International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 5 Issue 2, January-February 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Experimental Study of Waste Chicken Feather Fibre in Concrete

S. Pranavan[1], S. Manikandan[2], D. Selvakumar[3]

[1,2]Assistant Professor, [3]Professor,
[1]Dhanalakshmi Srinivasan College of Engineering, Coimbatore, Tamil Nadu, India
[2,3]Shanmuganathan Engineering College, Pudukkottai, Tamil Nadu, India

ABSTRACT

This work was carried out to investigate the possibilities of utilizing the natural chicken feather fibres (CFF) barbs and rachis in concrete at different volume fractions of (0.25%, 0.50%, 0.75%, 1.00%, 1.25%, 1.50%) in cement concrete composite for the development of low-cost and waste reusable building material in construction industry. CFF were sourced from poultry processing plants to reduce the solid waste problem (Feather fibres disposal in open lands) under environmental strategies. The various mechanical properties of compressive strength, split tensile strength and flexural strength tests of modified chicken feather fibres concrete have been studied and the results are compared to the conventional concrete.

KEYWORDS: *Chicken feather fibre (CFF), Concrete Composite, Solid Waste Management, Mechanical Properties Test*

How to cite this paper: S. Pranavan | S. Manikandan | D. Selvakumar "Experimental Study of Waste Chicken Feather Fibre in Concrete" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-5 | Issue-2, February 2021, pp.842-845, URL: www.ijtsrd.com/papers/ijtsrd38553.pdf

IJTSRD38553

I. INTRODUCTION

Concrete is the widely used raw material on the environment next to water. The global cement production for infrastructures is increasing day by day in order to preserve and accommodate the desires of the future population. Around environment, technological innovation and studies have helped peoples to enhance their requirements of residing through diverse trends and identifications. However some technology can create environmental impact. Therefore efforts are taken in making use of natural based material that exist in nature in place of create a new fabric.

II. CHICKEN FEATHER FIBRE

Chicken feathers are waste products from rooster and poultry farm. Around world 24 Billion chickens are killed yearly and round 10billion tonnes of hen feathers are generated each 12 months by rooster processing plants, growing a solid waste problem. According to recent report India's contribution alone is 350million tones. Traditional disposal of CFF results expensive and difficult contributing to environment pollution. Poultry feathers are dumped on landfills, incinerated or buried over the soil. Discarded feathers cause numerous human ailments like chlorosis, mycoplasmosis and bird cholera. However CFF are restricted in landfill disposal on grounds due to the pose of greenhouse gas generation that it is danger for the environment. Recent studies on the chicken feather waste demonstrated that the waste can be used as a potential composite reinforcement. The composite reinforcement application of CFF offers effective way to save the environment from solid waste disposal on landfill. Some advantages of CFF are inexpensive, renewable, easy available and light weight composite material.

Figure 1: Parts of Chicken Feather

Chicken feathers are enormously ordered, hierarchical branched structures, ranking many of the most complicated of keratin structures determined in vertebrates. Since the main parts of the Chicken feather includes barbs and rachis which leads good characteristic strength.

There are five commonly recognized categories of feathers: a) Semiplume, b) Contour Feather &Afterfeather, c) Filoplume, d) Bristle, and e) Down Feather.

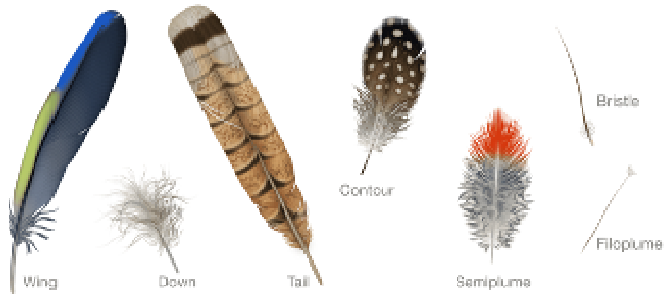


Figure 2: Types of Chicken Feather

III. EXPERIMENTAL PROGRAM

A. Descriptions of Material

Normally the CFF Concrete can be manufactured by the waste chicken feathers were obtained from A1 poultry farm, Pudukkottai, Tamilnadu, India. Waste chicken feathers collected are brought to the laboratory in polythene sacks and washed several times in laundry detergent and sodium chloride to remove blood and extraneous. The clean feathers were then spread on galvanized iron plates and dried in sun for 2days. Then sun/ oven dried feathers are sliced into 25mm long approximate pieces. Thus feather fibers barbs are cutted manually using scissors ranges 5 to 20mm. Fibre diameters were found to be in the range of 4 to 6mm by scanning electron microscopy, lengths are between 3 to 17.8mm and its density is about 1500kg/m3. Fine Aggregate used is to be clean oven dried/ dry river sand. By 4.75mm sieve the pebbles in the fine aggregate are to be cleaned. Fine aggregate used is of having a specific gravity of 2.60, bulk density of 1700.84kg/m^3 and fineness modulus of 3.82 are used. Coarse aggregates of 20 mm maximum size having specific gravity of 2.72 were used. Water used in the concrete manufacturing and curing is as per the confirming requirement of codal standards.

B. Mix Design of Chicken Feather Fibre Concrete

In the design of CFF Concrete mix, CFF, CA, FA together were taken as of entire mixture by mass. The CFF is added in mass basis with different proportions to the conventional Concrete mix. The mix was designed as M25 grade and mix proportions are given in below Table 1.

Table-1:M25Grade Concrete Mix Proportion for CFF Concrete

Cement (kg/m^3)	Fine aggregate (kg/m^3)	Coarse aggregate (kg/m^3)	Water (kg/m^3)
425.73	558.272	1241.08	191.58
1	1.31	2.92	0.40

C. Casting of Concrete Specimens

- Concrete Cube - 150 x 150 x 150mm size
- Concrete Cylinder - 150mm dia and 300mm depth
- Concrete beam/ Prism - 100 x 100 x 500mm size

Before concreting in the casting moulds, it should be kept clean & ready before concreting. Care should be taken on bolting in concrete moulds, because during vibrating the concrete expels some cement mortar at the ends of the mould. After bolting the inner surfaces are to cleaned and oiled before concreting. The filling of concrete in mould specimens is taken care as layer by layer filling and at the end it should be vibrated. Highest surface of concrete is smoothly finished with a trowel. Date of casting should be marked over the surface of concrete specimens.

Figure 3: Preparation of Concrete for different Chicken Feather Fibre (CFF) Proportions

IV. TESTS FOR CONCRETE

A. Test for Compressive strength of concrete cubes:

Compressive strength,

F_c= Maximum load/ Area =P/A

Where, **P** - Compressive Load

A - Plain Surface Area of Concrete Specimen

B. Test for Split tensile strength of concrete cylinders:

Split Tensile Strength,**Tsp = (2P/ (πdL))**

Where **P**= Maximum Load in kN

L= Length of the Specimen

d= Diameter of width of the specimen

C. Test for Flexural strength of concrete beams

Flexural Strength, **F_b= PL/ bd^2**

Where **b**= width in cm of specimen

d= depth in cm of specimen at point of failure

L= length in cm of specimen on which specimen was supported

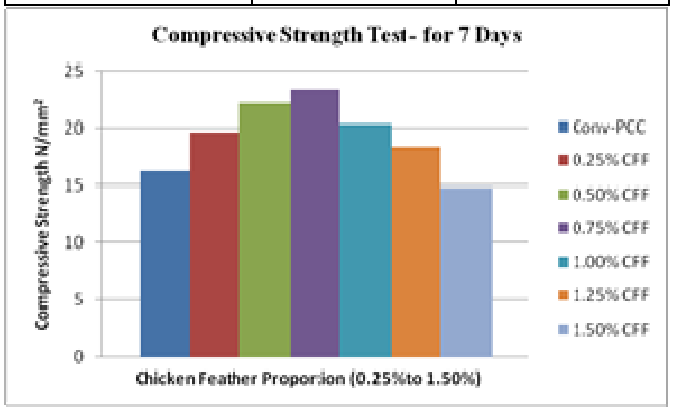
V. RESULTS AND DISCUSSION

A. Compressive Strength Test

The compressive strength test for concrete tested after 7 and 28 days of curing is shown below the table.2

Table 2: Compression Strength Test Result

Types of Fibre Proportions	@ 7 days (N/mm^2)	@ 28 days (N/mm^2)
Conventional PCC	16.22	28.80
0.25% of CFF	19.70	31.11
0.50% of CFF	22.15	31.99
0.75% of CFF	23.33	34.22
1.00% of CFF	20.37	35.85
1.25% of CFF	18.33	27.99
1.50% of CFF	14.81	17.47



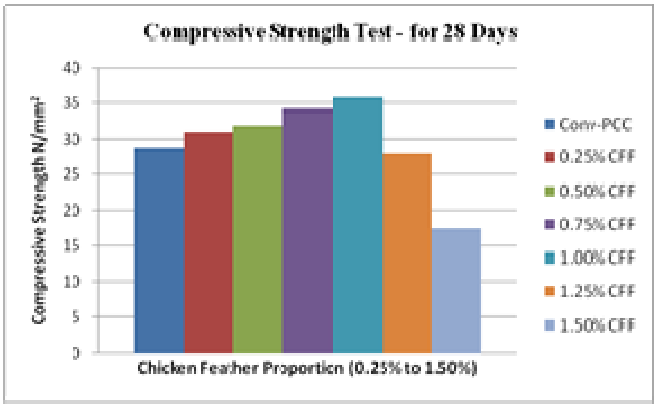


Figure 4: Compressive Strength Test @ 7 DaysFigure 5: Compressive Strength Test @ 28 Days

B. Split Tensile Strength Test

The split tensile strength test data tested after 7 and 28 days of curing is shown below the table.3

Table 3: Split Tensile Strength Test Result

Types of Fibre Proportions	@ 7 days (N/mm²)	@ 28 days (N/mm²)
Conventional PCC	2.17	2.90
0.25% of CFF	2.31	2.78
0.50% of CFF	2.36	2.69
0.75% of CFF	2.69	3.20
1.00% of CFF	2.40	2.76
1.25% of CFF	1.84	2.03
1.50% of CFF	1.55	2.07

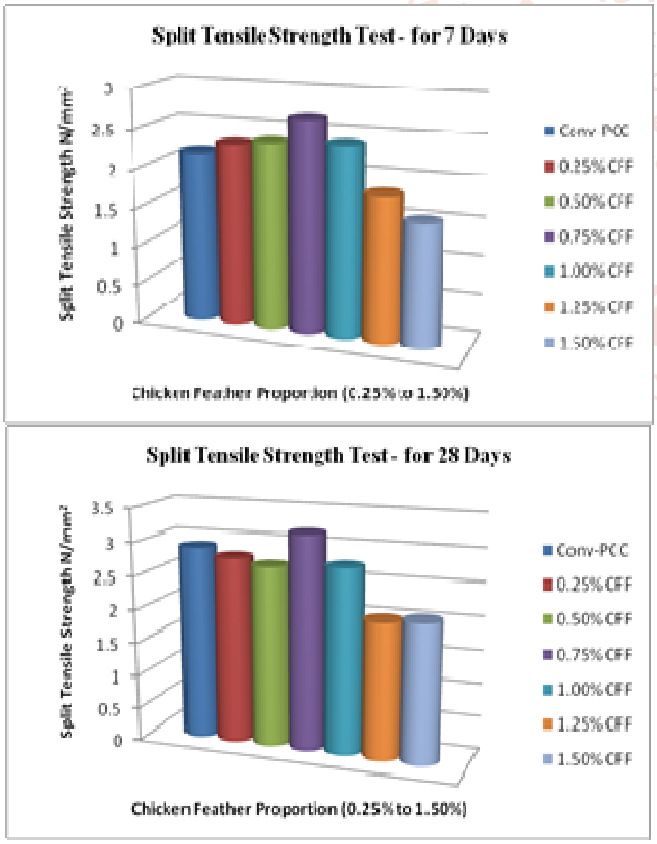


Figure 6: Split Tensile Strength Test @ 7 Days Figure 7: Split Tensile Strength Test @ 28 Days

C. Flexural Strength Test

The flexural strength test data tested after 7 and 28 days of curing is shown below the table.4

Table 4 Split Flexural Strength Test Result

Types of Fibre Proportions	@ 7 days (N/mm²)	@ 28 days (N/mm²)
Conventional PCC	3.10	8.00
0.25% of CFF	3.00	7.70
0.50% of CFF	2.80	7.10
0.75% of CFF	3.26	8.29
1.00% of CFF	3.55	8.56
1.25% of CFF	2.67	6.54
1.50% of CFF	2.40	6.20

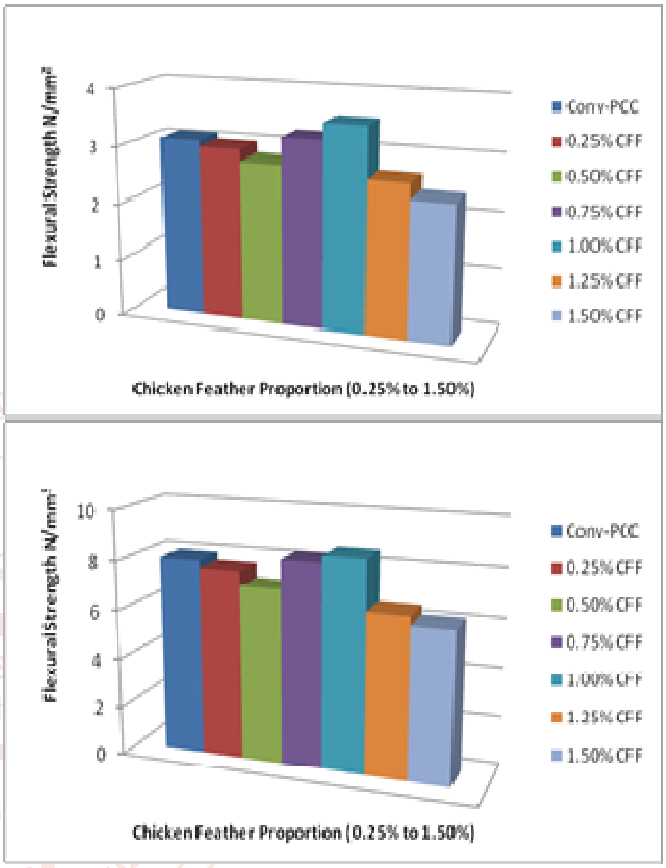


Figure 8: Flexural Strength Test @ 7 Days Figure 9: Flexural Strength Test @ 28 Days

From the above tested cocnrete specimen strength results that compressive strength of concrete cube for 7 and 28 days gives better results in 0.5 to 0.75% of CFF concrete mix with max strength value in 0.75% ratio of 23.33 N/mm² for 7days and 35.85 N/mm². In Split tensile strength test the max value is obtained in 0.75% CFF with max value of 2.69 N/mm² and 2.92 N/mm². In flexural strength test the max value is obtained in 1.00% CFF of 3.55 N/mm² and 8.56 N/mm².

VI. CONCLUSION

Based on the results of this experimental investigation the following conclusions are drawn, a detailed analysis of compressive strength, flexural strength and tensile strength of concrete mixed with chicken feather fibres is done. The results are taken after 7 & 28 days of curing. 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. Based on the above observation it has been formed that the maximum optimum value is obtained from 0.5 to 1%. Increase in percentage more than 1% of CFF in concrete results to decrease in strength on results during concrete manufacturing.

VII. CONFLICTS OF INTEREST/COMPETING INTERESTS

On behalf of all authors, the corresponding author states that there is no conflict of interest.

VIII. REFERENCES

[1] Schmidt WF. 1998. *Innovative Feather Utilization Strategies. Proc. National Poultry Waste Management Symposium, October 19-22, 1998. Auburn University Printing Services, Pp. 276-282.Schmidt Wf. 1998.*

[2] Schmidt WF. 2002. *Microcrystalline Keratin: From Feathers to Composite Products. In Wallenberger Ft, Weston Ne, Ford R, Wool Rp, Chawla K. (Eds).Proc. Material Research Symposium. December 2-6, 2002. Boston, Massachusetts. Pp. U1.5.1-U1.5.5.*

[3] Wool RP. 2005. *Bio-Based Composites from Soy Bean Oil and Chicken Feather. In Wool RP, Sun XS (Eds).Biobased Polymers and Composites. Elsevier Academic Press. 411 P.*

[4] Barone, J. R., and Schmidt, W. F., *"Polyethylene Reinforced with Keratin Fibers Obtained from Chicken Feather", Composites Science and Technology, Vol. 65, pp.1173-1181, 2005.*

[5] BaroneJr, Schmidt Wf, Liebner Cf. 2005b. *Compounding And Molding Composites Reinforced Keratin Feather Fiber. Composites Science and Technology 65, 683-692.*

[6] Hamoush SA, El-Hawary Mm. 1994.*Feather Fiber Reinforced Concrete. Concrete International 16, 33–35.*

[7] Savastrano JRH, Warden PG, Coutts*Rsp. 2005. Microstructure and Mechanical Properties of Waste Fibre Cement Composites. Cement and Concrete Composites 27, 583-592.*

[8] Gassner, George, Schmidt, Walter, Michael J., Thomas, Waters, R. M., *"Fiber and fiber products produced from feathers", 1998.*

[9] Jeffrey, W., Koc, J. W., *"Physical and mechanical properties chicken feather materials", A Thesis Presented to the Academic Faculty, 2006.*

[10] S. A. Hamoush, M. M. El-Hawary, *Feather fiber reinforced concrete. Concrete International, 16(6): 1994 33- 35.*

[11] J. W. Kock, *Physical and Mechanical properties of chicken feather materials, MS thesis, School of Civil and Environmental Engineering, Georgia Inst of Tech, 2006.*

[12] Durham, S. (2002). Save a Tree, Use Some Feathers. *From http://www.ars.usda.gov/is/pr/2002/020329.htmlAgricultural Research Service. Retrieved March 30, 2004.*

[13] Swamy, R. N., *"Natural Fibre Reinforced Cement and Concrete," Concrete Technology and Design, V. 5, Blackie and Son, Ltd., London, 1988.*

[14] Slate, Floyd 0; Nilson, Arthur H.; and Mardinez, Salvador, *"Mechanical Properties of High-Strength and Lightweight Concrete," Proceedings, AC1 Journal, V. 83, no. 4, Jul.-Aug. 1986, pp. 606-613.*

[15] Hansen, J. A., *"Strength of Structural Lightweight Concrete Under Combined Stress," Journal of the Research and Development Laboratories, Portland Cement association, V. 5, No. 1, Jan. 1963, pp. 39-46.*

[16] Chapman, Ralph A., and Shah, Surendra P., *"Early-Age Bond Strength in Reinforced Concrete," ACI Materials Journal, V. 84, No. 6, Nov.-Dec. 1987 pp. 501-510.*

[17] Swamy, R.; Jones, R.; and Chiam, T., *"Shear Transfer in Steel Fiber Reinforced Concrete," Fiber Reinforced Concreie Properties and Applications. SP-105, American Concrete Institute, Detroit, 1987, pp. 565-592.*