International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 06 | June-2018 www.irjet.net p-ISSN: 2395-0072

REPLACEMENT OF CEMENT WITH COCONUT SHELL ASH AND EGG SHELL POWDER FOR PREPARATION OF FRESH CONCRETE

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Abstract - *A waste material which is having cementious properties and can be used in concrete is becoming a worldwide practice. This cementious property waste materials becoming increasingly important because need of more sustainable binding products is require. The environmental impact of cement is significant because its manufacturing emits large amount of CO and green house gases. Waste material such as egg shell and coconut shell are having pozzolanic properties which can partially replace the cement. In this study report egg shell powder and coconut shell ash is used for partially replacing the cement. M-20 grade concrete designed specimen is tested for compressive strength. Egg shell powder + coconut shell ash are varies up to 13% (0%, 5%, 10%, 12%, 13%) to weight of cement in concrete. Compressive strength is evaluated after 7, 28 days of curing.*

Workability is also determined for same concrete of M-20 grade and water cement ratio 0.5. This workability test is done by slump cone test method.

Key Words: **Coconuts shell ash (CSA), egg shell powder (ESP), compressive strength, workability, concrete, cement.**

1. INTRODUCTION

Concrete is a composite material made of fine and coarse aggregate and bonded together with the cement, water (cement paste) that hardens over time. The ecological impact of concrete mainly occurs in its manufacturing and application process. The cement industry is one of the main producers of carbon dioxide (CO_2), and greenhouse gases. It can cause harm to the most fertile layer of the earth, the topsoil. Due to this backdrop, the search for substitute to cement is a needed. Many materials are tested but can only partially replace the cement. Egg shells and coconut waste are some of those which generate from domestic units as well as small scale industries. The chicken eggshell is having 95-97% calcium carbonate particles, which are stabilized by a protein matrix. About 1.61 million tones of egg shells are generated annually, which makes India a fifth largest country in the world. India is the third largest producer of coconut in world. From the reports, India produced 11.1 millions of tones coconut in year 2014. Coconut shells have better durability characteristics, high toughness and abrasion resistant property. In coconut shell lignin content is more and the cellulose content is less, coconut shells are having similar chemical composition to hard wood.

1.1 Materials

Cement used is OPC ordinary Portland cement of grade 43 is taken for testing in work.

For testing in this project egg shell is required. It is from local sources is collected for use. Egg shells require proper processing before using as cement. The process to follow is washing, air drying, grinding and sieving. Sieving is done through 90 micron sieve.

Coconuts shell with husk is obtained from the temple. This husk should be removed prior to use as we only require shell ash. Proper procedure should be followed before using it involves removal of husk, sun drying, combustion, sieving.

Natural river sand of size below 4.75 mm conforming to IS 383-1970 is used as a fine aggregate. Natural crushed stone of 20 mm size is standard for aggregate and the same size is used for testing purpose.

1.2 Mix Proportion

IS method is used for mix design and M-20 grade of concrete with mix of 1:1.5:3 is made with water/cement ratio of 0.5.

Figure-1: Coconut shell ash

Figure-2: Egg shell powder

Oxides	Percentage concentration (%) cement
CaO	60-67
SiO_2	17-25
Al_2O_3	3-8
Fe_2O_3	0.5-6
MgO	0.1-4
SO_3	1-3
Na_2O+ K_2O	0.5-1.3

Table-1: Chemical composition of cement

oxides	Percentage concentration (%) CSA
SiO_2	37.97
Al_2O_3	24.12
Fe_2O_3	15.48
CaO	4.98
MgO	1.89
Na_2O	0.95
K_2O	0.83
MnO	0.81
SO_3	0.71
P_2O_5	0.32
LOI	11.94

Table-2: Chemical composition of coconut shell ash

Oxides	Percentage concentration (%) ESP
CaO	60-67
SiO_2	17-25
Al_2O_3	3-8
Fe_2O_3	0.5-6.0
MgO	0.1-4.0
K_2O	0.4-1.3
Na_2O	0.4-1.3
SO_3	1.3-3.0

Table-3: Chemical composition of egg shell powder

2. TEST RESULTS

We have done two tests for finding the mechanical properties of concrete with replacement material. So the two tests are;

1) Compressive strength test

2) Slump cone test

Compressive strength test results:

Concrete cubes of 150mm has been casted according to the IS specification. These specimens were tested in compression testing machine as per IS: 516:1959 to determine the average compressive strength.

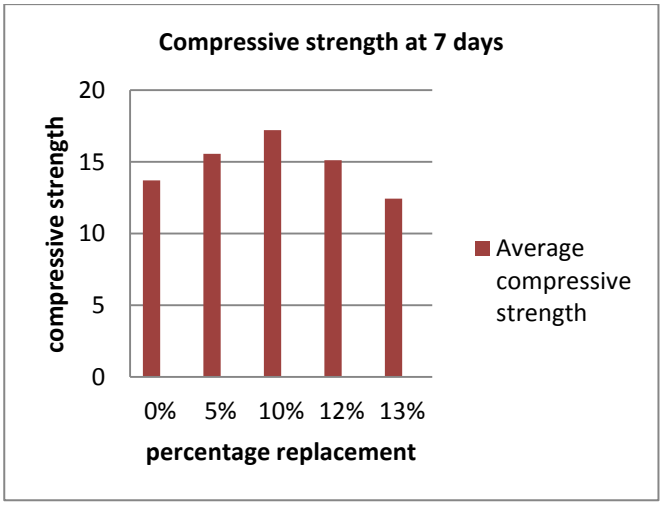

Chart-1: Average compressive strength at 7 days

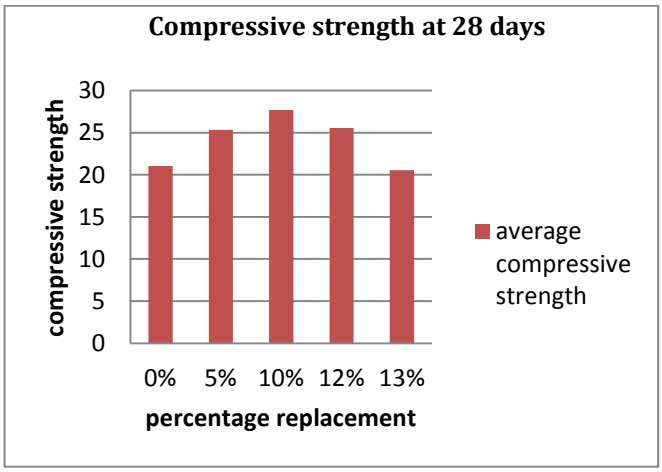

Chart-2: Average compressive strength at 28 days

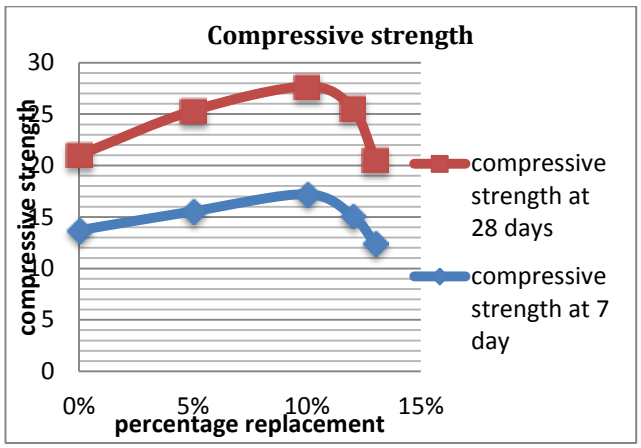

Chart-3: Overall compressive strength of concrete specimen

Table-4: Overall compressive strength of the specimen

S. No.	Concrete mix		Compressive strength	
	In mix	In percentage	7 days	28 days
1	E0 C0	0%	13.71	21.02
2	E2.5 C2.5	5%	15.55	25.33
3	E5 C5	10%	17.21	27.68
4	E6 C6	12%	15.11	25.55
5	E6.5 C6.5	13%	12.44	20.56

Slump cone test results:

Slump is made for 10% replacement of cement from ESP and CSA, as we are getting the maximum compressive strength in it.

Slump for the given sample = 19 mm

3. CONCLUSIONS

- CSA and ESP are founded as of useful binding materials. Properties of both the materials are very similar to cement, which we are using in concrete.
- ESP and CSA of 10% replacement give the maximum compressive strength.
- After 10% of replacement, strength gets retards as by increasing the CSA and ESP percentage.
- Up to 12% it is still slightly more compressive strength than that of conventional one. But at 13% compressive strength is less than that of conventional.
- If we want more compressive strength, we can go for 10% replacement as it gives more strength than conventional.
- As by slump cone test, we observed no subsidence i.e. true slump which signifies it very dry mix. It can be said it is having less workability.
- As we get slump height 19mm, which makes it appropriate for road construction at 10% replacement for M-20 grade.

ACKNOWLEDGEMENT

I express my heartfelt and profound gratitude to **Prof. Manish Dubey,** Head of Department of Civil Engineering Department, OIST Bhopal for his valuable suggestions at all stages of my research work.

Finally I would like to thank **Mr. Hrituraj Singh**, all of this would have been impossible without his constant support.

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