

A REVIEW STUDY OF EGG SHELL POWDER AS A CEMENT REPLACING MATERIAL IN CONCRETE

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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

1.0 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.

2.0 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 [10]. 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 CaCO_3 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 others 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 5 percent egg 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 \pm 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 \pm 5 per cent egg albumen was lower strength than the mortar control.

Okonkwo et al has concluded in his research that Egg Shell ash can be used as an alternate for cement which resulted in higher compressive strength on lateritic soil. Constant Cement of 6 and 8 per cent added with the egg ash powder of 0-10 per cent at 2 per cent intervals shows increase in 35 per cent of compressive strength but fell short of the strength requirements the durability. Ultimately they found that soil-cement egg shell mixture can be used for road pavements.

Arash Barazesh et al carried out the experiment on the effect of eggshell powder on plasticity index in clay and expansive soils and reported that plasticity index of the soil can be improved by adding egg shell wastes with the clay soil and can be used in construction projects including earth canals and earth dams.

Monisha T experimentally investigated the concrete using eggshell powder and polypropylene fibre. The food processing industries, hotels and restaurants are the places produces egg shell waste abundantly. Dumping of egg shell waste creates odour and various diseases. In order to overcome this problem we have to dispose the egg shell waste safely without environmental hazards. As a result, utilization of egg shell waste in the concrete has developed. The aim of this project work is to use egg shell powder 20% constantly as replacement of fine aggregate and to use polypropylene fibre in the range of 0%, 0.2%, and 0.4% in the M20 concrete by the volume of fraction. Various tests such as compressive strength, split tensile strength and flexural strength were carried out. The strength properties obtained were compared with the conventional concrete after the curing period of 7, 14 and 28 days. From the results it was observed that, the waste of egg shell powder used in the concrete will be comparatively low cost when compared with normal concrete.

Dinesh et al has conducted the experiment by replacing fine aggregate by rice husk ash and egg shell powder. Here they had replaced the Egg shell up to 10%, 20%, 30%, 40% & 50% using M25 grade concrete. They had conducted test for 7 days, 14 days and for 28 days. Based on the analysis in the present experimental work, they had concluded that the tensile strength, flexural strength was decreased with increasing egg shells percent. The compressive strength of the concrete is to meet required strength with 20% of the egg shell at the same time weight of the cubes are reduced upto 2kg to 2.8kg.

Jayasankar et al has investigated the experiment by partially replacing cement with flyash and egg shell powder. They had conducted experiment by varying percentage of RHA, ESP, Fly ash in M20, M25 and M30 concrete. Based on the results

obtained from the experiment it can be concluded that, RHA, Fly ash and ESP mixed cubes has equal strength with that of conventional concrete cubes in certain categories.

Karthick et al has conducted experiment by replacing the fine aggregate by egg shell. Here they had replaced the Egg shell up to 10%, 20%, 30%, 40% & 50%. They concluded that, the tensile strength, flexural strength was decreased with increasing egg shells percent. The tensile strength decreased from (2.36N/mm²) to (0.21 N/mm²) with increasing egg shell from (0 wt %) to (50 wt %).

Mahendra Prasad et al had done the research to investigate the workability and flexural strength of cement concrete containing silica fume and polypropylene fibers. Silica fume content used was 0%, 5%, 10% and 15% by replacement of equal weight of cement in concrete. Polypropylene fibers were added in 0%, 0.20%, 0.40% and 0.60% by volume fraction of concrete. Silica fume appeared to have an adverse effect on the workability of fiber concrete. It is observed from slump test results of PF0S0 to PF0.6S15 that there is continuous decrease in workability of concrete with increase in polypropylene fiber content. The increase in flexural strength was found to be around 40% with the use of polypropylene and silica fume compared to the reference concrete.

Praveen Kumar et al has investigated the combination of Egg shell with silica fumes are used in different combinations to find the feasibility of using Egg shell 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 in the M30 concrete. The compressive strength of concrete with egg shell powder increases up to 15 percent without silica fume. Addition of silica fume also enhances the strength but in economical point of view only the egg shell powder replacement is sufficient enough for getting higher strength. The split tensile strength of the egg shell powder concrete decreases with the addition of egg shell powder. The flexural strength of the egg shell concrete increases with the addition of egg shell powder up to 15 percent.

CONCLUSION

After studying the various researches done by various authors, Following conclusions are drawn:

1. The initial and final setting time of cement is 93 and 210 minutes.
2. The egg shells as a useful material instead of a waste material (harm to the environment) that they were hauled in many hundred tons annually had been use in an engineering applications.
3. The hardness and specific gravity were increased with increasing ESP.
4. Compressive strength increases with increase of percentage of Egg shell powder up to certain limit.
5. Better mechanical and physical properties of concrete can be obtained with the replacement of cement with Egg shell powder in mix.
6. The workability of concrete is decreased by increasing the amount of Egg shell powder
7. The results demonstrated that, irrespective of ESP percentage replacement there was good relationship between compressive strength and split tensile strength.

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