Target mean Strength

1)f 'ck = f ck + 1.65 * sigma (sigma=5, from IS :10262 2009, Table1)

= 30+ 1.65 * 5

= 38.25N=mm2

STEP-4: Selection of Water - Cement ratio

a) Max. Water - Cement ratio = 0.45

b) Adopted Water - Cement ratio = 0.45.

Step-5: Selection of water content

From IS: 456-2000 Table no.2

Max. water content = 186 lit (25 - 50mm Slump)

We are using chemical admixture so the water content is reduced to 20%

=186*0.8 = 148.8 lits

Step-6: Calculation of cement content

a) Water - Cement ratio = 0.45

Cement content = 148.8/0.45 = 330.67kg=m3

Step-7: Proportion of volume of Coarse aggregate and Fine aggregate

The corrected portion of coarse aggregate for W/C ratio 0.45 is 0.63 For manual placing of concrete there is no change in proportion Volume of course aggregate content= 0.62 + 0.01 = 0.63

Step-8: Mix calculations

a)Volume of concrete = 1m3

b)Volume of cement = Mass of cement/(Speci c gravity of cement * 1000)

= 330.67/(3.06 * 1000)

= 0.108m3

c)Volume of water =148.8/ 1000=0.1488m3

d)Volume of chemical admixture (super plasticizer @0.6% by mass of cement) =Mass of chemical admixture/(specific gravity of admixture)*1000 =1.984/(1.08)*1000

=0.0018

e)Volume of all in aggregate = (a-(b + c +d))

= (1-(0.108+0.1488+0.0018))

= 0.7414 m3

f)Mass of coarse aggregate= d * volume of the coarse aggregate * specific gravity of coarse aggregate * 1000

= 0.7414* 0.63 * 2.87 * 1000

= 1340.52kg =m3

g)Mass of ne aggregate = d * volume of the ne aggregate * specific gravity of coarse aggregate* 1000

=0.7414 * 0.37 * 2.538* 1000

= 696.219kg=m3.

step-9 : Field corrections

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Surface moisture corrections :

Quantity of surface moisture in coarse aggregate : 0

Quantity of surface moisture in fine aggregate : 0

Water Absorption Correction :

Water absorption of coarse aggregate :(0.65/100)*1340.52 = 8.713 kg

Water absorption of fine aggregate :(2/100)* 696.219 = 13.924 kg

Water content at site = 148.8+8.713+13.924 = 171.437lits=m3

Quantity of coarse aggregate at site = 1340.52-8.713 = 1331.807kg=m3

Quantity of fine aggregate at site = 696.219-13.924 =682.295kg=m3

Step-10: Mix proportions

Cement = 330.67kg=m3

Water = 171.437lits=m3

Fine aggregate = 682.295kg=m3

Coarse aggregate = 1331.807kg=m3

Water - Cement ratio = 0.45

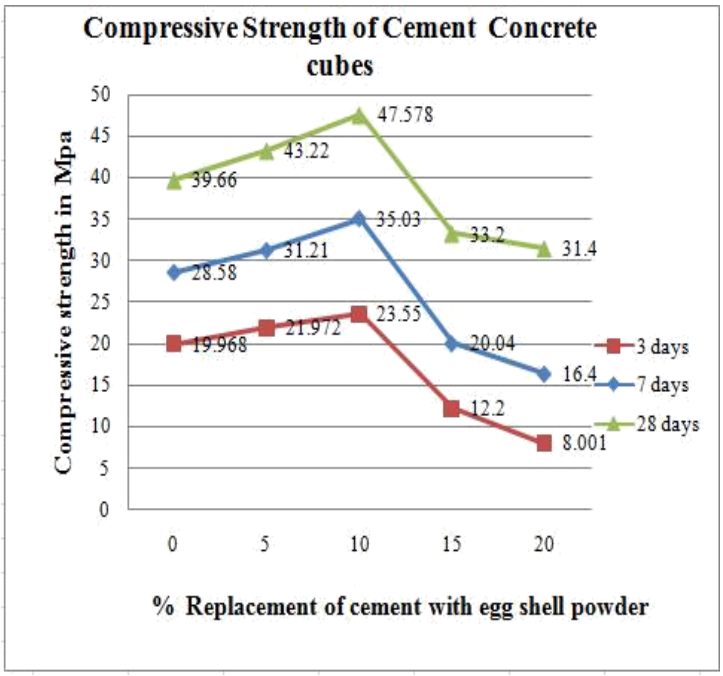
Super plasticizer(if we assume as 0.6% by weight of cement)S=1.984kg=m3

RATIO=1:2.063:4.027

EXPERIMENTAL RESULTS

Table 7.1: Compressive Strength of Cement Concrete Cubes

S. No	% of replacement of cement with eggshell powder	Compressive Strength (Mpa) at 3 days	Compressive Strength (Mpa) at 7 days	Compressive Strength (Mpa) at 28 days
1	0	19.97	28.58	39.66
2	5	21.97	31.21	43.22
3	10	23.55	35.03	47.58
4	15	12.20	20.04	33.2
5	20	8.001	16.40	31.4



CONCLUSION

[1] The compressive strength of cement concrete cubes has increased on 5% and 10% replacement of cement with eggshell powder.

[2] The poultry waste can be used in concrete works to reduce Environmental pollution.

[3] The cost of cement mortar works can be reduced using eggshell powder as partial replacement in cement.

[4] So we can replace cement with eggshell powder upto 10% to reduce the cost of construction in cement mortar works.

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