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Experimental Study on Usage of Egg Shell as Partial Replacement for Sand in Concrete

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Abstract
Through out the world, concrete is being widely used for the construction of most of the buildings,bridges etc.Hence, it has been properly labeled as the backbone to the infrastructure development of a nation.To meet out this rapid infrastructure development a huge quantity of concrete is required. Unfortunately,India a is not self sufficient in the production of cement ,the main ingredient of concrete and the demand for exceed the supply and makes the construction activities very costlier. Hence currently the entire construction industry is in search of a suitable and effective the waste product that would considerably minimize the use of ultimately reduces the construction cost. Few of such products have already been indentified like Rice Husk, flyash, Silica Fumes, Egg shell etc. Among these and egg shells are known to have good prospects in minimizing the usage of sand. So, in our concept of the project is replacing the fine aggregate by egg shell, and also reduce the weight of the concrete with achieve the required strength of concrete.

Keywords
Concrete, Characterization, Eggshell (ES).

I. Introduction

These materials are majority by products from other processes or natural materials. The major benefits of rice husk and egg shell is its ability to replace certain amount of fine aggregate and still able to display fine aggregate property, thus reducing the weight of concrete. The use of such by products 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.

II. Egg Shell

Eggshell is generally thrown away as a waste. The egg shell also creates some allergies when kept for a longer time in garbage. Disposal is a problem. It creates undesirable smell which can cause irritation. The main ingredient in eggshells is calcium carbonate (the same brittle white stuff that chalk, limestone, cave stalactites, sea shells, coral, and pearls are made of). The shell itself is about 95% CaCO3 (which is also the main ingredient in sea shells). The remaining 5% includes Magnesium, Aluminum, Phosphorous, Sodium, Potassium, Zinc, Iron, Copper, Ironic acid and Silica acid. Eggshell has a cellulosic structure and contains amino acids; thus, it is expected to be a good bio-sorbent and it was reported that large amounts of eggshells are produced in some countries, as waste products and disposed in landfills annually.

Table 1: Physical Properties of Egg Shell

Name	Physical Properties
Specific Gravity	0.85
Moisture content	1.18
Bulk Density (g/m^3)	0.8
Particle Density (g/m^3)	1.012
Porosity (%)	22.4 BET
Surface area m^2/g	21.2

A. Advantages of egg shell

1. Considerable reduction in alkali-silica and sulfate expansions.
2. Meets the most stringent environmental regulations nationwide.
3. Ideal for painting in occupied spaces.
4. Excellent durability and washable finish.
5. Resist mold and mildew on the paint film.
6. Saves money; less material required.
7. Meets strict performance and aesthetic requirements.

B. Application of Egg Shell:

- Concrete/Masonry Block.
- Plaster; Ferrous Metal.
- Wood.
- Gypsum Wallboard-Drywall. Road Pavements.

III. Results and Discussion

A. Properties of the coarse aggregate:

The properties of aggregate are found in the concrete engineering laboratory and find the values below,

Table 2: Specific Gravity

Materials	Specific gravity
Coarse aggregate(20mm)	2.8
Water absorption	0.3%
Impact value	6.15%
Attrition test	1.67%
Cursing value test	15.55%
Bulk density	1027kg/m^3

B. Split Tensile Strength

We are preparing the M25mix design with the help of properties of their materials.Then, we are replacing the Egg shell up to 10%, 20%, 30%, 40% & 50%.For each and every proportion, we are making the 3coulmns.After making that concrete structures are immersed in water. After we are testing the columns at 7day, 14day &28 days. Before testing the columns all are weighted. Tensile strength was calculated for the all proportion of columns by using

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tensile strength formula with help of their resisting loads.

Fig.1 : Split Tensile Strength

Table 3: Split Tensile Strength

ES added %	7 days N/ mm²	14 days N/ mm²	28 days N/ mm²
0	0.62	1.34	2.36
10	0.94	1.5	1.76
20	0.72	1.06	1.43
30	0.37	0.49	1.2
40	0.34	0.42	0.99
50	0.14	0.16	0.21

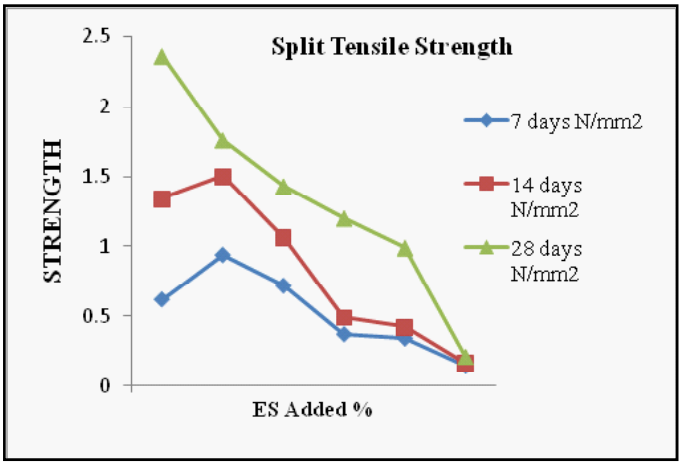

Fig. 2 : 7, 14, 28 days Split Tensile Strength

C. Compressive Strength

We are preparing the M25mix design with the help of properties of their materials. Then, we are replacing the Egg shell up to 10%, 20%, 30%, 40% & 50%.For each and every proportion, we are making the 3cubes.After making that concrete structures are immersed in water. After we are testing the cubes at 7day, 14day &28 days. Before testing the cubes all are weighted. Compressive strength was calculated for the all proportion of cubes by using compressive strength formula with help of their resisting loads.

Fig. 3 : Compression Test

Table 4 : Compression Strength

ESadded %	7 days N/ mm²	14 days N/ mm²	28 days N/ mm²
0	14.97	22.03	24
10	13.78	20.11	22.33
20	15.33	22.33	24.32
30	14.21	16.89	21.42
40	8.78	9.55	14.16
50	2.78	3.06	9.67

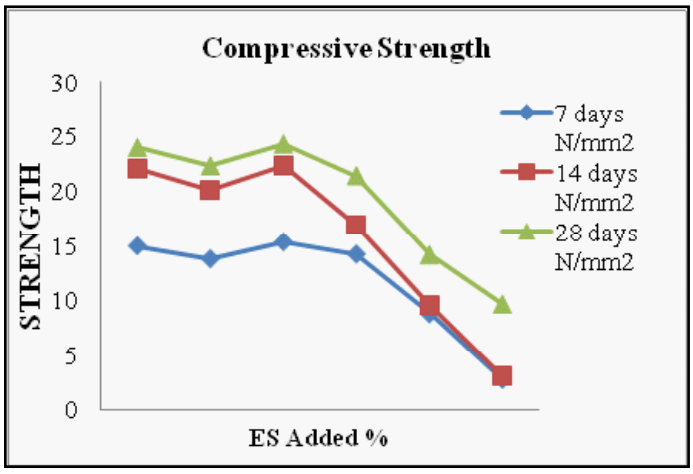

Fig. 4: 7, 14, 28 days Compression Strength

D. Flexural Strength

We are preparing the M25mix design with the help of properties of their materials. Then we are replacing the Egg shell up to 10%, 20%, 30%, 40% & 50%.For each and every proportion, we are making the 3beams.After making that concrete structures are immersed in water. After, we are testing the beams at 7day, 14day &28 days. Before testing the beams all are weighted. Flexural strength was calculated for the all proportion of beams by using flexural strength formula with help of their resisting loads.

Fig. 5 : Photograph taken in our laboratory during testing of beam.

Table 5. : Flexural Strength

EG added %	7 days N/ mm²	14 days N/ mm²	28 days N/ mm²
0	1.6	2.2	2.86
10	0.53	1.12	1.82
20	0.8	1.2	2.01
30	0.4	0.44	1.68
40	0.29	0.36	1.47
50	0.16	0.29	0.99

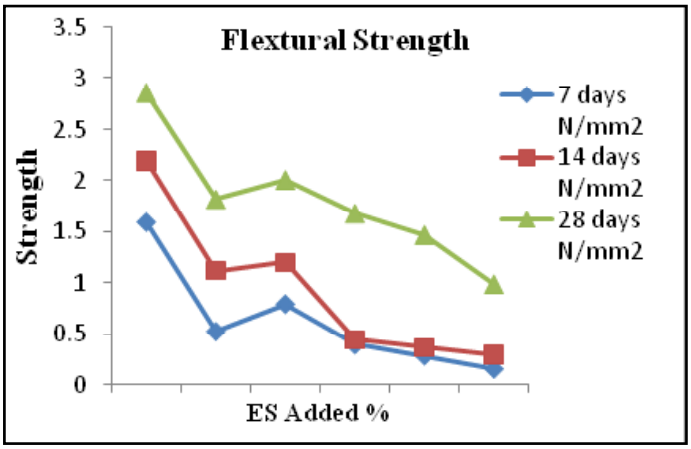

Fig. 6 : 7, 14, 28 days Flextural Strength

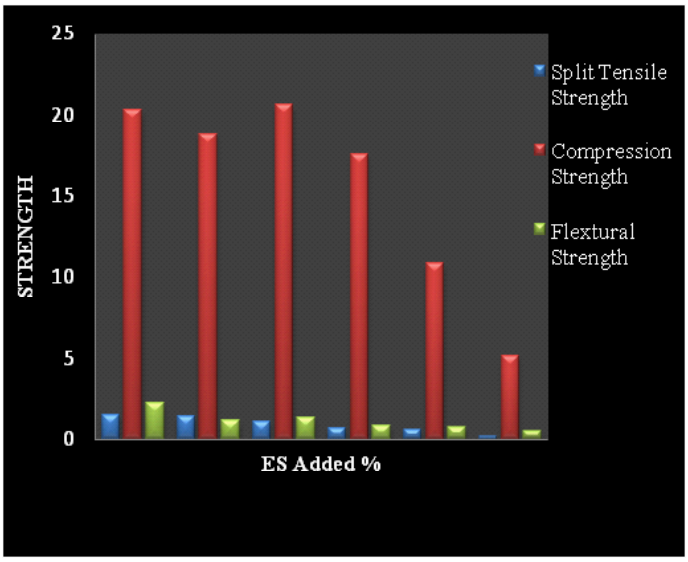

Fig. 7 : Combination of Tensile, Flextural and Compressive Strength

IV. Conclusion

In this paper, effect of egg shells on some mechanical and physical properties of concrete was investigated. Based on the analysis in the present experimental work, the following conclusions can be deduced:

1. The egg shells as a useful material instead of a waste material (harm to the environment) that they were hurled in many hundred tons annually had been use in an engineering applications.
2. 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 %).
3. 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.

V. Acknowledgement

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