Strength Characteristics Of Concrete On Partial Replacement Of Cement By Seashell Powder And Chicken Feather Fibers [CFF] As Fiber Reinforcement

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Abstract- *To develop green and economical cement, we introduce some partial replacement materials. In this project the OPC 53 grade cement is used and cement is partially replaced with Seashell powder. The partial replacement of cement is done in 5%, 10%, 15% and 20%. In today's rapid world the eco-friendly and biological composites has become very innovative, So here we investigated the use of Chicken Feather fibers [CFF] as reinforcement in cement bonded composites. The strength of the concrete is determined by performing the compression test, split-tensile test and flexural strength test after 7 days and 28 days curing period. Combination of Seashell powder and CFF is cost-efficient and improve the strength of the concrete blocks.*

Keywords- Chicken Feather Fiber [CFF], Compressive strength test, Flexural strength test, Seashell powder, Split-tensile strength test.

I. INTRODUCTION

Concrete is the backbone of modern infrastructure. It is commonly used for building foundations and footings due to its strength, durability and ability to resist water. Also easily adorable for all type of weather conditions. The concrete mix initially starts with the procedure of batching, mixing and placing of concrete. The concrete has been allowed to setting for 24 hours. Concretes workability is also a vital consideration in its utilization and quality. The use of waste materials in buildings is an innovative approach towards sustainability.

In every day, large quantity of chicken feathers are disposed of as waste at market. Utilizing waste feather in construction materials is considered a great free source and ensures a healthy environment through waste recycling. Chicken feather comprises more than 90% protein, the major part being beta-keratin, a fibrous and insoluble structural protein broadly cross-linked by disulfide bonds. So here CFF is opted as one of the most appropriate natural fiber used as fiber reinforcement.

Seashells are a renewable resource making an important contribution to developing a circular economic in wide range of industries ranging from agriculture to construction and can help in making positive contribution to food security and sustainability. Seashell powder as a cement replacement helps in improving the strength of concrete. The calcium carbonate in the seashell is more than 90% and is similar to calcium carbonate in the limestone dust that been used in Portland cement production.

II. LITERATURE REVIEW

Dr.M John Robert Prince, et al., (2020) studied the use of seashells in concrete in a beneficial way for recycling this material instead of using landfills and this study promotes the incorporation of seashells into concrete mixes. The strength of concrete made withseashell replacement met the target strength at 28 days. The compression strength, tensile strength and flexural strength gradually increases with the replacement of seashell powder. The 15% achieves the maximum tensile strength and flexural strength for partial replacement of cement with seashell Powder is found to be greater than the conventional concrete.

Karthika S, et al., (2020) The quantity of materials are calculated as per the requirement of cubes and cylinders for further consideration tests in terms of strength of the concrete. The seashell powder under gone to the test of X-Ray Diffraction (XRD) test for analyzing the properties of seashell powder. It is basically used for the crystalline structure of seashell powder. The properties of seashell powder studied through the X-RAY Diffraction (XRD) test. It gave the optimized strength of concrete while adding the seashell powder as a replacement.

S. Pranavan, et al., (2021) The percentage increase of compressive strength of chicken feather fiber concrete with 7 & 28 days. compressive strength is 23.33% for 0.75% of CFF&35.85% for 1.00% of CFF. The percentage increase of split tensile strength of chicken feather fiber concrete with 7 &

28 days strength is 2.69% & 3.20% for 1.00% of CFF. The percentage increase flexural strength of chicken feather fiber concrete with 7 & 28 days strength is 3.55% & 8.56% for 1.00% of CFF.

V. Thirumurugan. et al., (2018) Cashew nut shell ash can increase the overall strength of the concrete when used up to a 20% cement replacement and chicken feather fiber as 2% with w/c ratio of 0.45.when cashew nut shell ash is used up to 30%in concrete with w/c ratio of 0.45 it gives lower strength to the 20%of replacement. Since Cashew nut shell ash is a by product material, its use as a cement replacing material reduces the levels of CO_2 emission by the cement industry.

III. MATERIALS AND METHODOLOGY

3.1 MATERIALS USED

3.1.1 Ordinary Portland cement

Shows characteristic properties of adhesion and cohesion by which it can bond well with aggregate.

Table 1: physical properties of cement

Sl no	Properties	Result
1	Fineness	8%
2	Specific gravity	2.82
3	Initial setting time	30 min
4	Final setting time	410 min

3.1.2 Fine aggregate

Locally available sand passing through IS 4.75 mm sieve and helps in increasing the strength of the concrete.

Table 2: Physical properties of fine aggregate

Sl no	Properties	Result
1	Specific gravity	2.58
2	Bulk density	1.75 g/cc
3	Porosity	30.11%

3.1.3 Coarse aggregate

Aggregates passing through IS 20 mm sieve are used. Crushed stone is generally used as coarse aggregate.

Table 3: Physical properties of coarse aggregate

Sl no	Properties	Result
1	Specific gravity	2.81
2	Bulk density	1.69 g/cc
3	Porosity	39.75%

3.1.4 Chicken feather

Chicken feathers are waste product from rooster and poultry farm and it act as a light weight composite material.

Fig 3.1: Chicken feather

3.1.5 Seashell powder

Seashell is the dead remain of marine organism. It also shows the properties of chemical admixture.

Fig 3.2: Seashell powder

3.1.6 Water

Potable tap water available in laboratory is used for mixing.

3.2 METHODOLOGY

3.2.1 Mix design

M30 grade mix has been designed and calculated mix proportions are given below Table 4.

Table 4:Quantity of Materials Required Per Cubic Meter for M30 Grade Concrete

Cement	Fine aggregate	Coarse aggregate	Water
387.5 kg/m^3	663.73 kg/m^3	1179.47 kg/m^3	193.85 kg/m^3

3.2.2 Experimental progress

Chicken feathers has been collected from poultry farms. The collected feathers has been sorted out then they are cleaned disinfectant and dry under sunlight for 10 days. Later the dried chicken feathers were trimmed using pair of scissors to remove the avian fibers (barbs) from the rachis part of the feathers. After the extraction of fibers the cut pieces of fibers has been mixed with the concrete in ratios 1%, 2% and 3% of mass of cement for finding its accurate optimum value and the result has been observed that the maximum optimum value of CFF is obtained at 2%, more than 2% of CFF in concrete result to decrease in its strength.

Seashell powder refers to the powder made of oysters, clams, and scallops. 95% of them are calcium carbonate, chitin, and a small number of aminoacids and polysaccharides. Seashell powder can be made by breaking the shell and grinding into fine powder. The shells has been collected in large numbers the collected shell is rinsed with water and scrubbed with brush for removing the dirt particles on them. After cleaning the shells has been dried under sunlight for removing moisture content on them. Then the shell has been crushed using hammers to break into small particles later it is grinded into fine particles with the help of industrial grinding machines. The grinded shell powder is then sieved using 2.36mm sieve. This sieved shell powder is used for replacing cement. Later the concrete specimens for test has been casted with replacing cement in ratios 5%, 10 % , 15% and 20 % of mass of cement and CFF with optimum value 2%.

3.2.3 Preparation of specimens

Size of concrete cube- 150 x 150 x 150 mm
Size of concrete cylinder- 150mm diameter and 300mm depth.
Size of concrete beam- 100 x 100 x 500mm

The concrete specimens are casted and its strength after 7 days and 28 days curing period is determined.

Fig 3.3: Casting of specimens

Fig 3.4: Curing of specimens

3.2.4 Tests for concrete

Test for compressive strength of concrete cubes
The compressive strength of specimen was calculated by formula
F_{ck} = P/A
Where, P=failure load in compression in N
A=Area of cube in mm^2
F_{ck}=Compressive strength in N/mm^2

Test for split tensile strength of concrete cylinders
The tensile strength of specimen was calculated by formula
F_{sp}= 2P / (πdL)
Where, f_{sp} =Split tensile strength in N/mm^2.
P = Maximum applied load in N
L = Length of cylinder in mm
d = Diameter of cylinder in mm

Test for flexural strength of concrete beams
The flexural strength of specimen was calculated by formula
F_b= PL/bd^2
Where, f_b =Flexural strength in N/mm^2.
P = Maximum applied load in N
L = Length of specimen in mm
d = Depth of specimen in mm
b = width of specimen in mm

IV. RESULTS

4.1 Compressive strength Test

Table 4: Compressive strength Test Result

Partial replacement of cement with seashell powder	Percentage of CFF	Age of curing 7 days (N/mm^2)	Age of curing 28 days (N/mm^2)
0%	2%	17.3	30.07
5%	2%	19.82	30.10
10%	2%	21.25	30.78
15%	2%	29.25	32.11
20%	2%	19.25	30.99

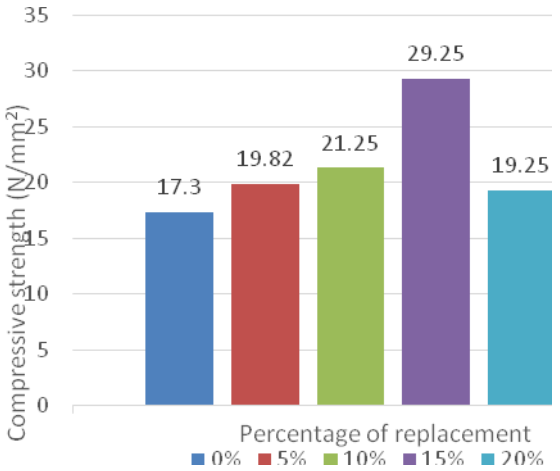

Fig 4.1 : Compressive strength after 7 days curing period

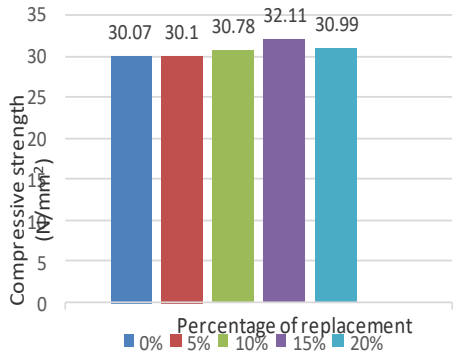

Fig 4.2 : Compressive strength after 28 days curing period

4.2 Split Tensile strength Test

Table 5: Split tensile strength Test Result

Partial replacement of cement with seashell powder	Percentage of CFF	Age of curing 7 days (N/mm^2)	Age of curing 28 days (N/mm^2)
0%	2%	1.72	2.37
5%	2%	1.87	2.42
10%	2%	1.99	2.47
15%	2%	2.52	2.65
20%	2%	2.21	2.43

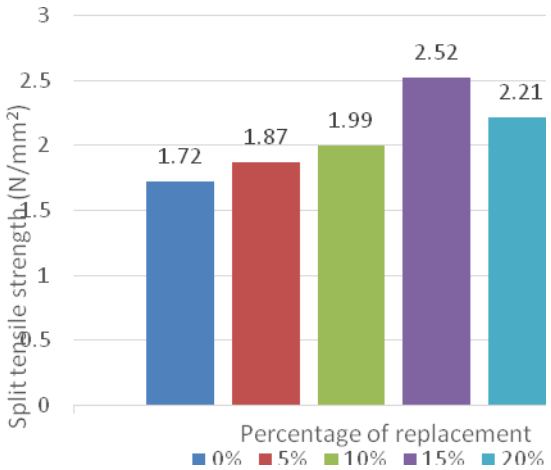

Fig 4.3 : Split-Tensile strength after 7 days curing period

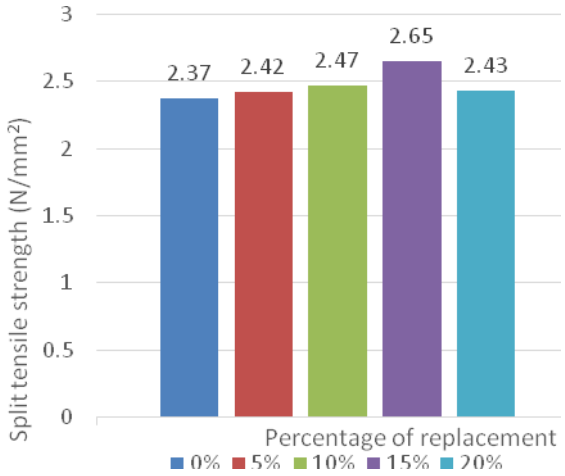

Fig 4.4 : Split-Tensile strength after 28 days curing period

4.3 Flexural strength Test

Table 6: Flexural strength Test Result

Partial replacement of cement with seashell powder	Percentage of CFF	Age of curing 7 days (N/mm^2)	Age of curing 28 days (N/mm^2)
0%	2%	2.60	4.03
5%	2%	2.91	4.09
10%	2%	3.26	4.13
15%	2%	4.00	4.9
20%	2%	3.33	4.37

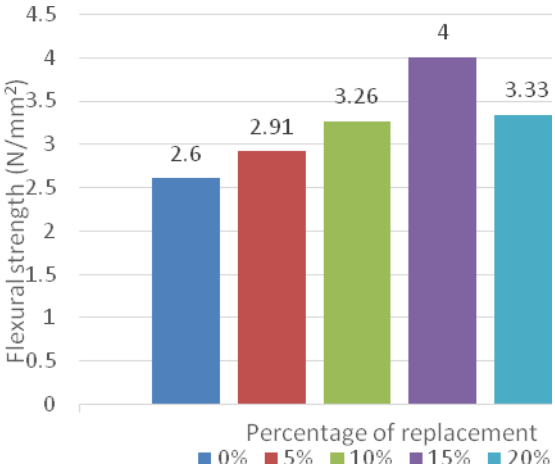

Fig 4.5 : Flexural strength after 7 days curing period

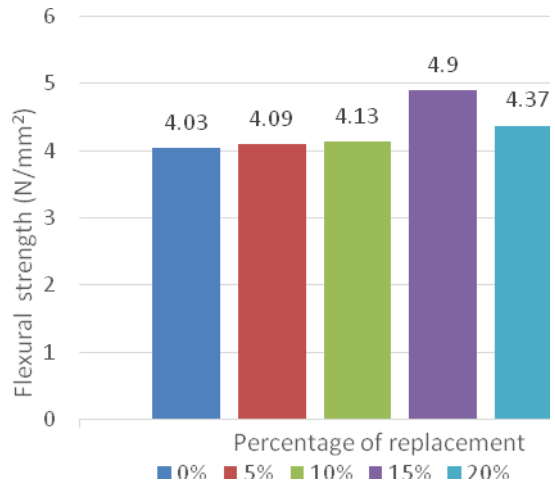

Fig 4.6 : Flexural strength after 28 days curing period

V. CONCLUSION

In this paper, we have conducted test on partially replacing cement by seashell powder and adding CFF as fiber reinforcement in a optimum value 2% . The fresh concrete shows moderate workability on slump test. The strength determination test such as compression test, split-tensil test and flexural test has been conducted by replacing cement in 5%, 10%, 15% and 20%. The results has been obtained such that on 15% replacement of cement, the concrete shows maximum compression, split tensile and Flexural value. On further replacement of cement, the value gradually decreases.

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