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Experimental Study on Concrete Using Zygote Encastment Powder, Crushed Groundnut Shell and Nylon Fiber as a Partial Replacement for Materials

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ABSTRACT: In this modernized world, concrete occupies the major part and huge amount of concrete is being made use in most of the construction practice. The crushed groundnut shell is partially replaced for fine aggregate as sand. As the eggshell also contains calcium and has same chemical composition they can be used as a partial alternative material for cement as anyhow they get disposed as poultry waste.As eggshell are utilized in different percentage combinations(0 -15%) to find out the possibility of using them as a material which can replace cement, Crushed groundnut shell is replaced partially with fixed percentage(3%) as an alternate to sand and in addition 1% of nylon fibre has been added along with these combinations. Crushed Groundnut Shell and eggshell contributes towards Waste management and also helps in reducing the cost of construction as it reduces the quantity of natural sand and cement to a certain limit. In this experimental research we study various strength parameters like Standard Compressive strength, Standard Flexural strength, Standard Split Tensile strength.

KEYWORDS: Concrete, Nylon Fibre, Crushed Groundnut shell, Eggshell powder, Cement, Fine Aggregate.

I. INTRODUCTION

Concrete is a material which is a conglomerate of three elements, comprising of cement, aggregate (fine aggregate and coarse aggregate) and water along with admixtures and fibres. In the making of concrete, cement, sand (fine aggregate), coarse aggregate (gravel, rock) are fused together with water in a certain percentage to attain the desired strength. It has been seen over the past few years concrete technology have seen a rapid growth and its improvement in strength and other structural properties through the use of steel reinforcements. Due to increase in demand and consumption of more natural sand (fine aggregate) and cement, made us to inspect alternative substance(material) for “Cement” and “Sand”. So in our experimental study, cement will be partially replaced by eggshell powder and fine aggregate will be partially replaced with constant percentage of crushed groundnut shell along with the addition of nylon fibre which contributes towards waste management and also to lessen the cost of construction and environmental pollution .As building industry develops, increasingly specialized and more durable materials or products are in a great demand which is why fibre reinforcement took an important role in modern construction techniques.

II. Objective:

Our main objective is to:

- To find out or investigate the pre-eminent mix proportion for the partial replacement of ESP for cement , constant percentage replacement of CGS for fine aggregate along with the addition of nylon fiber in concrete.

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- To find the workability of the replacing material in cement concrete by carrying out significant strength tests of concrete such as standard split tensile, flexural and standard compressive test of strength.

III. Experiment materials and methods

3.1 Materials:

3.1.1 Cement:A cement is a powdery substance mainly consisting of Lime or Calcium Oxide, Silica and Alumina. Cement is an adhesive substance, or a binder used in construction of structure which hardens and attaches to other material such as water and aggregate to bind them together. The cement used in construction are usually inorganic and can be differentiated as hydraulic and non-hydraulic.

3.1.2 Aggregate: Aggregate is a granular material used to construct concrete or mortar. The sizes of these granular materials differ and can be classified into;
i)Fine Aggregate: The material used as fine aggregate are habitually natural sand (river sand) or powered stone; they pass through sieve no. 4 (4.75 mm sieve) and retains on sieve no. 2 (0.075 mm sieve). The fine aggregate fills the voids between the other materials used and are used to increase the volume of the structure. It provides dimensional stability. The quality and density of the fine aggregate adversely impacts the hardened characteristics (properties) of the concrete.
ii)Coarse aggregate: Coarse aggregates are of larger stones or gravels and retains on sieve no. 4 (4.75 mm sieve). It acts as inert filler material for concrete.

3.1.4 Water: To cast a high standard concrete, water is an indispensable element. The corrosion of the reinforcement can be due to bad quality water. Thus, it is quite necessary to make sure that water which are used for production of concrete needs to be free from detrimental or harmful substances like acid, oil, sugar, salt, alkali, slit etc.

3.1.5 Eggshell: An eggshell is the hardened outer covering of an egg. It is fundamentally composed of Calcium Carbonate. The eggshell used for this project were bought from a local store. Using eggshell powder in concrete can contribute to the industry of construction and can reduce the cost of the raw materials Eggshell powder can contribute in reducing the budget set by the construction industry and provide high durability strength in concrete. Therefore, eggshell can be used as a new alternative raw material for evolution in construction field.

Figure 1: Eggshell Powder

3.1.6 Groundnut shells: The Crushed Groundnut shells were purchased from Latha Rice Mill(Chennai) where they produced oil from groundnut. The groundnut shells were oven dried and then crushed using mixture machine which in turn reduced its sizes satisfying to those of sand (fine aggregate) as stated in BS 882 [8] It was noticed that the Bulk Density of CGS is 254.55kg/m^3.

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Figure 2: Crushed Groundnut Shell

3.1.7 Nylon Fibre: It is a man-made polymer which can be processed into fibers, films or shapes etc. Nylon is a rigid material which makes them very difficult to shred and it also exhibits excellent resistance to abrasion. They have high melting temperature of 2560c (4500F). It is an absorbent material and hence tends to absorb moisture from the surrounding environment. Nylon fiber easily gets decomposed undersunlight so to avoid this, often UV resistance add-on are used. Fibers are usually a tiny piece of material used as reinforcingwhose aspect ratio ranges from 30 to 150

i. LENGTH OF FIBER -45mm
ii. DIAMETER -0.30mm
iii. SPECIFIC GRAVITY -1.12
iv. WATER ABSORPTION -3%
v. COLOR -Green

Figure 3: Nylon Fibre

3.2 Methods:

This study deals with the test on concrete specimen by partially replacing cement by eggshell powder. The following tests are conducted.

- Compressive strength test.
- Split tensile strength test.
- Flexural strength test.
- Slump cone test

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3.2.1 Compressive Strength: It is one test to find out the mechanical strength of concrete. The concrete cube which needs to be tested until it fails to a maximum load. The series of the load is considered to be between 20 seconds and 80 seconds. All the characteristics of concrete cube is given by the standard compressive strength test. By this test, an individual can judge whether Concreting is done correctly or not. The compressive strength test procedure was followed according to IS code 516 (1959)

3.2.2 Tensile strength: It is one among the basictest, which considerably influence the length and size of fracturing in structures. The test process for split tensile strength of cylinder is followed according to IS code 5816 (1999).

3.2.3 Flexural strength: Flexural test indirectly estimates the tensile property of the prism. The slab has to retain its strength even in the case of bending condition during it was tested. The specimen is in a size of 40 x40 x 160 mm and the tests are performed such that it is loaded at its center until the specimen reaches its failure.

IV. Results and discussion

4.1 Slump cone test results:

The slump cone test is executedaccording to the proceduregiven in IS: 1199 – 1959
Slump cone test was first carried out for a fresh concrete 0 % of eggshell powder along with, certain part replacement for cement using eggshell. The following results were obtained for particular percentage of eggshell replaced

Table 1: Slump Cone Test Results

Sl.No	% of ESP	SLUMP RESULT
1	0	89mm
2	2.5	78mm
3	5	64mm
4	7.5	52mm
5	10	43mm

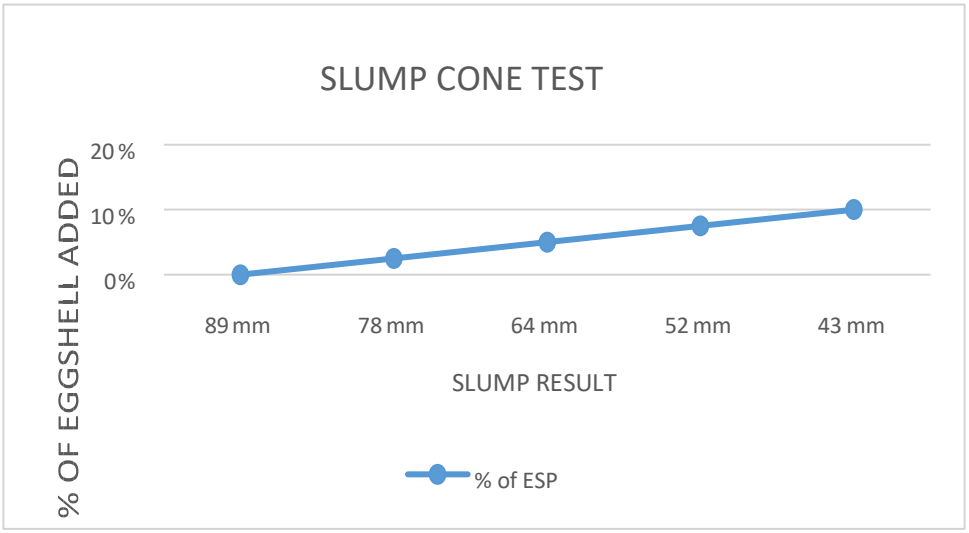

Figure 4: Graphical Representation of Slump Cone Result

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The above table shows the results of workability of fresh concrete using slum cone method. The cement was replaced partially by eggshell in a calculated amount/quantity. As seen from the table, it was recorded that the slump resulted in an increase up to 5% from 0% and a decrease from 7.5% to 10%. The data showed that for a normal mix slump, the slump cone test resulted in 89 mm. the feasibility of the fresh concrete was checked by adding eggshell powder which replaces cement by a percentage of 2.5%, 5%, 7.5% and 10% which gave the result of 78 mm, 64 mm, 52 mm and 43 mm respectively.

After the specimens (cube, prism and cylinder) were casted and kept for curing process, the compressive strength, flexural strength and split tensile strength were determined on 7th day, 14th, 21st day and 28th day
The following results were obtained for each strength test on the 7th, 21st and 28th day of curing.

V. Compressive strength result

Table 2: Average Compressive Strength of Cubes On 7, 14, 21, And 28 Days

Sl. NO	VARIOUS % OF ESP(Cement) +3%of CGS +1% of NF	AVERAGE COMPRESSIVE STRENGTH (N/mm^2) ON 7 DAYS	AVERAGE COMPRESSIVE STRENGTH (N/mm^2) ON 14 DAYS	AVERAGE COMPRESSIVE STRENGTH (N/mm^2) ON 21 DAYS	AVERAGE COMPRESSIVE STRENGTH (N/mm^2) ON 28 DAYS
1	0	22.75	24.32	27.39	29.11
2	5	25.22	26.1	31.17	31.54
3	10	26.73	29.32	31.91	32.21
4	15	25.94	26.12	30.12	31.18

ESP – Egg Shell Powder
CGS- Crushed Groundnut Shell
NF- Nylon Fibre

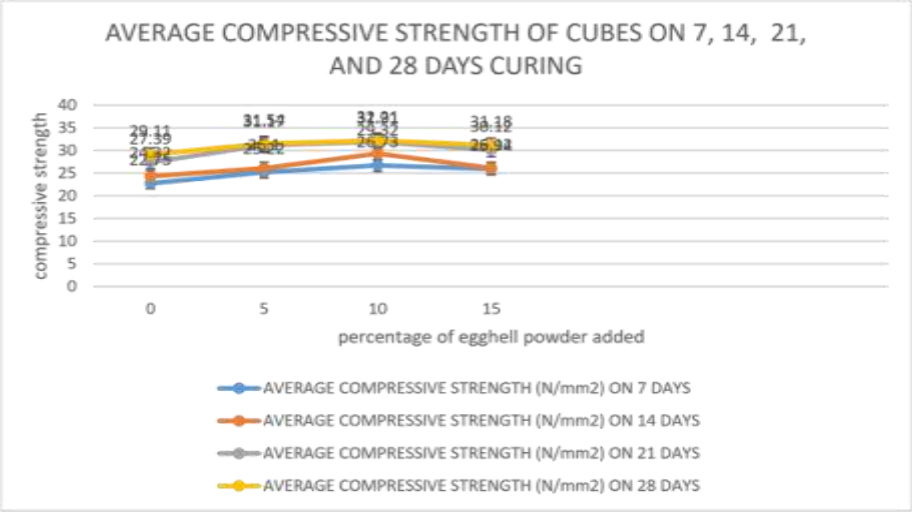

Figure 5: Graphical Representation of Compressive Test Results

From the above obtained results in Table 2 and Figure 5, it was seen that, after curing for 7 days, the compressive strength of normal concrete was 22.75 MPa. When cement was partially replaced by eggshell powder with 5%along with 3% of CGS and 1% of NF, the compressive strength increased to 25.22 MPa. Furthermore, an improvement of the compressive strength was also seen with an increase of 10% replacement of cement by esp. On the contrary, a decline on the strength was seen on 15%. Similarly, for the 14th day, 21st day and 28th day, there

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was a gradual increase of compressive strength for normal concrete as well as for the cement replacement by 5% and 10% However, even on the 14th, 21st and 28th day, on adding 15% of eggshell powder, it recorded a decrease of compressive strength.
Therefore, with respect to each result recorded for specific percentage of eggshell added for replacing cement and from the data analysed, it showed improvement up to 10 % eggshell powder (esp) and also, 10% gave the optimum compressive strength among the tested cubes.

4.2 Split tensile strength test result

Table 3: Split Tensile Strength Test Results

SL. NO.	VARIOUS % OF ESP(Cement) +3% of CGS+1% of NF	AVERAGE SPLIT TENSILE STRENGTH (N/mm^2) ON 28 DAYS
1	0	2.76
2	5	3.10
3	10	3.18
4	15	3.11

Figure 6:Graphical Representation of Split Tensile Strength Test Result

With respect to the data recorded in Table 3 and shown in fig: 6, a gradual increase in split tensile strength can be seen with a decline of the strength on 15 percentage. Similar to compressive strength of cube, the improvement of the tensile strength is seen till 10% replacement of cement by eggshell powder along with 3% CGS and 1% NF and also being the optimum recorded value.
The result showed that on adding 5% (with 3% CGS and 1% NF) of eggshell powder to replace cement partially, it gave a strength of 2.76 MPa on 28th day. The split tensile strength further improved to 3.1 MPa on 28th day of curing for 10% cement replacement by eggshell powder. However, for 15% partial replacement, the tensile strength decreased when compared to 5% and 10% replacement as it gave 3.11 MPa on 28th day. Nevertheless, it gave much better strength than the normal concrete. From the data analyzed, we can say that the tensile strength of the concrete continued to improve from 0% to 10% of eggshell powder and saw a decrease in the split tensile strength on replacing 15% of cement with eggshell powder.

SL. NO.	VARIOUS % OF ESP(Cement)+3%of CGS+1% of NF	AVERAGE FLEXURAL STRENGTH OF PRISM (N/MM^2) ON 28 DAYS
1	0	2.85
2	5	3.21
3	10	3.28
4	15	3.11

Table 4: Flexural Strength Test Result

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4.4 Flexural strength test result*:*

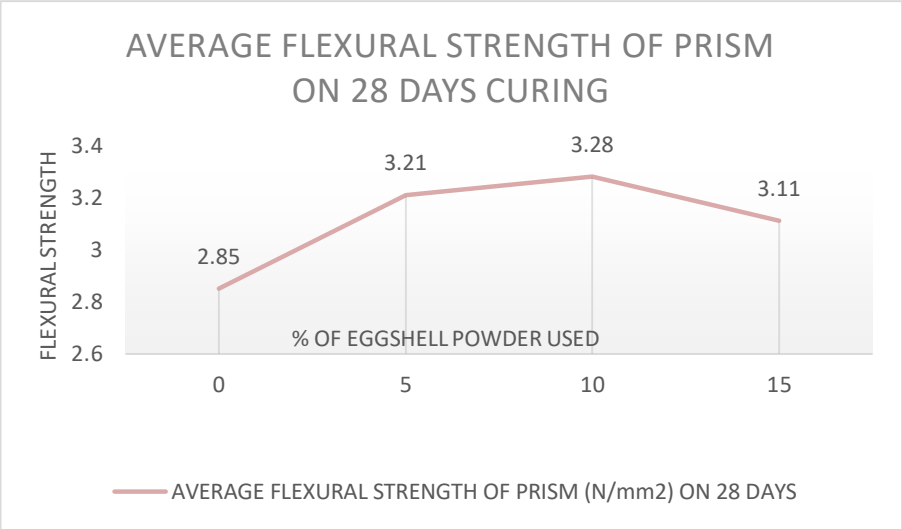

Figure 7:Graphical Representation ofFlexural Strength Test Result

From the data recorded, a gradual increase in flexural strength can be seen with a decline of the strength on 15 percent similar to compressive strength of cube and split tensile strength of cylinder. An improvement of the flexural strength is seen till 10% replacement of cement by eggshell powder with CGS and NF and also it being the optimum recorded value.

VI. Conclusion

The project work is planned to analyze the practicalities of utilizing zygote encastment powder (eggshell powder) as substitution of cement, crushed groundnut shell as 3% replacement of sandand then 1% of nylon fiber is added. It offers interesting focal points of being plenitude, easy availability, cost productive and also contributing towards waste management. The test outcome shows that the utilization of zygote encastment powder (eggshell powder) have the ability of improving the performance of the solidified cement. The compressive quality of cement is changed with addition of zygote encastment powder up to a specific rate by the weight of sand(partially replaced with CGS) in the event that it is utilized over half the quality may consequently diminish. The standard compressive strength recorded the improvement of concrete strength from 0% to 10% of eggshell powder, crushed groundnut shell as 3% replacement of sandand then 1% of nylon fiber is added and a decrease was recorded from 15% of eggshell used. The std. split tensile strength is diminished with addition of 100%, so partial replacement with sand the quality may comply up to that rate of percentage. By the durability of std. compressive strength and std. split tensile strength of concrete with 5%, 10% and 15% with 3% replacement of fine aggregate with CGS as demonstrated increases in quality for 7, 14, 21 and 28 days in case of std. compressive strength of cube test and 28 days for std. split tensile strength test of cylinder and std. flexural strength test of prism. So, we conclude that the expense of all the replacing material per ton is very reasonable and hence it is recommended for future construction projects.

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