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EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF CEMENT WITH EGG SHELL POWDER AND SILICA FUMES

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Abstract : Construction industry is one of the fastest growing sectors in India. Increasing construction activity and rising housing demand have resulted in a shortage of traditional building supplies. Bricks, cement, sand, and wood are currently scarce materials. The demand for high-quality building materials to replace traditional materials, as well as the necessity for cost-effective and hard materials for low-cost housing, has compelled researchers to create a wide range of new and novel construction materials. So, we have the egg shell powder which is a food waste used in the cement mortar. The purpose of this research is to assess the efficacy of waste eggshell powder (ESP) as a partial replacement for Portland cement in mortar to increase strength while also reusing waste eggshell powder. After a 28-day curing time, it is tested for compressive strength, split tensile strength, flexural strength, and durability, and the findings are analysed and published.

Keywords: Egg Shell Powder, Silica Fumes, Compressive Strength, Flexural Strength.

1.Introduction:

In the present scenario in the construction industry, almost all the materials using in the construction industry is non-renewable. So, we have to find out the alternative materials to overcome the scarcity of non-renewable materials. An estimated yearly output of eggshell waste in India, the United States, and the United Kingdom is 190000, 150000, and 11000 tonnes, respectively, according to research. Eggshell waste can be utilized in fertilizer, animal feed, and other applications. Yet, the most majority of eggshell trash is disposed of in landfills. Egg production grows at a rate of 5-8% every year. Moreover, according to estimations from the Ministry of Agriculture, India ranks sixth in grill production, with a yearly output of 2.39 million tonnes of grill meat. Eggshell waste attracts vermin in landfills owing to the attached membrane and causes problems with human health and the environment. Many studies have been undertaken to look at the use of eggshell waste in civil engineering applications. Hence, in this project, we will perform an experimental investigation to replace egg shell powder in cement mortar. For that we are considering three different proportions of cement, silica fumes, fine aggregate as well as egg shell powder. By these proportions we are going to make cement mortar cubes and after that we will find out which proportion gives maximum strength comparing to normal cement mortar cubes.

2. Literature Survey:

Parthasarathi, N. (2017) Concrete is often employed for constructions in this article. Cement is the primary component of concrete, although it is expensive due to increasing demand. In order to reduce the cost of the project, different materials must be used to manage trash in an environmentally acceptable manner. The goal of this research is to use the egg shell powder as a limited addition of cement.

D. Gowsika (2014) This paper discusses the findings of studies exploring the use of eggshell powder from an egg processing business as a partial replacement for normal Portland cement in cement mortar. The chemical composition of the eggshell powder was decided, as well as the compressive strength of the cement mortar. The cement mortar of mix shares 1:3, in which cement is partially replaced with eggshell powder as 5%, 10%, 15%, 20%, 25%, and 30% with the help of weight of cement.

Amarnath Yerramala (2014) This study examines the qualities of concrete utilizing eggshell powder (ESP) as a cement replacement and the utilization of chicken waste in concrete through concrete enhancement. By replacing 5-15% ESP for cement, several ESP concretes were created. The results demonstrate that there is a proper relationship between compressive strength and split tensile strength independent of the ESP% replacement.

3. Scope and Objective:

Further study can be conducted with the inclusion of super plasticizers to improve the workability of the concrete. Many large constructions are being processed in the world, In the preparation of cement there is a large emission of gases occurs. To overcome those harmful gases, we are searching for an alternative which is giving more or similar properties to that of cement. Egg shell powder is an alternative material which can be used in the replacement of the cement with best mix proportions. Further studies can be conducted with a larger proportion of egg shell powder added to concrete for better classes of concrete to assess its qualities. Deeper analysis might look at additional calcium-based components as a replacement for cement in concrete and examine their qualities. The scope of using the egg shell powder is mainly because of increased strength of cement when it is mixed with the egg shell powder. The purpose of this research is to employ eggshell powder and silica fume as a limited additional of cement. To determine the optimal mix proportion for the partial substitution of egg shell powder for cement in mortar based on the sample specimen's strength per weight ratio. This includes all of the preliminary testing performed on the material and mortar. These tests assist us in determining the qualities of the material used in the concreting process and in determining the mix ratio. To study the feasibility of using the aforesaid material as a partial substitute in mortar by assessing its compressive and flexural strengths.

4. Experimental Investigation:

Experimental Investigation includes the initial tests conducted on the materials taken in the process. Some of the tests are Specific Gravity test, Normal Consistency Test, Initial and Final Setting time, and Sieve Analysis tests. Materials like cement, silica fumes, egg shell powder and fine aggregate, each material has its own tests which are to be conducted. By conducting these tests, we obtain the standard values of the materials.

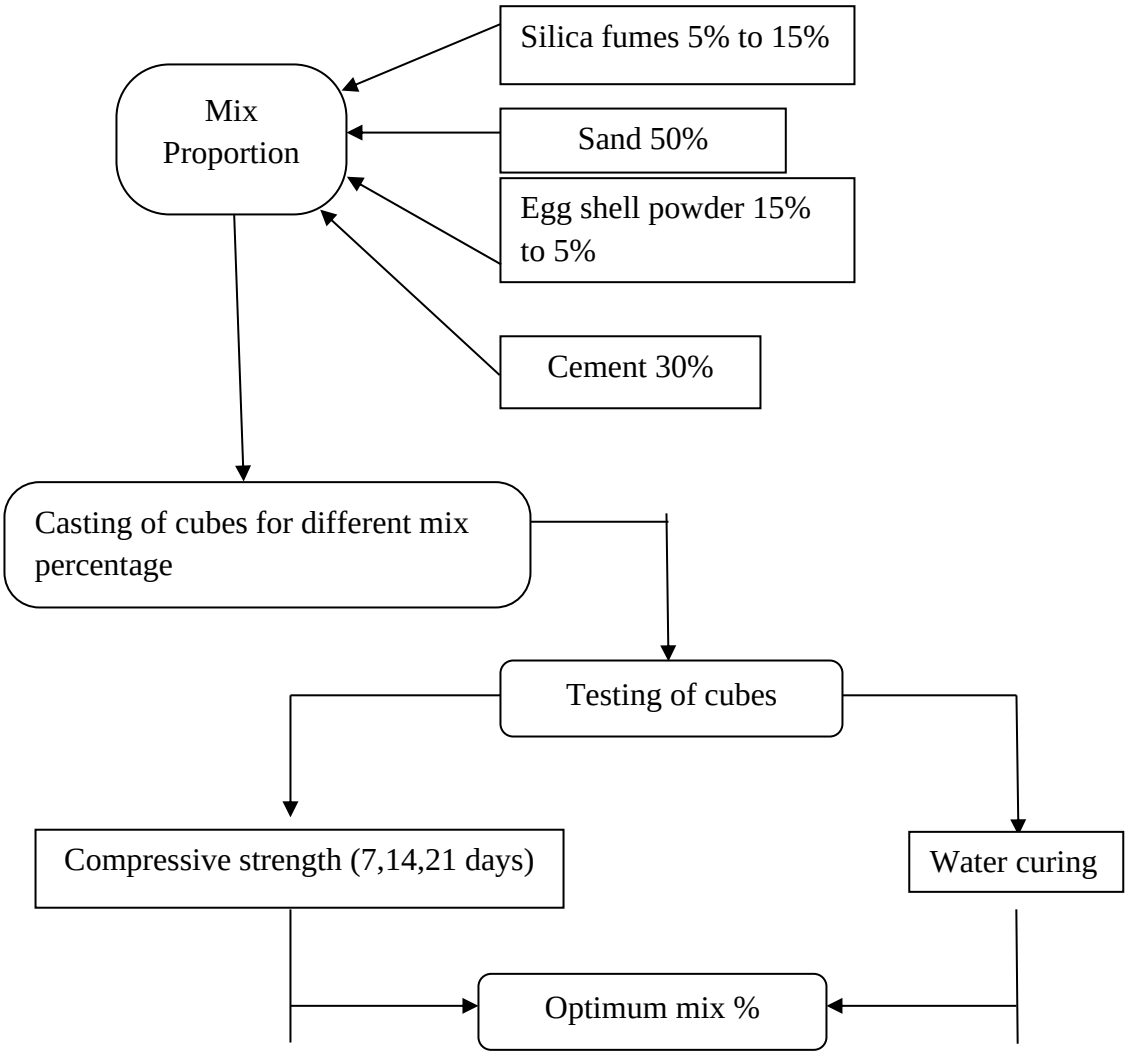


Figure - Flowchart of the process

Mix Proportions:

To manufacture the Mortar cubes, the following mix proportions are determined by trial and error.

Proportions	Silica Fume (%)	OPC (%)	Sand (%)	Egg Shell Powder (%)
1	15	30	50	5
2	10	30	50	10
3	5	30	50	15

Table: Mix Proportion Table

5.Result and Discussion :

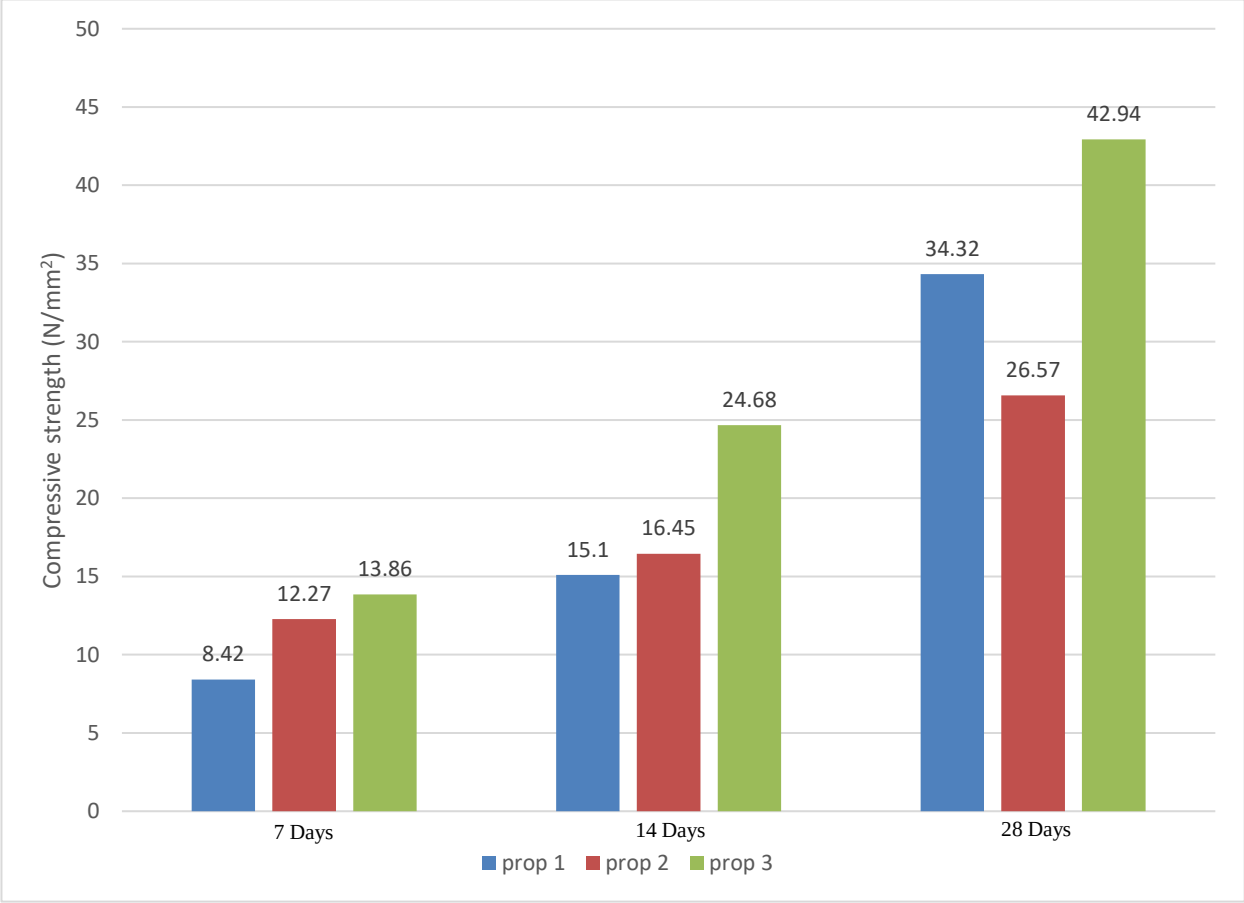
Casting of Cubes:

The typical 70.6mm x 70.6mm x70.6mm cubes are cast using a basic hand mould. These were cast using the conventional technique, with different mix proportions arriving. The amount of Silica Fumes, Sand, Cement, and Egg Shell Powder required is estimated based on how well the elements are combined. The needed amount of water was then added. They then completely combined. The produced mix was then squeezed in the mould. The mould is kept at room temperature for 24 hours after compacting. The cube is then removed from the mould. The cubes are stored in curing tanks for seven, fourteen, and twenty-eight days.

Figure 1: Mixture of the materials

Proportions	Cubes ID	7 days(N/mm^2)	14 days(N/mm^2)	28 days(N/mm^2)
1	A_1	8.42	15.10	34.32
2	B_1	12.27	16.45	26.57
3	C_1	13.86	24.68	42.94

Table 2: Values of cubes tested for 7,14 & 28 days of curing



Graph 1: Comparison of cubes tested after different days of curing

7.Conclusion :

The experiment was conducted to ascertain the optimal cube mix%. However, Cube specimens of size 70mm x 70mm x 70mm were casted for various percentages of Silica Fumes (5 to 15%), OPC (30%), River Sand (50%), and Egg Shell Powder (15 to 5%). However, the specimens were evaluated for three different mix amounts. 7, 14, and 28 days of curing, cube specimens of 70mm x 70mm x 70mm were cast with varying percentages of Silica Fumes, OPC, Sand, and Egg Shell powder. Based on the results, it was determined that the best mix percentage of Silica fumes-5% opc-30%, sand-50%, and egg shell powder-15% gave the highest optimized compressive strength of 42.94N/mm^2 among the 3 proportions.

8.References :

[1] Prabir Kumar Chaulia and Reeta Das, Process Parameter Optimisation for Fly Ash Bricks Using the Taguchi Method: Material Research, 2008.11.159-164.
[2] M. King'ori, A review of poultry eggshell and shell membrane usage. 10(11), 908-912. International Journal of Poultry Science.
[3] Characterization of raw eggshell powder as an excellent bio-filler, A, S. M. Bashir, and Y. Manusamy. Journal of Engineering Research and Technology, 2(1), pp. 56-60, 2015.
[4] M. Petchiyammal, R. Jeyanthi, and J. Karthick, Experiment with using eggshell as a partial replacement for sand in concrete. 7 - 10 in International Journal of Advanced Research in Education Technology, 1(1), 2014.
[5] Amarnath Yerramala, Properties of concrete with eggshell powder as cement replacement., The Indian Concrete Journal October 2014.
[6] Effects of Eggshell Powder on Cement Setting Time, Vol 3, January 12, 2011, M.O.A. Mtallib and A. Rabiu.