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Comparative Study of Eggshell Concrete and Conventional Concrete

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ABSTRACT: In present world, cement plays an important role in concrete and it's being produced in large quantity so, the increasing accumulation of carbon dioxide content in atmosphere is causing environmental pollution and global warming. In this project we studied about compressive strength of eggshell concrete and conventional concrete. For that Different eggshell powder concrete were produced by replacing cement with 5%, 10% and 15% of eggshell powder. Eggshell powder is reduce the impact of carbon dioxide emissions and protect the environment. Eggshell is one of the most common forms of solid waste. It's production worldwide is several tons per years. It is easily available in hotels, poultry farms, street-food vendors, etc. It contains calcium carbonate then it shows lime properties. Compressive strength of eggshell concrete increases with increase of percentage of eggshell powder upto certain limit. It is acknowledged that the future need of construction materials that need to be durable, simple to use, economic and yet more sustainable and eco-friendly for environment.

KEYWORDS: Compressive strength, Conventional concrete, Eggshell powder (ESP), Eggshell concrete.

I. INTRODUCTION

Now a day's various construction techniques are adopted to reduce the conventional building material costs for green construction and affordable housing system for both the rural and urban population. Cement plays major role within concrete mixture and affects most important aspects of the mix, such as workability, compressive strength, drying shrinkage and durability. During the manufacturing of concrete tons of CO₂ are produced which impacts in environmental pollution. We have discussed the use of eggshell as alternative building material that can reduce the material cost of construction and pollution. Cement has been replaced with eggshell powder to reduce the impact of carbon dioxide emissions and protect the environment. Eggshell waste is rampant on global scale. Eggshell waste is basically composed of calcium carbonate and has the potential to be used as raw material in the production of lime. It's weigh 5-6g on average and contains about 85-95% calcium carbonate (CaCO₃), 1.4% magnesium and other elements. These waste is used for fertilizer, animal feed ingredients and other uses. These solid waste utilize in landfills.

In eggshell concrete is used of poultry waste through the development of concrete incorporating eggshell powder (ESP). ESP concretes were produced by replacing cement with 5%, 10% and 15% of ESP. This study aimed at waste material is used in construction and environmental pollution. In this study are analyzed the compressive strength of eggshell concrete at varying percentage of eggshell powder (5%, 10%, 15%).

II. LITERATURE SURVEY

2.1 Praveen Kumar et. al. (2006): Experimentally investigated the Partial Replacement of Cement with Egg Shell Powder. The goal of this takes a look at the chemical composition of the egg shell to locate its suitability of substitute within the concrete. To look at the probability of using the egg shell and silica fume as cement alternative cloth. To take a look at the strength parameters of the egg shell powder combined specimens and to examine it with traditional specimens. The scope of the look at is to the concrete samples and conduct the compressive strength check, split tensile strength take a look at and flexural power check at 7th & 28thday, with the desired mixtures of eggshell powder and evaluate it with the controlled concrete specimens. In this assignment M30 Concrete is designed for numerous combos. Egg shell with silica fumes are used in special combos to discover the possibility of using the Egg shells as a trade to cement Egg shell powder replaces 10%, 20% and 30%

further with the silica fume by using 5%, 10%, 15% of weight of cement. Concrete is cast and Compressive check, split tensile and Flexural assessments were performed to discover the best combination which leads to optimum percent of power.

- 2.2 S. Karthikeyan et. al. (2012):** Reduce and Reuse of the opportunity substances is a whole lot energetic to preserve our strength assets. In the field of construction, the use of admixtures and re-utilization of available wastage substances is not a new one. But it is deals with a look at of Egg Shell Powder as a partial substitute of cement in concrete, to improve the strength in addition to reuse & reduce the egg shell wastage. The various traits of ESP are examined and it's far allowed to concrete as a partial alternative of cement. The numerous proportions such as 2.5, 5 and 7.5% are tried on this research and the strength performed by way of ESP concrete is much higher than a nominal concrete. Every admixture has its own strength. There became a pointy decrease inside the power while the proportion of ESP is beyond the extent of 5%.
- 2.3 D. Gowsika et. al. (2014):** In this paper opinions the outcomes of experiments evaluating using egg shell powder from egg manufacturing company as partial opportunity for normal Portland cement in cement mortar. The chemical composition of the egg shell powder and compressive strength of the cement mortar changed into decided. The cement mortar of blend shares 1:3 where in cement is partly modified with egg shell powder as 5%, 10%, 15%, 20%, 25%, 30% with the aid of the use of weight of cement. The compressive strength turned into decided at curing a long time 28 days. There become a pointy lower in compressive power beyond 5% egg shell powder replacement. In this course, an experimental research of compressive strength, split tensile strength, and Flexural power changed into below taken to use egg shell powder and admixtures as partial alternative for cement in concrete.
- 2.4 N. Parthasarathi et. al. (2017):** In this paper, concrete is broadly used for the structures. Cement is main material in concrete but due to high demand of cement is costly. And to minimize the cost of structure, alternate material is required to manage the wastes in eco-friendly way. The intention of this research work is to apply the egg shell powder constrained extra of cement. Eggshell powder is changed by using 5%, 10% and 15% weight of cement. An experimental study proves the strength capabilities consisting of split tensile strength take a look at that is decreased with addition of eggshell powder, compressive strength test and flexural strength take a look at which can be increased up to 15%.
- 2.5 Pradeep Sharma et. al. (2018):** In this study performed to decide the very best excellent percent of eggshell powder as partial cement replacement. The creation industries are looking for 'alternative material that may lessen the Construction cost. Over 5% of world CO2 emissions can be credited to Portland cement manufacturing. Demand for cement maintains to develop different ESP concretes were established through replacing 4 to 16% of ESP for cement. Concrete performs the important thing function and a large quantity of concrete is being implemented in every introduction exercise. The egg shell commonly that are disposed, is used as an exchange for the cement for the reason that shell is manufactured from calcium. An egg shell is utilized in first rate combos to discover the feasibility of the use of the egg shells as an exchange to cement. Intention of this task is to prevent the pollution of environment with the aid of the usage of the wrong disposal of the Eggshell waste, a live from eggshells domestic waste which includes schools, restaurant, bakeries, homes and rapid food accommodations, via the use of the usage of it as an additive fabric inform of ash & powder in traditional concrete with grade M35 because it's far usually utilized in manufacturing internet websites.
- 2.6 Manzoor Ahmad Allie et. al. (2018):** In this paper, it is studied that quality of construction material is an important issue which enhances the stability of the structure, an attempt has been made to study the possibilities of using Eggshell powder in paver block. Cement was partially replaced by Eggshell Powder at 5% intervals from 0% to 25% by the method of replacement by weight. The paver block Curing process is done for 7 days and 28 days, after curing it is checked for its Compressive Strength and flexural strength. It was noted that 13.4% increase of compressive strength at 10% replacement of Eggshell Powder. Flexural strength was also 19.5% increased at the same 10% replacement of Eggshell Powder. The result showed the Eggshell Powder can gives more strength if it was replaced as 10% of cement.



III. PROPOSED METHODOLOGY

Mix ratio: Our project is proposed of M20 grade of concrete and the mix design was based on IS 10262:1982.

3.1 Material collection: We were collected the all materials required for manufacturing of cubes such as cement, sand, aggregate and eggshell.

Processing of ESP: The processing of ESP is given in steps-

Step 1- Firstly, we collected waste eggshell from street-food vendor, poultry farms, hotels, etc.

Step 2- Then we washed eggshell 2-3 times by normal water.

Step 3- After that eggshell dried in sunlight for 2-3 days.

Step 4- After the eggshells were dry, we crushed them by hand.

Step 5- Then we grinded the crushed eggshells with the help of a mixer.

Step 6- The eggshell powder was sieve through 90 micron sieve. Finally, a fine eggshell powder is obtained.



a. Eggshell Powder (ESP)

Table 3.1- Chemical composition of PPC

Sr. No.	Oxide content	Percentage (%)
1.	CaO	41-43
2.	SiO ₂	28-32
3.	Al ₂ O ₃	7-10
4.	Fe ₂ O ₃	4.9-6
5.	MgO	1-2
6.	SO ₃	2.4-2.8

Table 3.2- Chemical composition of eggshell powder

Sr. No.	Oxide content	Percentage (%)
1.	CaO	50.7
2.	SiO ₂	0.09
3.	Al ₂ O ₃	0.03
4.	MgO	0.01
5.	Fe ₂ O ₃	0.02
6.	Na ₂ O	0.19
7.	P ₂ O ₅	0.24
8.	SrO	0.13
9.	NiO	0.001
10.	SO ₃	0.57
11.	Cl	0.219



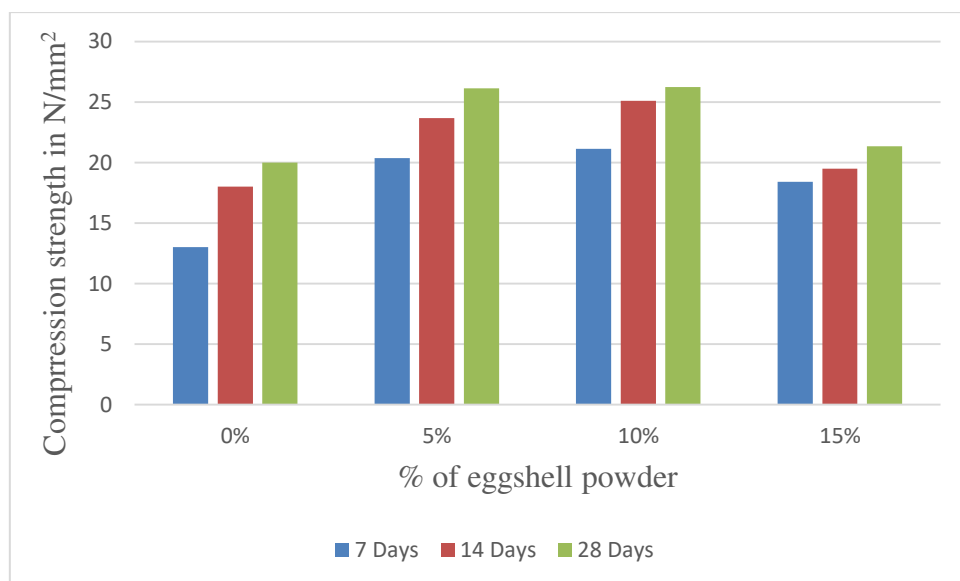
- 3.2 **Batching:** We were taking the material for mixing by weight batching.
- 3.3 **Mixing:** After the process of batching then material are firstly (dry) thoroughly. All the procedure are follow as per given in IS code 456:2000 for mixing.
- 3.4 **Moulding:** After the mixing then it fill into mould.
- 3.5 **Remoulding:** Remould cubes after 24 hours of casting.
- 3.6 **Curing:** After remoulding the cubes were placed for curing in curing tank. The cubes are cured for 7 days, 14 days and 28 days of each proportion.
- 3.7 **Testing:** The compressive strength test was carried out on cubes for checking its compressive strength of 7 days, 14 days and 28 days cured cube.

IV. EXPERIMENTAL RESULTS

Compressive strength: If we add eggshell powder (ESP) in concrete at varying proportions (5%, 10% and 15%, of that of weight of cement). Then the compressive strength can be increase up to 30% than normal concrete with replacing cement up to 10% of ESP.

Table 4.1- Compressive strength after different % addition of ESP

Sr. No.	% of ESP added	w/c ratio	Compressive strength on 7 days N/mm ²	Compressive strength on 14 days N/mm ²	Compressive strength on 28 days N/mm ²
1.	0%	0.5	13	18	20
2.	5%		20.37	23.68	26.13
3.	10%		21.13	25.1	26.24
4.	15%		18.40	19.48	21.34



a. Graph showing variation of compressive strength at varying percentages of ESP

We get compressive strength highest at 10% replacement of cement with ESP. At 15% ESC compressive strength get reduce as compared to 10% but 15% of ESC compressive strength more than conventional concrete.



V. COMPARISON BETWEEN EGGSHELL CONCRETE & CONVENTIONAL CONCRETE

Sr. No.	Basis For Comparison	Eggshell Concrete	Conventional Concrete
1.	Material	Eggshells, cement, sand, aggregate, water	Cement, sand, aggregate, water
2.	Uses	Used for a construction work	Used for a construction work
3.	Cost	Low	High
4.	Workability	Decreases by increasing amount of ESP	Increases by increasing amount of cement and water
5.	Compressive strength	Increases with increase percentage of ESP up to 15%	Low as compared with eggshell concrete
6.	CO ₂ emission	Decrease	Increase
7.	Initial setting time	93 min	30 min
8.	Final setting time	210 min	600 min
9.	Suitability	Not suitable for strong acid or sulphate environment	Suitable for all type of environment
10.	Eco-friendly	It is eco-friendly	It is not eco-friendly

VI. FUTURE SCOPE

1. This project will help in yielding high strength concrete in near future.
2. This will also help in reducing the expenditure behind the concrete materials as eggshell is a waste product.
3. Development of high strength eggshell concrete manufactured.
4. Investigations on the effect of varying percentage of eggshell powder on compressive strength.
5. Study on the addition of various proportions of ESP on concrete and their effect on enhancement of strengths.

VII. CONCLUSION

1. Compressive strength increase with increase percentage of eggshell powder up to 15%. We get compressive strength highest at 10%.
2. Workability of concrete decrease by increasing amount of egg shell powder.
3. Eggshell powder reduce the emission of carbon dioxide as well as required percentage of cement for concrete work.
4. The eggshell concrete solve the problem of disposal of waste eggshell and also reduce the environment pollution.
5. Eggshell powder improves hardness property, reduce setting time and it also improve mixture of concrete.

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