International Journal of ChemTech Research
CODEN (USA): IJCRGG, ISSN: 0974-4290, ISSN(Online):2455-9555
Vol.10 No.8, pp 453-457, 2017

Experimental Investigation on Partial Replacement of Eggshell Powder in Conventional Concrete

Anand Babu.A[1]*, Ramprasanth A A[2]., Shanmugavadivu V A[3]

Department of Civil Engineering, SNS College of Engineering, Coimbatore, Tamilnadu, India

Abstract : This paper reports the results of experiments evaluating the use of egg shell powder from egg production industry as partial replacement for ordinary Portland cement in cement mortar. The chemical composition of the egg shell powder and compressive strength of the cement mortar was determined. Calcium rich egg shell is a poultry waste with chemical composition nearly same as that of limestone. This paper describes research into use of poultry waste in concrete through the development of concrete incorporating eggshell powder (ESP). Different ESP concretes were developed by replacing 5-25% of ESP for cement. The results indicated that ESP can successfully be used as partial replacement of cement in concrete production. The data presented cover strength development and transport properties. With respect to the results, at 5% ESP replacement the strengths were higher than control concrete and indicate that 5% ESP is an optimum content for maximum strength. In addition, the performance of ESP concretes was comparable up to 10% ESP replacement in terms of transport properties with control concrete. Few of such products have already been identified like Rice Husk Ash (RHA), Fly Ash, Silica Fumes, Egg shell etc. Amongst these RHA and Egg shells are known to have good prospects in minimizing the usage of cement.

Keywords : Concrete, characterization, eggshell power (ESP), partial replacement, performance.

1.0 Introduction

Energy plays a crucial role in growth of developing countries like India. In the context of low availability of non-renewable energy resources coupled with the requirements of large quantities of energy for Building materials like cement, the importance of using industrial waste cannot be under estimated. During manufacturing of one tonnes of Ordinary Portland Cement we need about 1.1 tonnes of earth resources like limestone, etc. Further during manufacturing of 1 tonnes of Ordinary Portland Cement an equal amount of carbon-di-oxide are released into the atmosphere. The carbon-di-oxide emissions act as a silent killer in the environment as various forms. In this Backdrop, the search for cheaper substitute to OPC is a needful one.

Calcium rich egg shell is a poultry waste with chemical composition nearly same as that of limestone. Use of eggshell waste instead of natural lime to replace cement in concrete can have benefits like minimizing use of cement, conserving natural lime and utilizing waste material[1,2,3]. According to a study eggshell waste generation in India, the United States and the United Kingdom is 190000, 150000 and 11000 tonnes per annum respectively. 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. Few investigations

were conducted to use eggshell waste in civil engineering applications. Amu et al., studied eggshell powder as a stabilizing material for improving soil properties[4,5]. A. J. Olarewaju et al, 2011 studied suitability of eggshell stabilized soil as subgrade material for road construction[6]. Apart from these studies, no other investigations were found in literature to use eggshells in civil engineering applications.

Therefore, to initiate use of eggshell waste for partial replacement of cement in concrete, there is a need to understand concrete properties made with eggshell powder. Thus, the primary objective of this study was to understand the possibilities of use of ESP in concrete. Investigations were systematically conducted on performance of ESP concretes in terms of strength properties like compressive strength and splitting tensile strength and transport properties like water absorption and sorption. The control and ESP replaced concretes were tested for 7, 14 and 28 days. Based on the test results, the influence of ESP replacement and the curing age on the concrete properties were discussed.

2.0 Egg Shell

Eggshell consists of several mutually growing layers of $CaCO_3$, the innermost 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 top layer is a vertical layer covered by the organic cuticle. The eggshell primarily contains calcium, magnesium carbonate (lime) and protein. In many other countries, it is the accepted practice for eggshell to be dried and use as a source of calcium in animal feeds. The quality of lime in eggshell waste is influenced greatly by the extent of exposure to sunlight, raw water and harsh weather conditions. It is the fine grained powder with suitable proportion which is sieved to the required size before use with concrete/mortar.

Fig1. Egg shell powder

3.0 Objectives

To investigate the utilization of Industrial wastes as a replace-ment for cement in concrete and influence of this on the Strength of concretes made with different cement replacement levels with admixtures.

3.1 Experimental Program

3.1.1 Materials Used

Ordinary Portland Cement of 53grade confirming to IS 12269-1987 was used in this study. River sand confirming to grading zone III of Is 383-1970 was used as a fine aggregate. Well graded coarse aggregate passing through 20mm sieve according to IS 383-1970 was used. Well graded coarse aggregate passing through 20mm sieve according to IS 383-1970 was used. Egg shell procured from local industry. It grained and sieved to the required size before used in concrete mix used for the research and experimental works in our project.

Table 1Physical properties of cement

S.NO	Description	Test Values
1	Standard Consistency	33%
2	Initial Setting Time	34 min
3	Final Setting Time	350 min
4	Compressive Strength	54.5 N/mm^2
5	Fineness Modulus	3.2%

Table 2Physical Properties of Fine Aggregate and Course Aggregate

S.NO	Description	Fine Aggregate	CoarseAggregate
1.	Fineness modulus	2.630	6
2.	Water Absorption	0.51%	0.30%
3.	Specific gravity	2.63	2.68

Table 3Chemical Properties of Cement and Eggshell Powder

Composition	Cement	ESP
CaO	63.8%	47.49%
SiO2	21.4%	0.11%
Al2O3	5.1%	Nil
Fe2O3	2.6%	Traces
MgO	0.36%	Nil
SO3	3.38%	0.38%
K2O	1.88%	Nil
Na2O	0.14%	0.14%
Sp. Gravity	3.12	2.14

3.1.2 Mix Proportioning

The mix proportioning for M20 grade concrete used in the present work. It is designed as per IS 10262-1982 stand-ards. The mix proportioning adopted was cement: sand: coarse aggregate: water/cement ratio respectively.

Table 4Adopted Mix Proportion

Cement	Fine Aggregate	Coarse Aggregate	Water
383.16 Kg/m^3	652.35 Kg/m^3	1181.77 Kg/m^3	191.58 Lit
1.00	1.70	3.08	0.50

3.1.3 Experimental Work

Determination of strength for M20 grade concrete, using Ordi-nary Portland cement (OPC) with 5% egg shell powder and increasing admixtures content as a part replacement of cement. The different proportion of admixtures (Fly ash, Micro silica, Saw dust ash) will be 0%, 10%, 20%, 30%[7]. The different mixes are conveniently designates as C, F10, F20, F30, M10, M20, M30, S10, S20 and S30 respectively. The cubes of 150 x 150 x 150 mm size and beam of 100 x 100 x 500 mm were tested. The concrete specimens will be tested

for following strengths: i) Compressive strength for 28 days curing using standard cube specimen and ii)Split tensile strength after 28 days curing using standard cylinder specimen.

4.0 Results and Discussion

Table5Average compressive strength of Cement Concrete and Eggshell powdered concrete

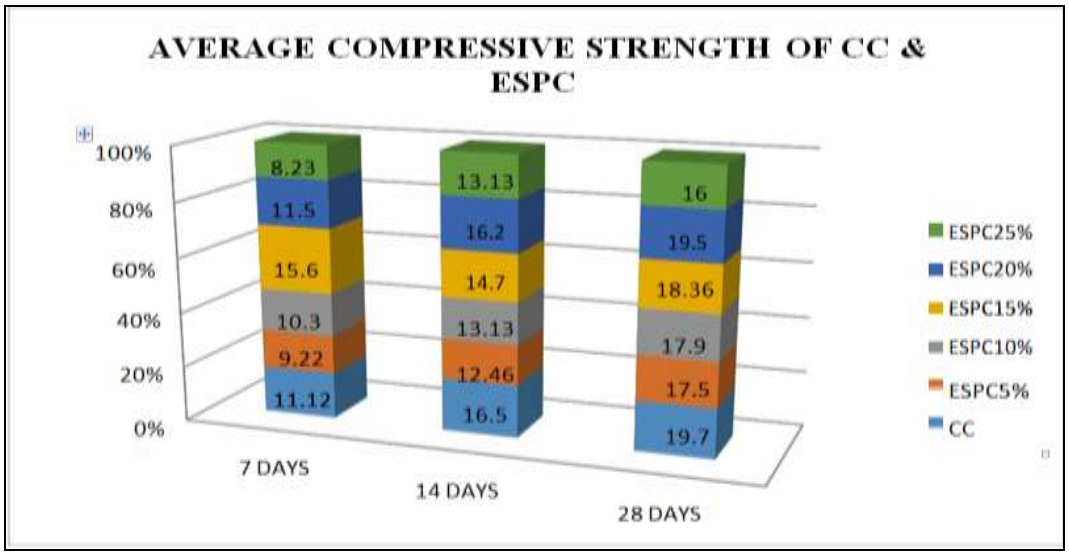


Table 6Average Split tensile strength of Cement Concrete and Eggshell powdered concrete after 7 days

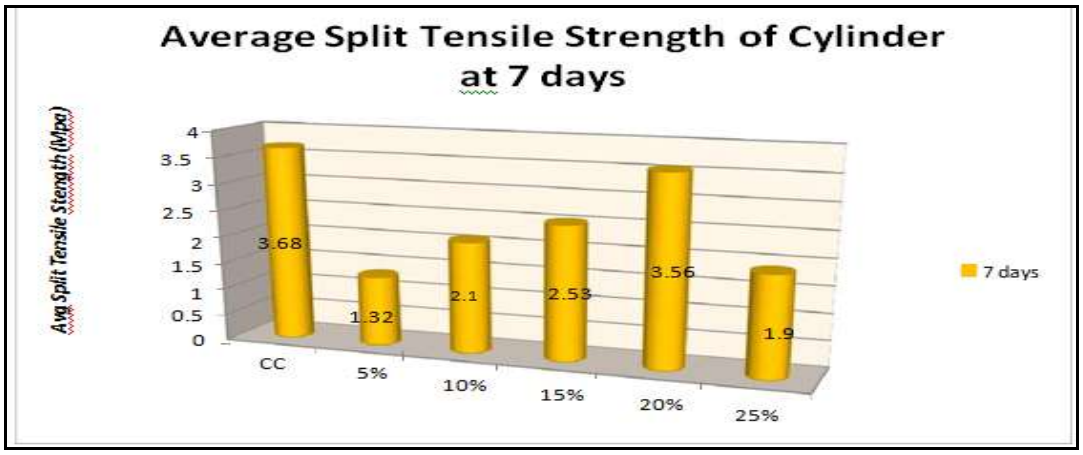
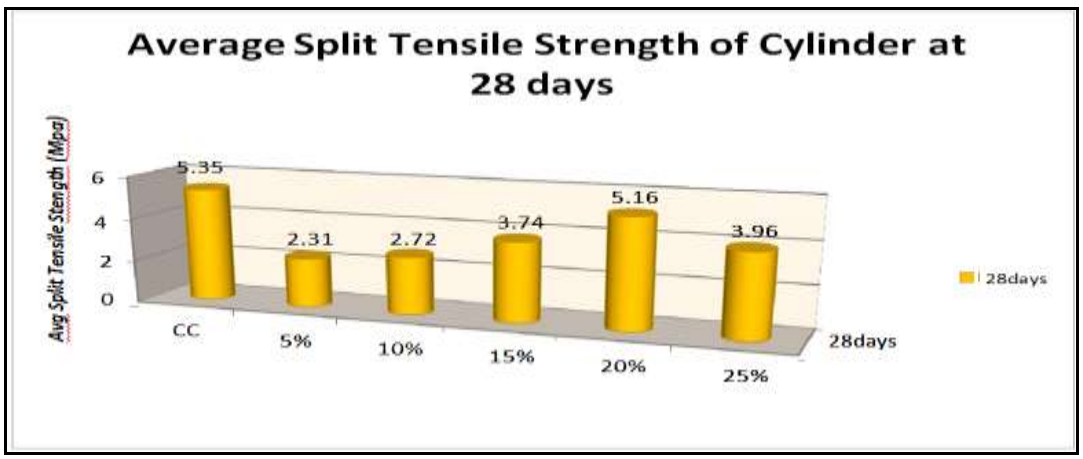


Table7Average Split tensile strength of Cement Concrete and Eggshell powdered concrete after 28 days



5.0 Conclusion

- The compressive strength of 20% Eggshell powder Concrete increases up to 19.5% than that of conventional concrete.
- The split tensile strength of 20% Eggshell powder Concrete increases to 5.16% than that of conventional concrete.
- All the percentage of EGGSHELL POWDER proves better compressive strength and split tensile strength compared than that of conventional concrete.
- Because of using the EGG SHELL POWDER we can reduce the cost of the cement and also the construction cost.
- Hence we can provide eco-friendly concrete with use of EGGSHELL POWDER.

6.0 References

1 SathishKumar.R, "Experimental Study on the Properties of Concrete Made With Alternate Construction Material", International Journal of Modern Engineering Research (IJMER), Vol. 2, Issue. 5, Sept.-Oct. 2012, pp-3006-3012.

2 C Freeda Christy, D Tensing, "Effect Of Class F – Flyash As Partial Replacement With Cement And Fine Aggregate in Mortar", Indian Jour-nal Of Engineering and Material Science, Vol 17, April 2010, pp. 140-144.

3 C.Marthong, "Sawdust Ash (SDA) as Partial Replacement of Cement", International Journal of Engineering Research and Applications (IJERA), Vol. 2, Issue4, July-August 2012, pp.1980-1985.

4 Nilforoushan, Mohammed Reza, the Effect Of Micro Silica On Permea-bility And Chemical Durability Of Concrete Used In The Corrosive Envi-ronment, Iran J. Chem and ChemEng, vol 24 ,No 2, 2005.

5 Mohammed Razzaq, Ahmed NamahHadi, "Effect Of Egg Shells Powder On Some Mechanical And Physical Properties Of Natural Rubber", The Iraqi Journal For Mechanical And Material Engineering, Vol.12, No.3, 2012.

6 Phil Glatz, Zhihong Miao and Belinda Rodda, "Handling and Treatment of Poultry Hatchery Waste: A Review", Vol 3, 12 January 2011.

7 M.O.A. Mtallib and A. Rabiu, "Effects Of Eggshells Ash On The Setting Time Of Cement", Vol 3, 12 January 2011.

8 JayrajVinodsinhSolanki, JayeshkumarPitroda, "Flexural Strength of Beams by Partial Replacement of Cement with Fly Ash and Hypo Sludge in Concrete" International Journal of Engineering Science and Innovative Technology (IJESIT) Volume 2, Issue 1, January 2013.

*****