

EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF COARSE AGGREGATE BY COCONUT SHELL : REVIEW

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Abstract— Concrete is the Preliminary construction material around the world. It is a man-made product, essentially consisting of a mixture of cement, aggregates, water and admixtures. Traditionally aggregates have been readily available at economic prices and of qualities, but the use of natural aggregate in highly increasing rate leads to a question about the preservation of natural aggregates sources. In light of this, few studies identified that coconut shells, the agricultural by product can also be used as aggregate in concrete as India occupies premier position in the world for the production of coconut. Limited research has been conducted on mechanical properties of concrete with coconut shells as aggregate replacement. However, further research is needed for better understanding of the behaviour of coconut shells as aggregate in concrete. The aim of this work is to examine the strengths of coconut shell concretes at different coconut shells (CS) replacements with constant w/c ratio. Utilising coconut shell as aggregate in concrete production not only solves the problem of disposing this solid waste but also helps conserve natural resources. The other benefit of using CS is that it makes the concrete light weight as compared to ordinary concrete. It has been observed from the previous research data that the overall strength decreased with CS replacement increased when compared to ordinary concrete, but after all the CS concrete resulted in acceptable strength required for structural concrete.

Keywords— Coconut Shell, Concrete, Coarse Aggregate, strength Properties, waste disposal, Natural Resources.

I. INTRODUCTION

Infrastructure development across the world created demands for construction material. Concrete is the premier civil engineering material. Concrete manufacturing involve consumption of ingredients like cement, aggregates, water & admixtures. Among all the ingredients, aggregates form the major parts. Two billion of aggregate are produced each year in the United States. Production is expected to increase to more than billion tons per year by the year similarly; the consumption of the primary aggregate was 110 million tones in the UK in year 1960 and reached nearly 275 million tones by 2006. Use of natural aggregates in such a rate leads to a question about the preservation of natural aggregates sources. In addition, operation associated with aggregates extraction and processing is the principal causes environmental concern. In light of this in the contemporary civil engineering construction, using alternative materials in place of natural aggregate in concrete production makes concrete as sustainable and environmentally friendly construction material. Different waste material like rubber, fly ash, glass, bottom ash, artificial sand etc has been used as alternative for replacing natural aggregates. Apart from the above mention waste material, a few studies shows that agriculture waste coconut shell can also be used as coarse aggregate for concrete.

II. PROPERTIES OF COCONUT SHELL

- Coconut Shell contains high strength and modulus properties.
- It absorbs less moisture as compared to other agricultural waste because of having low cellulose content.
- They are being naturally available in nature and since its shells are non-biodegradable, it can be used readily in concrete.
- There is lignin content available in coconut shell, which makes the composite more weather resistant.

III. LITERATURE REVIEW

A. Amarnath Yerramala, Ramachandrudu C, "Properties of Concrete with Coconut Shells as Aggregate Replacement", International Journal of Engineering Inventions(IJIEI), Structures and Materials laboratory department of Civil Engineering , Intell Engineering College, Anantapur, India.

In order to investigate properties of CS concretes, mixes were employed. Control mix (M1) that is, without CS was made. Coarse aggregate was then replaced with CS in 10 (M2), 15 (M3), 20 (M4) percentages to study effect of CS replacement. With CS percentage increase the 7 day strength gain also increased with corresponding 28 day curing strength. However, the overall strength decreased with CS replacement when compared to control concrete. Similar to compressive strength, the split tensile strength also decreased with increase in CS replacement. Increase in CS replacement permeable voids also increased. With 10% CS replacement the permeable were 30 percent higher than control concrete. Similarly, the permeable voids were 88 percent higher than control concrete for 20% CS replacement.

B. Kalyanapu Venkateswara Rao, A.H.L.Swaroop, Dr.P.Kodanda Rama Rao, Ch.Naga Bharath, “Study on Strength Properties of Coconut Shell Concrete”, International Journal of Civil Engineering and Technology(IJCIET), Gudlavalleru Engineering College.

In order to investigate properties of coconut shell concretes, M1, M2, M3 mixes were employed with 0,10,20 percentage of CS respectively, to study the effect of CS replacement in M30 mix design. The replacement of 10% CS as coarse aggregate (M2) will decrease the marginal value of 2.88% in compression and 2.7% in split tensile strength. While the replace of 20% CS as coarse aggregate (M3) will decrease marginal value of 8.39% in compression and 10.25% in split tensile strength.

TABLE I. CONVENTIONAL CONCRETE TEST RESULTS

S No	Compressive Strength, MPa			Split Tensile Strength, MPa			Water Absorption (%)	Permeable Voids (%)	Sorptivity (mm/sec ^{1/2})
	Days	3	7	28	3	7			
1	15.1	23.4	37.3	1.7	2.5	3.7	0.431	9.67	0.124
2	14.7	24.2	38.1	1.74	2.52	3.6	0.51	8.45	0.126
3	14.9	23.9	37.1	1.79	2.9	3.7	0.45	8.92	0.123

TABLE II. 10% REPLACEMENT OF CS AS COARSE AGGREGATE

S No	Compressive Strength, MPa			Split Tensile Strength, MPa			Water Absorption (%)	Permeable Voids (%)	Sorptivity (mm/sec ^{1/2})
	Days	3	7	28	3	7			
1	16.6	26.67	36.7	1.45	2.31	3.6	2.43	10.7	0.134
2	16.83	27.43	37.0	1.40	2.2	3.5	2.43	13.42	0.135
3	17.10	27.14	36.8	1.43	2.27	3.4	2.429	11.29	0.133

TABLE III. 20% REPLACEMENT OF CS AS COARSE AGGREGATE

S No	Compressive Strength, MPa			Split Tensile Strength, MPa			Water Absorption (%)	Permeable Voids (%)	Sorptivity (mm/sec ^{1/2})
	Days	3	7	28	3	7			
1	17.34	25.01	34.7	1.32	1.96	3.5	4.22	13.71	0.156
2	18.02	25.42	34.9	1.28	1.98	3.2	4.45	13.72	0.163
3	18.47	24.78	32.8	1.33	2.34	3.3	4.6	13.25	0.159

C. Dr. B. Rajeevan, Shamjith K. M., “A Study on Utilization of Coconut Shell as Coarse Aggregate in Concrete”, International Journal of Engineering Research and Technology(IJERT), Department of Civil Engineering, Government Engineering College, Kannur.

A total of 24 cubes, 21 cylinders and 21 beam samples with various percentage of CS, namely 5%, 10%, 15%, 20%, 25%, 30%, 35% by volume of coarse aggregate were tested to evaluate the mechanical properties. The results shows that, The compressive strength varied from 26 to 21 N/mm² for 0% to 35% replacement of coarse aggregate with CS. The split tensile strength for 0% CS at 28 day was 2.82 N/mm², It was observed that the split tensile strength was near to the target value when the percentage replacement is between 5-15%. With 0% CS. The flexural strength was comparable to that of control concrete (M20 grade), when the percentage replacement was in between 5-15%.

Results With 0% Replacement Of Coconut Shell
 TABLE IV. Aggregate

Mechanical property	7 days	28 days
Compressive strength(N/mm ²)	18	26
Split tensile strength (N/mm ²)	1.43	2.82
Flexural strength (N/mm ²)	2.05	3.17

Results With 5% Replacement Of Coconut Shell
 TABLE V. Aggregate

Mechanical property	7 days	28 days
Compressive strength(N/mm ²)	17.9	24
Split tensile strength (N/mm ²)	1.05	2.45
Flexural strength (N/mm ²)	1.98	2.28

Results With 10% Replacement Of Coconut Shell
 TABLE VI. Aggregate

Mechanical property	7 days	28 days
Compressive strength(N/mm ²)	16.9	24
Split tensile strength (N/mm ²)	1.32	2.54
Flexural strength (N/mm ²)	2.01	3.1

IV. CONCLUSIONS

From the study of above research papers it can be concluded that,

- Addition of CS decreases workability and densities of the concretes.
- With CS percentage increase the 7 day strength gain also increased with corresponding 28 day curing strength. However, the overall strength decreased with CS replacement when compared to control concrete.
- Similar to compressive strength, the split tensile strength also decreased with increase in CS replacement.
- It is concluded that the Coconut Shells are more suitable as low strength-giving lightweight aggregate when used to replace common coarse aggregate in concrete production.
- Coconut Shell Concrete can be used in rural areas and places where coconut is abundant and may also be used where the conventional aggregates are costly.
- The observed value for 15% replacement in M20 grade concrete at 28 days of compressive strength, split tensile strength and flexural strength were 24.6 N/mm², 2.57 N/mm² and 2.89 N/mm² respectively. This indicates that concrete made with coconut shell aggregate has strength comparable with that of conventional concrete.

V. SCOPE OF WORK

In this Review paper, it is concluded that the strength gained by CS concrete is less as compared to the control concrete, So light weight construction units can be made by using these wastes like panels & block production, internal wall casting, outdoor furniture etc.

References

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