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Experimental Study to Check the Effect of Egg Shell Powder & Rice Husk Ash on the Property of Concrete

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ABSTRACT

This paper summarizes the upshot of various research papers dealing with the investigations on cement concrete proportioned with eggshell powder as a substitute mantle for cement. Although, it aims to understand the approaches covered by main research streams in area so as to highlight the advantages and uses of calcium rich material. Developed, developing countries nowadays exploit the potentiality of chicken eggshell powder and in a way they were fruitfully cast it on as an ingredient of animal and poultry feed, land fertilizer and even an excellent substitute option in construction industries. These marginal usages fed into the minimization of open land disposal scenarios which associates landfill problems, human and environmental health issues. This paper briefly reveals the investigations endured on strength and structural characteristics of conventional cement concrete that are evenly proportioned with calcium rich eggshell powder and their potential feasibility were exemplified.

Keywords: Eggshell powder (CaCO3), Eggshell ash (CaO on incinerated, Strength characteristics

1. INTRODUCTION

Eggs are being predominantly used by humanity in large scale and also small scale industries all over the world and the egg shell waste is commonly disposed without any pretreatment in landfills because it is traditionally futile. Meanwhile the egg shell is treated as natural solid waste which is non hazardous, that tang may attract worms and rats, that pretends to be a health crisis to the public. There are many types of disposal such as landfill, open burning, drains clogged up with rubbish and river fill. The outlay for waste disposal is expensive due to the scarcity of land and through large amounts of waste disposal there poses contamination in groundwater. Therefore, the ways should be found to utilize the waste efficiently by recycling.

Fig 1. Egg shells

Nowadays the waste products from food manufacturing industries are recycled and are used in the construction industry to maximize the profit while reducing the amount of construction budget. Egg shells are known to have good strength characteristics when mixed with concrete. Thus eggshells are applicable for the development of the construction industry.

Fig 2. Egg shell powder

II. LITERATURE REVIEWS

Gowsika et al.,(2014) experimentally investigated on eggshell powder (ESP) as partial replacement with cement in concrete. The chemical composition and strength properties of ESP in cement mortar was determined at 28 days curing period by replacement of ESP at 5, 10, 15, 20, 25, 30% by weight of cement with mix proportion 1:3. In compressive strength there was a sharp decrease beyond 5% ESP substitution and so to bump up the strength, admixtures like saw dust ash, fly ash and micro silica were used. It was found that replacement of 5% ESP with 10% micro silica contributes high strength of hardened concrete when compared to conventional concrete. [1]

Amaranth Yerramala et al., (2014) investigated the properties of concrete with eggshell powder as cement replacement. The different properties of hardened concrete have been investigated at the 7th day and 28th day curing period on replacing 5, 10, 15% of ESP for cement and tests were determined. Further result shows that addition of fly ash along with ESP up to 15% is beneficial than control concrete.The absorption property decreased with decrease in permeable voids.Sorptivity decreased with strength and increased with water absorption.[2]

Mohd Ali Khaled et al., (2014) studied the behavior of eggshell powder as partial replacement of cement in concrete. In this paper a partial amount of cement is replaced by eggshell powder as 5% increment up to 30% by weight and strength characteristics at the end of
28 days is noted down. To obtain the strength that decreased beyond 5% are enhanced by replacement of some mineral admixtures namely fly ash, micro silica and saw dust. By this scenario it is found that 5% of ESP with 10% micro silica, fly ash, saw dust replacement increase the strength property of concrete. [3]

Praveen Kumar et al.,(2015) experimentally studied on partial replacement of cement with eggshell powder. To study the strength parameters M30 concrete is designed for various combinations, ESP is replaced by 10, 20, 30% with silica fume by 5, 10, 15% and tests are undertaken at 7th day and 28th day of well cured specimens. It was observed that the strength increases up to 15% without the addition of silica fume as addition of silica fume also enhancesthe strength, but in economical vise ESP is only enough for getting higher strength. [4]

Dhanalakshmi et al.,(2015) has presented a comparative study on eggshell concrete with partial replacement of cement by fly ash. Here two wastes are used as partial replacement to cement and various properties were gathered. Increase in density and workability was found with addition of fly ash to optimum ESP concrete. [5]

Mohamed Ansari et al., (2016) studied the replacement of cement using eggshell powder. The characteristics were carried out for concrete replaced with 10, 15, and 20% of ESP replacement in cement. From the results it is proved that replacement of ESP about 10 to 15% is effective, on further addition there is weakness in strength. [6]

Monisha et al., (2016) experimentally investigated on concrete using eggshell powder and polypropylene fiber. This paper derives the usage of ESP 20% and polypropylene fiber in range of 0, 0.2 and 0.4% as replacement of fine aggregate. The strength properties obtained are compared with conventional concrete at 7, 14 and 28 days of curing period. The test results showed that optimum strength was obtained at 20% of fine aggregate replaced by ESP and 0.2% of polypropylene fiber by the weight of concrete for M20 grade. [7]

Nurul Shahadahtul Afizah Asmaetal.,(2016) studied the mechanical properties of concrete using eggshell ash and rice husk ash as partial replacement of cement. This research was carried out to determine the optimum percentage of eggshell ash (ESA) and rice husk ash (RHA) as partial cement replacement. The samples were tested with proportions of 2:8, 4:6 and 6:4%. By review on previous research, the strength of concrete is reduced with eggshells, thus to increase the strength RHA is introduced into mix design. The result is found due to high content of amorphous silica in ash. [8]

Bysani Mythili et al., (2017) studied on Limited Substitution of egg shell powder with cement in concrete. This project reports the results of experiments evaluating the utilization of ESP at replacement of 5% up to 30% by weight of cement. The admixtures used are saw dirt ash and small oxide to reinforce the strength of concrete combined with 5% ESP. The final result of the dissertation indicates that replacement of 5% ESP with 22% of micro silica are often superimposed with no reduction in strength properties of typical cement. [9]

Divya et al.,(2017)investigated on cement concrete mixed with egg shell powder. The experimental inquiry consisted by 5, 10, 15 and 20% of ESP as partially replaced with ordinary Portland cement and strength for 7^{th} and 28^{th} day tests were determined. Replacement up to 15% isaffordable. [10]

Priyanka et al.,(2017)experimentally investigated eggshell powder and rice husk ash as partial replacement of cement. This paper summarizes the research work on the properties used as a partial replacement of RHA 10 and 15% with ESP 4 and 5% of cement. The strength tests are carried out on hardened concrete after 28 days of curing. Better properties are obtained with replacement of cement in rice husk ash and eggshell powder. [11]

Amrutha K Francis et al., (2017) studied the effect of replacement of Portland cement by sugarcane bagasse ash (SCBA) and eggshell powder on high performance concrete (HPC). This study tries to examine the mechanical properties of HPC with different mix proportion.Here cement is replaced partially with ESP as 2.5, 5 and 7.5%by weight of cement and 5, 10 and 15%of SCBA respectively, from this mechanical property such as compressive and tensile strengths are examined. Final result shows that one with 5% ESP and 10% SCBA produced the preeminent HPC in the experiment. [12]

Ranjith Kumar et al., (2017)experimentally studied on concrete using coconut shell ash (CSA) and egg shell powder. This study explores the use of ESP and CSA from 5 to 25% replacement of cement in M30 grade concrete. The mechanical properties are evaluated at 7, 14, 21 and 28^{th}day's test. Due to its high pozzolanic activity both strength and durability of concrete are enriched and this may increase the strength of concrete against cracking. It was observed that up to 10% replacement can be used on concrete. [13]

Anisha et al. (2017) experimentally investigated the effect of fly ash on eggshell concrete.
In the present study, concrete cubes of grade M30 and M40 were prepared in the laboratory by

replacing the fine aggregate with fly ash and ESP at combined proportions of 0, 7, 14, 21, 28, 35 and 42% by weight. Studies on strength properties are conducted at the 7th and 28^{th} day's age test. Outcome of this investigation suggests that fly ash and eggshell could be very conveniently usedin structural concrete. [14]

Bandhavya et al., (2017) experimentally studied partial replacement of cement with eggshell powder in concrete. In this paper eggshell is replaced by 0, 5, 10 and 15% of cement and the tests were carried out to find the best combination which results in optimum strength. The result shows that ESP replacement greater than 10%had minor strength than conventional concrete and this can be augmented if the concrete is used with reinforcement. [15]

Parthasarathi et al., (2017) experimentally studied partial replacement of cement with eggshell powder and silica fume. The goal of this research demonstrates the strength features by using ESP at 5, 10 and 15% with 2.5, 5 and

7.5% silica fumes as additional to cement. It shows that the compressive strength of concrete with ESP as cement replacement material increases up to 15% without silica fume.Addition of silica fume also improves the potency but in expensive point of view only the ESP replacement is adequate for getting superior strength. [16]

Afolayan et al., (2017) experimentally investigated the effect of partial replacement of cement with eggshell ash (ESA) on the rheological properties of concrete. This research presents the experimental results by using ESA as a replacement of 5 to 30%. From the consequences of hardened concrete it has been observed that increase in the percentage of ESA leads to decrease inthe compressive strength. [17]

Vijayvenkatesh Chandrasekaran et al.,(2018) experimentally investigated partial replacement of cement with eggshell ash in concrete. The ESA powder in this project is replaced by 20, 30 and 40% to cement by weight. It is more reliable for mixing ratios for M20 grade of concrete. From the experimental test it has been noted that replacement of ESA at 30 and 40% gives an end result in strength feature. [18]

Haripriya et al., (2018) experimentally studied partial replacement of cement with eggshells powder and aggregates with coconut shells. In this paper ESP is used by 0, 5, 10 and 15% replacement of cement with natural coarse aggregate. The concrete is casted with a mix proportion of 1:1.5:3 and the tests are determined at the curing age of 7, 14 and 28 days. Final result concluded that the strength is increased on 10% replacement up to 7 days test and gets decreased from 14 to 28 days. The cubes with replacement of cement at 15% act as a brittle material when compared to 5 and 10%. The optimum strength obtained is 12% which is greater than conventional concrete. [19]

Baskar et al., (2018) experimentally studied partial replacement of cement with glass powder and eggshell powder. The aim of this study experimentally investigates the effect on partial replacement of cement by glass powder and ESP at 20, 30 and 40%. Instead of using a piece of glass powder as an alternative to cement, egg shell powder is clear due to its increase in workload and strength. [20]

Ramathilagam et al., (2018) has done an experimental investigation on eggshell powder as a partial replacement of cement in paver blocks. Here cement is partially replaced by ESP at 5% ntervals from 0 to 25%. The main function of this admixture is to reduce the water cement ratio and enhance workability in paver blocks. After the curing process of 7 days and 28 days it is checked for its strength characteristics. It showed that ESP can be advantageous if it was replaced at 10% by weight of cement. [21]

Pradeep Sharma et al., (2018) have undergone an experimental investigation on partial replacement of cement with eggshell powder and fine aggregate with copper slag in concrete. On this project the copper slag is replaced with sand at 10 and 40% and the optimum proportion was

found by conducting the following tests. The strength has been increased with 12% of cement by ESP and 30% of fine aggregate by copper slag in concrete. It is also found that, addition of super plasticizer into concrete shows small change in strength properties. [22]

III. CRITICAL REMARKS

By the above investigations on strength and structural characteristics of conventional cement concrete that are evenly proportioned with calcium rich eggshell powder and their potential feasibility were exemplified and are concluded.

1. ESP about 10% to 15% is effective for replacement and on further increasing the percentage of ESP decreases the compressive strength and this can be augmented if the concrete is used with reinforcement.

2. The replacement of 5% ESP with 10% micro silica, fly ash and saw dust contributes high strength of hardened concrete when compared to control concrete and addition of fly ash along with ESP up to 15% is more beneficial than control concrete. Increase in workability and density was found with addition of fly ash to optimum ESP concrete.

3. The absorption property decreased with decrease in permeable voids.

4. Sorptivity decreased with strength and increased with water absorption.

5. Optimum strength was obtained at 20% of fine aggregate replaced by ESP and 0.2% of polypropylene fiber by the weight of concrete for M20 grade.

6. 5% ESP and 10% SCBA, CSA produced the preeminent HPC in the experiment.

7. The replacement of ESA at 30 and 40% gives an end result in strength feature, further increase in the percentage of ESA leads to decrease in the compressive strength.

8. Cost wise ESP is inexpensive.

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