A COMPREHENSIVE ENHANCEMENT IN FINDING THE PROPERTIES OF EGGSHELL CONCRETE WITH REPLACEMENT OF CEMENT BY FLYASH

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Abstract:

This analysis 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. This research was carried out to determine the optimum percentage of eggshell ash and rice husk ash (RHA) as partial cement replacement. The samples were tested for its mechanical properties by using concrete grade G30 with cube mould (100 mm x 100 mm x 100 mm) and prisms (100 mm x 100 mm x 500 mm). The samples were mixed with eggshell ash and RHA admixture with different proportions (2%:8%, 4%:6%, 6%:4%). Several types of test were conducted towards the samples, which are the slump test, compressive and flexural test. Based on previous researches, the strength of concrete reduced as replaced with eggshells.

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 underestimated Throughout the world, waste products are seriously polluting the environment. There are many types of waste disposal system such as land filling, open burning, drains clogged up with rubbish and river fill definitely indicate solid waste is a major environmental problem in India. Despite the massive amount and complexity of waste produced, the standards of waste management in India are still poor. These include outdated documentation of waste generation rates and its composition, inefficient storage and collection systems, disposal of municipal wastes with toxic and hazardous waste, indiscriminate disposal or dumping of wastes and inefficient utilization of disposal site space. (Global Environmental Centre) Nowadays, waste products such as oil palm shell, fly ash and bottom ash used in construction industry to maximize the profit while reducing the amount of waste. The construction industries are searching for alternative products that can reduce the Construction cost.

Egg shell powder:

Eggshells are known to have good strength characteristics when mixed with concrete Most of the eggshell waste is commonly disposed in landfills without any pretreatment because it is traditionally useless. The use of eggshell ash in concrete production reduced the cost of raw material and contributes to the construction industry. Eggshell also contribute to construction industry which is it can be reduce in construction budget with high strength durability of the concrete. Thus, eggshells can be applicable to reduced cost of construction material and produced a new raw material for development in the construction industry

FLY ASH

Fly ash is a residual material of energy production using coal, which has been found to have numerous advantages for use in concrete. Some of the advantage include improved workability, reduced permeability, increased ultimate strength, reduced bleeding, and better surface and reduced heat of hydration. Several types of fly ash are produced depending on the coal and coal combustion process. It is a pozzolanic material and has been classified into two classes Fly ash is one of the residues generated in combustion, and comprises the fine particles that rise with the flue gases. Ash which does not rise is termed bottom ash. In an industrial context, fly ash usually refers to ash produced during combustion of coal.

Background of study:-

Earlier works on the combination concrete conducted by scholars have led us to the point that the Eggshell Powder and Fly ash can be used as an additive in concrete production. Eggshells are agricultural waste materials generated from chick hatcheries, bakeries, fast-food restaurant among others which can litter the environment and consequently constituting environmental problems or pollution which would require proper handling. In the ever increasing efforts to convert waste to wealth, the efficacy of converting eggshell to beneficial use becomes an idea worth embracing. The composition of eggshells indicates that the effect of it ash on cement treated materials should be articulated.

PROBLEM STATEMENT

The chart below shows that the waste composition generated in India. The highest waste production is from food or organic waste as the main waste component with 21%, follow by paper and plastic with composition of 11% and 15% respectively. Thus, waste generate in India is comes from food organic. Egg is the food that highly consumed by Indian therefore it is creating eggshell waste. Eggshell is the waste material from domestic sources such as hatcheries, bakeries, and home fast food. This amount is seriously to environmental pollution.

Advantages of Egg Shell:-

- Considerable reduction in alkali-silica and sulfate expansions.
- Meets the most stringent environmental regulations nationwide.
- Ideal for painting in occupied spaces.
- Excellent durability and washable finish.

2.0 Literature review

Jose Ravindraraja.B[1] through their studies and experiments encountered that Concrete is a mixture of cement, fine aggregate, coarse aggregate and water. Concrete plays a vital role in the development of infrastructure Viz., buildings, industrial structures, bridges and highways etc. leading to utilization of large quantity of concrete. High Performance Concrete (HPC) is a concrete meeting special combinations of performance and uniformity requirements that cannot be always achieved routinely by using conventional constituents and normal mixing. This leads to examine the admixtures to improve the performance of the concrete.

Kumar M, Milan Charles J [2] described that the effect and experimental result of replacement of eggshell powder in cement. The compressive test was carried out for concrete replaced with 10%, 15% and 20% of eggshell powder in Portland pozzolona cement. The results came indicates the eggshell powder can be used in replacement for cement. They conclude that The results which came after carrying out all tests found successful which indicates that eggshell powder can be used as a replacement material for cement.

S.Sarankokila, K.Sargunan [3] have noticed the this paper presents the effects of using ESP as a partial replacement of cement and Saw Dust ash, Fly Ash and Micro silica used as a admixtures. They reported that 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.

3.0 Materials

Concrete:

Concrete is a composite construction material made primarily with aggregate, cement, and water. There are many formulations of concrete, which provide varied properties, and concrete is the most used man-made product in the world.

Cement:

Cement is a material with adhesive and cohesive properties. Cement when mixed with mineral fragments and water, binds the particles into a whole compact. Cement is the most important and costliest ingredient of concrete. For the purpose of constructions works, the cement is used to bind stones, sand, bricks etc.

Types of cement:

By altering the proportions of the ingredients of cement, by adding other ingredients or by changing the intensity of grinding, different types of cement useful for particular situations can be manufactured. IS 456-2000 has recognized the following types of cements for construction purpose.

Ordinary port land cement confirming to

- 33 Grade (IS 269)
- 43 grade (IS 8112)
- 53 grade (IS 12269)

Egg Shell Powder:

Eggshell consists of several mutually growing layers of CaCO3, 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.

Figure: Egg shell powder

4.0 Egg shell powder & fly ash:

The standard consistency of a cement paste is defined as that consistency which will permit the vicat plunger to penetrate to a point 5 to 7mm from the bottom of the vicat mould.The apparatus required for this experiment are

- Vicat's Apparatus Conforming to IS: 5513-1976.
- Balance of capacity 1Kg and sensitivity to 1gram.
- Gauging trowel conforming to IS: 10086-1982.

Procedure:

- Unless otherwise specified this test shall be conducted at a temperature 27 + 20C and the relative humidity of laboratory should be 65 + 5%
- Take ordinary Portland cement of 400 grams and weight it in the electrical balance.
- Take 24-27% of water to cement. To start with add 25% of portable water and mix it by means of spatula.
- The time of gauging should be between 3 to 5 minutes. The gauging is counted from the time of adding water to the dry cement until commencing to fill the mould.
- Remove the excessive cement paste from the mould with the help of spatula and place the mould under the plunger needle of 1mm.
- If the penetration of the plunger in the paste is less than 33 to 35 mm from the top of the mould, prepare the trial paste with increasing percentage of water and repeat the above mentioned procedure until the plunger penetrates to a depth of 33 to 35mm from the top or 5 to 7mm from the bottom of the mould.

Table: Standard consistency of cement

Trial No	Quantity of cement (gm)	Volume of water (ml)	Penetration of plunger from bottom(mm)	Percent of water taken (%)
1.	400	96	8	24
2.	400	104	6.5	26
3.	400	112	7	28

Percentage of water taken = (volume of water /quantity of cement) x100
Standard consistency of cement: 26 %

Sieve analysis:

Sieve analysis helps to determine the particle size distribution of the fine aggregates. This is done by sieving the aggregates as per IS: 2386 (Part I) – 1963. In this we use different sieves as standardized by the IS code and then pass aggregates through them and thus collect different sized particles left over different sieves. The following apparatus are used

- A set of IS Sieves of sizes – 80mm, 63mm, 50mm, 40mm,31.5mm, 25mm, 20mm, 16mm, 12.5mm, 10mm, 6.3mm,4.75mm, 3.35mm, 2.36mm, 1.18mm, 600µm, 300µm,150µm and 75µm.
- Balance or scale with an accuracy to measure 0.1 percent of the weight of the test sample.

Initial and Final Setting Times of Cement

Cement (gm)	400
Initial setting time (min)	38
Final setting time (min)	480

Specific Gravity:

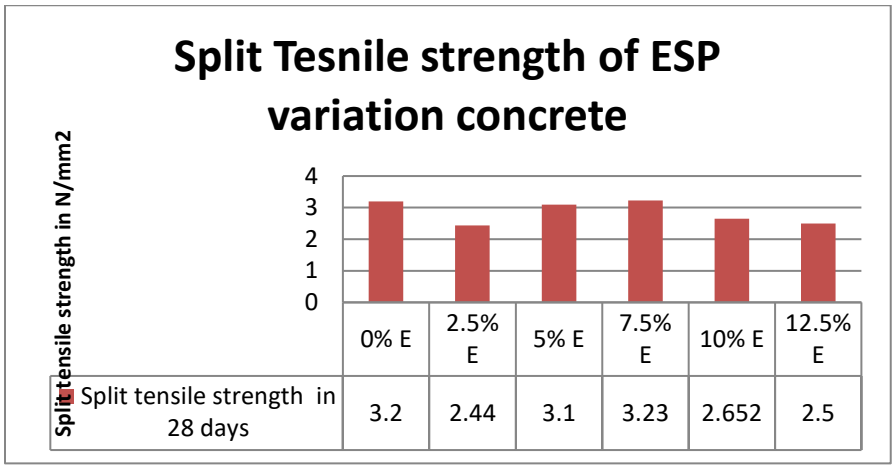
Table: Specific Gravity

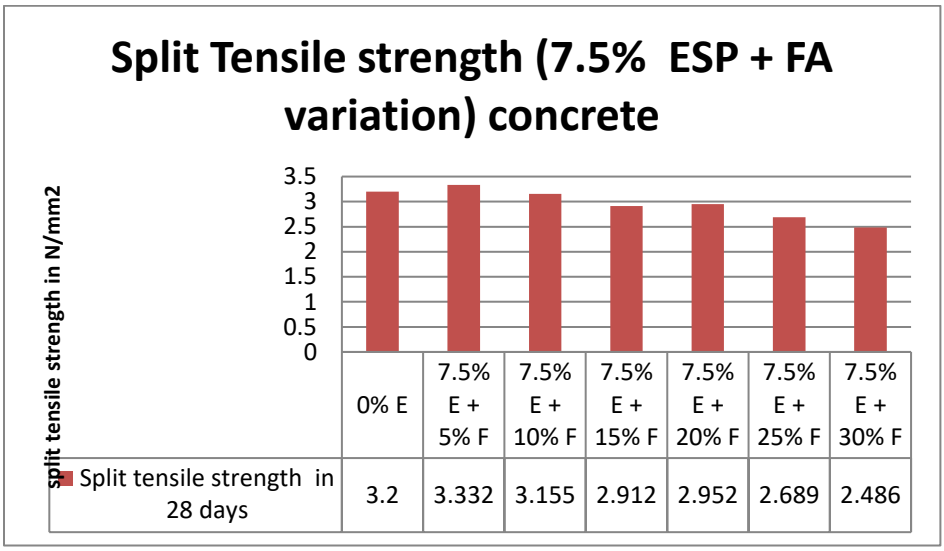
Trial no	M1 (gm)	M2 (gm)	M3 (gm)	M4 (gm)	Specific gravity $G = \frac{(M_2 - M_1)}{(M_2 - M_1) - (M_3 - M_4)}$
1	655	845	1800	1682	2.64
2	655	846	1801	1683	2.62
3	655	845	1800	1682	2.64
Average					2.63

- The soil grains whose specific gravity is to be determined should be completely dry.
- Inaccuracies in weighting and failure to eliminate the entrapped air are the main source of error. Both should be avoided by careful working.

- If pycnometer is used, the cap of the pycnometer should be screwed up to the same mark for each test.

Specific gravity = 2.63





Conclusion:

Based on the experimental investigation the following conclusion are drawn

- ❖ Compressive strength of egg shell concrete at 7 days is almost similar to control concrete mix (M40) and greater than control mix strength at 28 days.
- ❖ Egg shell concrete gives greater split tensile compared to concrete without egg shell powder
- ❖ The combination of ESP + FA showed the reduction in compressive strength compared to egg shell concrete mixes beyond 5% replacement of fly ash to optimum egg shell content concrete.
- ❖ As the percentage of FA increased beyond 5% in optimum egg shell concrete, the split tensile strength is found to be decreased compared to control concrete mix.
- ❖ Addition of ESP to cement concrete leads to reduction in workability.

- Density decreased with addition of ESP to cement concrete.
- Increase in workability was found with addition of fly ash to optimum egg shell powder concrete
- Increase in density was observed to addition of fly ash to optimum egg shell concrete
- Compressive strength of egg shell concrete was lower than control concrete mix (M40).

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