

A Review on Partial Replacement of Cement by Egg shell Powder

Kamran Basit¹, Nitish Kumar Sharma², Brij Kishor³

¹M.Tech Student, Department of Civil Engineering, Chandhigarh University, Gharuan, India

^{2,3}Assistant Professor, Department of Civil Engineering, Chandhigarh University, Gharuan, India

Abstract:- The use of SCM's was done from the ancient Greeks who incorporated volcanic ash with hydraulic lime to create a cementitious mortar. The Greeks passed this knowledge on to the Romans, who constructed such engineering marvels as the Roman aqueducts and the Coliseum, which still stand today. Early SCMs consisted of natural, readily available materials such as volcanic ash. Nowadays, most concrete mixture contains supplementary cementitious material that forms part of the cementitious component. These materials are majority byproducts from other processes or natural materials. The major benefits of SCM is its ability to replace certain amount of Portland cement and still able to display cementitious property, thus reducing the cost of using Portland cement. More recently, strict air-pollution controls and regulations have produced an abundance of industrial byproducts that can be used as supplementary cementitious materials such as Pozzocrete, Saw dust ash, Rice husk ash, Egg shell powder, Sugarcane bagasse ash, etc. The use of such byproducts in concrete construction not only prevents these products from being land-filled but also enhances the properties of concrete in the fresh and hardened states. This paper presents a brief history and review of Egg shell powder in concrete with the aim of introducing the technology.

Keywords:- Cement replacing material, Egg Shell powder, Compressive strength

I. INTRODUCTION

Concrete is a mixture of different materials like binder (cement), fine aggregate, coarse aggregate and water. Use of concrete is very large so availability of natural material is reduced and there is no material which plays the role of this ideal material. So to fulfill the requirement of industries we have to replace fully or partially all the materials. In India number of waste materials is produced by different manufacturing companies, thermal power plant, municipal solid wastes and other wastes. Solid as well as liquid waste management is one of the biggest problems of the whole world. During manufacturing of one tonnes Ordinary Portland Cement (OPC) we need about 1.1 tonnes of earth resources. Further during manufacturing of one tones of cement an equal amount of carbon dioxide is released in to the atmosphere which acts as a silent killer in the environment as various forms. In this backdrop, the search for cheaper substitute to OPC is a needful one. Egg shells are agricultural throw away objects produced from chick hatcheries, bakeries, fast food restaurants etc. which can damage the surroundings and as a result comprising ecological issues/contamination which would need appropriate treatment. Egg shell also creates some allergies when kept for longer time in garbage. Use of egg shell 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. The egg shell primarily contains calcium, magnesium carbonate and protein. Egg Shell Powder (ESP) is the fine grained powder with suitable proportion which is sieved to the required size before use with concrete/mortar.

II. LITERATURE REVIEW

Amarnath Yerramala studied the Properties of concrete with eggshell powder as cement replacement. 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 5-15% 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 order to investigate properties of ESP concretes, five mixes were employed in this study. Several laboratory trial mixes were carried out with 300kg/m³ cement. Water to cementitious ratio, coarse and fine aggregate quantities was arrived for concretes to be tested from the trial mixes. In this study, Compressive loading tests on concretes were conducted on a compression testing machine of capacity 2000 KN. For the compressive strength test, a loading rate of 2.5 kN/s was applied as per IS: 516.1959. The test was conducted on 150mm cube specimens at 1, 7 and 28 days. Compressive strength was higher than control concrete for 5 % ESP replacement at 7 and 28 days of curing ages. ESP replacements greater than 10 % had lower strength than control concrete. Addition of fly ash improved compressive strength of ESP concrete.

D.Gowsika et al experimentally investigated the Egg Shell Powder as Partial Replacement with Cement in Concrete. 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. The cement mortar of mix proportion 1:3 in which cement is partially replaced with egg shell powder as 5%, 10%, 15%, 20%, 25%, 30% by weight of cement. The compressive strength was determined at curing ages 28 days. There was a sharp decrease in compressive strength beyond 5% egg shell powder substitution. The admixtures used are Saw Dust ash, Fly Ash and Micro silica to enhance the strength of the concrete mix with 5% egg shell powder as partial replacement for cement. In this direction, an experimental investigation of compressive strength, split tensile strength, and Flexural strength was undertaken to use egg shell powder and admixtures as partial replacement for cement in concrete.

Praveen Kumar R et al experimentally investigated the Partial Replacement of Cement with Egg Shell Powder. The aim of this study is to study the chemical composition of the egg shell to find its suitability of replacement in the concrete. To examine the feasibility of utilizing the egg shell and silica fume as cement replacement material. To study the strength parameters of the egg shell powder mixed specimens and to compare it with conventional specimens. The scope of the study is to cast the concrete specimens and conduct the compressive strength test, split tensile strength test and flexural strength test at 7th & 28th day, with the specified combinations of egg shell powder and compare it with the controlled concrete specimens. In this project M30 Concrete is designed for various combinations. A combination of Egg shell with silica fumes are used in different combinations to find the feasibility of using the Egg shells as an alternate to cement Egg shell powder replaces 10%, 20% and 30% in addition with the silica fume by 5%, 10%, 15% of weight of cement. Concrete is cast and Compressive test, Tensile and Flexural tests were carried out to find the best combination which results in optimum percentage of strength.

Freire et al carried out the investigation on egg shell waste and found out its use in a ceramic wall tile paste. Based on the presence of CaCO₃ in egg shell it can be used as an alternative raw material in the production of wall tile materials they also found that egg shell can be used as an excellent alternative for material reuse and waste recycling practices.

Lau yih bling conducted the investigation in egg albumen and reported that foamed concrete were prepared by egg albumen which has reduce the cost and time of project. 1 per cent and 5 per cent egg albumen were used. From the investigation it is concluded that 5 per cent of EAFC consists of unstable compressive strength and higher flexural strength with increase density when compared with control foamed concrete which was 64 per cent and 35 per cent. In this study it is proved that Egg Albumen Foamed Concrete (EAFC) can produce light weight concrete which is more environment friendly and improved properties.

Amu et al carried out the experiment and stated that common salt with egg shell on lateritic soil obtaining a good compliment for egg shell as a useful stabilizer for road works. Stabilization obtained by adding 2-10 per cent of common salt with optimum egg shell powder. The result showed that the addition of common salt improved the compaction and CBR characteristics of egg shell stabilized soils.

Ngo slew kee investigated on the topic of .Effect of coconut fiber and egg albumen in mortar for greener environment. And reported the effect of coconut fiber and egg albumen on mortar compressive and flexural strength. 3 types of samples were tested to compare the strength development of each other's that was mortar control, mortar containing 0.1 per cent coconut fiber with 1 per cent egg albumen and mortar containing 0.5 per cent coconut fiber with 5percentegg albumen. The strength of mortar containing 0.1 per cent coconut fiber with 1 per cent egg albumen was higher than the mortar control whereas the mortar containing 0.5 percent coconut fiber ± 5 per cent egg albumen was lower strength than the mortar control. The strength of mortar containing 0.1 per cent coconut fiber with 1 per cent egg albumen was higher than the mortar control whereas the mortar containing 0.5 per cent coconut fiber ± 5 per cent egg albumen was lower strength than the mortar control.

III. MATERIAL & METHODOLOGY

MATERIAL

1. Cement

Portland Pozzolana Cement (53 grade) conforming to IS: 12269 -1987 and with the specific gravity 3.15 was used for casting all the specimens. Tests conducted on cement are fineness of cement by sieve analysis (using 90 μ sieve), specific gravity using Le-chatlier's apparatus, initial setting time and final setting time using vicat apparatus.

2. Fine aggregate

Clean and dry river sand available locally was used. Sand passing through IS 4.75 mm sieve and as per IS: 383-1970 was used for all the specimens. Test conducted on fine aggregate are specific gravity using pycnometer, fineness modulus by sieve analysis.

3. Coarse aggregate

Crushed granite aggregate with specific gravity of 2.6 and passing through 20 mm sieve and retained on 12.5 mm sieve and as given in IS: 383 - 1970 is used for all the specimens.

4. Eggshell powder

Eggshell are collected cleaned and dried and then crushed into fine powder form to use as a replacement with fine sand.

Methodology

It is the method followed to perform the experiment. In this section we have made step wise procedure to perform experiment which is briefly described as follows:

- 1) Mix designed
- 2) Batching
- 3) Experimental programmed of casting
- 4) Mixing
- 5) Compaction
- 6) Curing
- 7) Testing

REFERENCES

1. Amarnath Yerramala, .Properties of concrete with eggshell powder as cement replacement., The Indian Concrete Journal October 2014.
2. D. Gowsika, .Experimental Investigation of Egg Shell Powder as Partial Replacement with Cement in Concrete., International Journal of Engineering Trends and Technology (IJETT). Volume 14 Number 2. Aug 2014.
3. M.O.A. Mtallib and A. Rabi, .Effects Of Eggshells Ash on the Setting Time of Cement., Vol 3, 12 January 2011.
4. Isaac O. Igwe, Genevive C. Onuegbu, .Studies on Properties of Egg Shell and Fish Bone Powder Filled Polypropylene., American Journal of Polymer Science 2012, 2(4): 56-61.
5. Praveen Kumar R, .Experimental Study on Partial Replacement of Cement with Egg Shell Powder., International journal of innovations in engineering and technology, Volume 5, ISSN: 2319-1058.
6. Dinesh.N, Ramesh Kumar.R, Arunachalam, Chandrasekhar, Gautam.P (2001), .Partial Replacement of Fine Aggregate by Rice husk ash and Eggshell Powder., International Journal of Innovative Science and research, Vol.3, Issue 1, pp.1-17.
7. Jayasankar.R, Mahindran.N, Ilangovan.R (2010), .Studies on Concrete Using Fly Ash, Rice Husk Ash and Egg Shell Powder., International Journal of Civil and Structural Engineering, Vol. 1, Issue No 3, pp. 362-373.

8. J.Karthick, R.Jeyanthi, M.Petchiyammal (2012), .Experimental Study on Usage of Egg Shell as Partial Replacement for Sand in Concrete., International Journal of Advanced Research in Education Technology, Vol.1, Issue 1, pp. 7-11.
9. M. Sivakumar, Dr. N. Mahendran, Strength And Permeability Properties Of Concrete Using Fly Ash (Fa), Rise Husk Ash (Rha) And Egg Shell Powder (Esp), Journal Of Theoretical And Applied Information Technology vol. 66 No.2.
10. Sathish Kumar.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.
11. C Freeda Christy, D Tensing, "Effect Of Class F – Flyash As Partial Replacement With Cement And Fine Aggregate in Mortar", Indian Journal Of Engineering and Material Science, Vol 17, April 2010, pp. 140-144.
12. 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.
13. Nilforoushan, Mohammed Reza, the Effect Of Micro Silica On Permeability And Chemical Durability Of Concrete Used In The Corrosive Environment, Iran J. Chem and Chem Eng, vol 24 ,No 2, 2005.
14. Mohammed Razzaq, Ahmed Namah Hadi, "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.
15. Phil Glatz, Zhihong Miao and Belinda Rodda, "Handling and Treatment of Poultry Hatchery Waste: A Review", Vol 3, 12 January 2011.