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Experimental analysis of the use of coconut shell as a course aggregate in concrete

G.Tamilarasi[1], G.Vairamani[2], Dr.R.Lavanya[3]

[1]Assistant Professor, Department of Civil Engineering, KSR College of Engineering, Tiruchengode

[2]Lecturer, Department of Civil Engineering, Thiagarajar Polytechnic College, Salem

[3]Lecturer, Department of Civil Engineering, Thiagarajar Polytechnic College, Salem

ABSTRACT

The cost of conventional building materials increasing every day and it is a major factor affecting constructions. This has necessitated research to find alternative materials of construction so that the availability of materials made easy for construction. In this study, a alternate building material, the coconut shell is used as light weight aggregate in concrete. The properties of coconut shell and coconut shell aggregate concrete is examined and the use of coconut shell aggregate in construction is tested. Conventional coarse aggregate in concrete will be partially used so as to control the quality of concrete. While natural material in coconut shell as a coarse aggregate, it will be investigated to replace the natural coarse aggregate in concrete. The project paper aims to analyse the compressive strength characteristics with partial replacement for M30 grade concrete. The project also aims to show that the Coconut shell aggregate is a potential construction material and it simultaneously reduces the environment problems.

Objective of the paper

The main objective is to encourage the use of these agricultural waste products as construction materials in low-cost housing. In this studies, M30 concrete mixes with different combination of natural material content namely 25%, 50% and 75%.Three sample specimen will be prepared for each concrete mixes [1]. The parameters will be tested are compressive strength, tensile strength, modulus of elasticity

Keywords: Coconut shell, Coarse aggregate, Codes and Standards, Mechanical properties.

INTRODUCTION

Concrete is the widely used number one construction material in the world. Concrete manufacturing involve consumption of ingredients like cement, aggregates, water and admixtures. Among all these ingredients, aggregates form the major part. The high demand for concrete in the construction using normal weight aggregates such as granite gets drastically reduced from the natural stone deposits and this has damaged the environment, thereby causing ecological imbalance [2]. Hence it is needed to explore and to find out suitable replacement to substitute the natural stones and makes the concrete as sustainable and environmentally friendly construction material.

The crushed stone and sand are the components that are usually replaced with light weight aggregates. Lightweight concrete is typically made by incorporating natural or synthetic lightweight aggregates' or by entraining air into a concrete mixture. Natural organic waste materials are used for making lightweight concrete. Some of the lightweight aggregate used for lightweight concrete productions are pumice, perlite, expanded clay or vermiculite, coal slag, sintered fly ash, rice husk, straw, sawdust, cork granules, wheat husk, oil palm shell and coconut shell [3].

Author for correspondence:
Assistant Professor, Department of Civil Engineering, KSR College of Engineering, Tiruchengode

Coconut shell is grown in more than 90 countries worldwide and India occupies the premium position. India is the third largest producer of coconut products in the world. Coconut trees are widely cultivated in the southern states of India, especially in the Kerala and Tamilnadu. Coconut shells get accumulated in the mainland without being degraded for around several decades. Disposal of these coconut shells is therefore a serious environmental issue [4].

In this juncture, the study on use of coconut shell as a substitute or replacement for coarse aggregate in concrete, is gaining importance in terms of possible reduction of waste products in the environment and finding a sustainable alternative for non-renewable natural stone aggregates.

MATERIALS USED

- The constituent materials used in this investigation were produced from local sources.
- Cement: OPC 53 grade conforming to IS – 12269 - 2009
- Fine Aggregate: Well graded river sand passing through 4.75mm
- Coarse Aggregate: Crushed blue granite of maximum size 20mm
- Coconut shell: Freshly discarded coconut shells collected from market and oil mill
- Water : Potable water conforming to IS 456-2000

TESTS ON MATERIALS

Cement

Cement in concrete acts as a binder for binding the other materials together and also it gives strength to the concrete. It hardens and set independently on addition of water. In this study, Ordinary Portland Cement of 53 grade is used according to IS 12269. The typical content of cements 350-450 Kg /m^3 for making concrete.

Figure 1: Cement

Table: 1 Test Result of Cement

S. No	Particulars	Test Results	Indian Standards
			OPC 53 Grade
1.	Fineness – Specific Surface in m^2/Kg	266	Minimum 225
2.	Initial Setting time in minutes	120	Minimum 30
3.	Final Setting time in minutes	190	Maximum 600
4.	Compressive strength (MPa)-72 ± 1hour	28.93	27
5.	Compressive strength (MPa)-168 ± 1hour	38.86	37
6.	Compressive strength (MPa)-672 ± 1hour	---	53
7.	Soundness in mm	1mm	>10

Fine aggregate

All types of river sands are suitable for making concrete. Either crushed or rounded sands can also be used as fine aggregate. The sand should conform to IS 383 for its suitability to use in concrete.

Figure 2: Fine aggregate

Table: 2 Test Result of Fine Aggregate - Sieve Analysis

IS sieve	Weight Retained in grams	Percentage of Weight Retained	Cumulative Percentage Retained	Percentage of finer	BIS Standards
					Percentage Passing Limits for Zone II
4.75mm	6	0.6	0.6	99.4	90 - 100
2.36mm	108	10.8	11.4	88.6	75 - 100
1.18mm	312	31.2	42.6	57.4	55 - 90
600micron	180	18.0	60.6	39.4	35 - 59
300micron	284	28.4	89.0	11.0	8 - 30
150micron	92	9.2	98.2	1.8	0 - 10
Pan	18	1.8	100	0	- - -

Specific gravity: 2.41

Course aggregate

All types of aggregates are suitable for making concrete. The normal maximum size is generally 20 mm. Consistency of grading is of vital importance for making good concrete. Regarding the characteristics of different types of aggregate, crushed aggregates tend to improve the strength because of the interlocking of the angular particles, whilst rounded aggregates improve the flow because of lower internal friction. The Coarse Aggregate should conform to IS 383 for its suitability to use in concrete.

Figure 3: Coarse Aggregate

Table: 3 Test Result of Coarse Aggregate - Sieve Analysis

IS sieve	Weight Retained in grams	Percentage of Weight Retained	Cumulative Percentage	Percentage of Finer	BIS Standards Percentage Passing for single sized aggregate of Nominal size
40mm	0	0	0	100	100
20mm	440	14.67	14.67	85.33	85 - 100
10mm	2470	82.33	97.0	3.0	0 - 20
4.75mm	90	3.0	100	0	0 - 5
Pan	0	0	100	0	- - -

Specific gravity – 2.72
Water absorption – 0.1%

Coconut shell

Coconut shell can be grouped under light weight aggregate. It can also be used in concrete to solve environmental and economic problem.

Figure 4: Coconut Shell

The coconut shells were crushed manually using hammers to a size such that passes through a 20mm sieve and retained on 4.75mm sieve. The material passed through 20mm size was used to replace coarse aggregate. Crushed shells were washed to remove fibers, mud etc., from them. The washed shells were dried in sunlight for 2 days. The crushed edges were rough and spiky. The

surface texture of the shell was fairly smooth on concave and rough on convex faces. Coconut shell aggregates used were in saturated surface dry condition.

Table: 4 Test Result of Coconut Shell – Sieve Analysis

IS sieve	Weight retained (gm)	Cumulative Weight retained(gm)	% cumulative weight	% passing
40mm	-	-	-	-
20mm	76	76	1.52	98.48
10mm	4286	4362	87.24	12.76
4.75mm	483	4845	96.90	3.10
2.36mm	115	5000	100.00	00
1.18mm	-	-	-	-
600micron	-	-	-	-
300micron	-	-	-	-
150micron	-	-	-	-

Water

Portable water conforming to the requirements of water for concreting and curing purposes as per IS: 456-2000.

Table: 5 Test Result of Water

S. No.	Name of the Test	Test Results	BIS Permissible limit, Max (as per IS 456-2000)
1.	pH	7.6	Not less than 6
2.	Chlorides	85	2000 ppm for concrete not containing embedded steel and 500 ppm for reinforced concrete work
3.	Sulphates	15	400 ppm
4.	Organic	140	200 ppm
5.	Inorganic	110	3000 ppm
6.	Suspended matter	150	2000 ppm

Test on fresh concrete
Slump cone test

Figure 5: Slump cone test

Compaction factor test

Figure 6: Compaction Factor Test

Test on hard concrete

Figure 7: Compressive Strength test

Compressive strength of concrete is defined as the load, which causes the failure of a standard specimen, divided by the area of cross section in uniaxial compression under a given rate of loading. The test of compressive strength should be made on 150mm size cubes.

Table.6 Test result of concrete cubes

% replacement of aggregate	Trial No	Load (KN)	Compressive Strength Mpa	Average Compressive Strength Mpa
25	1	548	24.35	24.48
	2	531	23.60	
	3	576	25.60	
50	1	513	22.80	22.10
	2	490	21.78	
	3	489	21.74	
75	1	365	16.22	14.93
	2	330	14.80	
	3	310	13.78	

Advantages

Concrete with coconut shell can be

1. Grouped as light weight concrete.
2. Used as filler materials in framed structures.
3. Used as flooring tiles.
4. Used as thermal insulating concrete.

CONCLUSION

By using the innovative materials like (i.e., Coconut shell) in construction to reduce the volume of the coarse aggregate to make the construction economical. It meets the demands placed by the requirements of speed and quality in concrete construction. The utilization of Coconut Shell solves the problem of its disposal thus keeping the environment free from pollution and thus it is a green building material.

REFERENCE

[1]. Filipponi P, Polettini A, Pomi R, Sirini P. Physical and mechanical properties of cement based products containing incineration bottom ash. Waste Management 23(2), 2003, 145-156.

[2]. Dhir Rk,Paine KA, Dyer TD, Tang MC. Value added recycling of domestic ,industrial and construction arising's as concrete aggregate. Concrete Engineering International 8(1), 2004, 43-48.

[3]. Poon CS, Shui ZH, Lam L, FokH, Kou SC. Influence of moisture states of natural and recycled aggregates on the slump and compressive strength of concrete. Cement and Concrete Research 34(1), 2005, 31-36. [Khatib ZM. Properties of concrete incorporating fine recycled aggregate. Cement and Concrete Research 35(4), 2005, 763-769.

[4]. Andrade LB, Rocha JC, Cheriaf M. Evaluation of concrete incorporating bottom ash as a natural aggregates replacement. Waste Management 2007, 1190-1199.