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APPLICATION OF AGRICULTURE WASTE FOR PRODUCTION OF SUSTAINABLE CONCRETE

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Abstract: This paper present the application of agricultural waste for concrete development. in Indiathe production of waste materials from agriculture is increasing day by day. Agricultural wastes are biologically decomposable in the open exposure. In this investigation coconut shell (agricultural waste)is used as coarse aggregate in concrete. The size of coconut shell is chosen as 10 mm to develop concreteand the concrete termed as coconut shell aggregate concrete (CSAC). The results of an experimental work carried out on the coconut shell aggregate concrete is produced by using coconut shell aggregate. The coconut shell aggregate replacement for conventional granite aggregate is 100 percentages in this investigation. The mix ratios of(1 : 1.6 : 2.4 and 1 : 1.8 : 2.7) were used through the investigation. The test results of coconut shell aggregate concrete are nearer to the conventional granite aggregate concrete at 28 days. The increment of results from the prepared two concrete mixes is goes to first mix. The reason may be due to higher cement content and lesser water cement ratio. However, concrete obtained from coconut shells (CS) exhibited normally comparable compressive strength with Conventional Granite Aggregate Concrete (CGAC) in the two mix proportions. Considering the strength it was concluded that coconut shells were normally suitable when used as substitute in concrete production.

Keywords: Agricultural waste, Coconut shell, Coconut shell aggregate (CSA), Coconut shell aggregate concrete (CSAC), Conventional granite aggregate (CGA), Conventional granite aggregate concrete (CGAC),

1. INTRODUCTION

Agricultural wastes as coarse aggregate in concrete is one of the economic advantages. The properties of agricultural waste (coconut shell) such as mechanical and durability properties are suitable in concrete making. In low-cost building construction, utilizing the waste discarded coconut shell as coarse aggregatein the matrix part of concrete is suitable one. Pretreatment is not necessary for coconut shell aggregatebefore using in concrete, because there is no dust andoil coating in surrounding the coconut shell after discarded the coconut for cooking benefits. In this experimental work the size of discarded coconut shell is chosen as 10 mm to avoid flakiness effect by concave and convex shape of coconut shell. The coconut shell nominal size of 10 mm is collected by sieving the discarded shells. The presents of dusts also removed by sieving the discarded coconut shells. The biological decomposition is not affect thecoconut shell after the coconut shell encapsulated into the concrete even though coconut shell is wood based material is referred in literatures. Regarding properties of coconut shell, the physical and mechanical

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properties were studied. Coconut shellaggregate concrete mix design is derived based on volume batch method due to lesser specific gravity.In this study the coconut shell 100% replaced for the conventional granite aggregate in volume batchmethod.

1. MATERIALS AND PROPERTIES

1.1. Cement

Ordinary Portland cement (OPC) is the most commontype of binder used for concrete production and hence, OPC 53 Grade conforming to Indian Standard was used as a binder. These properties are shown in Table 1 and coconut shell is shown in fig 1

TABLE 1: Properties of cement

Properties	
Fineness – Specific surface, (m^2/g)	305
Initial setting time, (min)	76
Final setting time, (min)	430
Soundness, (Le Chatelier method), (mm)	0.4
Specific gravity	3.07
Magnesia (MgO), %	1.37
Alkalies, %	0.5
Chloride, %	0.02
Loss on ignition, %	1.5

Fig -1: Well graded Coconut Shell

1.1. Fine Aggregate

River sand was used throughout the investigation as fine aggregate conforming to grading zone III as per IS 383:1970. The sand was air-dried and sieved to remove any foreign particles prior to mixing.

1.1. Crushed Granite Aggregate (CGA)

Crushed granite aggregate (CGA) - 10 mm sizes wereused for Conventional Concrete. Crushed Granite aggregate concrete (CGAC) was produced and compare with CSAC. The bulk density,

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specific gravity, water absorption, aggregate impact value, aggregate crushing value, aggregate abrasion value, and particle size distribution were determined andshown in Table 2.

1.2. Coconut Shell Aggregate (CSA)

Coconut Shell Aggregate Concrete (CSAC), which is produced using Coconut Shell Aggregate (CSA), is the main concrete in this investigation. Coconut shell was collected from the local coconut oil mills to analyze the properties in this study. The required crushed sizes are in the range of (4.75 – 10) mm. The sieve analyses was conducted and the Particle size distribution of CS is determined. The test results are shown in Table 2.

1.3. Water

The quality of water is important because contaminants can adversely affect the strength of concrete. Water used for producing and curing the concrete. It should be reasonably clean and free from deleterious substances such as oil, acid, alkali, salt, sugar, silt, organic matter and other elements which are detrimental to the concrete. If the water is drinkable, it is considered to be suitable for concrete making. Hence, potable tap water was used in this study for mixing and curing.

Table-2: Properties of coconut shell aggregate and conventional granite aggregate

Sl.No	Mechanicalproperties		CSA	CGA
1	Maximum size (mm)		10	10
2	Shell thickness (mm)		2 to 8	-
3	Specific gravity		1.7	2.68
4	Impact value (%)		7	12.4
5	Crushing value (%)		2	6.3
6	Abrasion value (%)		0.4	1.85
7	Attrition value (%)		0.67	4.3
8	Bulk density (kg/m^3)	Compacted	640	1650
		Loose	530	1450
9	Fineness modulus		6.3	6.94
10	Moisture content (%)		4	-
11	Water absorption (%)		22	0.5

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2. MIX PROPORTION

Mix design is the process of selecting an optimum proportion of cement, fine and coarse aggregates and water to produce a concrete with specified properties of workability, strength, and durability. The best mix involves a balance between economy and the required properties of concrete. Based on the properties of the available materials, the mix proportions of the CS concrete were approximated using absolute volume method. Hence, the mix design for the CSAC in this study was based on performances of trial mixes and the measure of the selected mix was so adjusted to get the most favorable mix proportion.

3 Workability

Workability is the fresh concrete property. It is an ability of fresh concrete to satisfy the followings mobility for mixing, transporting, placing, and better compaction. The measured slump values are presented below inTable 3.

Table – 3: Mix proportion results

Mass in (kg/m^3)		$\frac{w}{c}$	Mass in (kg/m^3)		Mix ratios			Slump (mm)
C	W		FA	CA	C	FA	CA	
450	180	0.40	711.74	1083.62	1	1.6	2.4	25
400	180	0.45	728.78	1083.62	1	1.8	2.7	40

3.1 Coconut Shell Aggregate Concrete

When wood based materials are used as aggregate in concrete, the biological decomposition is not apparent. This message is referred from the collected literature. Coconut shell aggregate concrete producedwith maximum size of aggregate as 10mm.It is targeted to produce CSAC of compressive strength more than 20 N/mm^2 to meet the minimum strength of structural as per IS 456 : 2000

3.2 Conventional Granite Aggregate Concrete

Conventional concrete mixes were produced with crushed granite aggregate of maximum sizes 10 mm. the size of granite aggregate is chosen based on the coconut shell aggregate size of 10 mm the minimum size of coarse aggregate is to avoid the flakiness effect of coconut shell aggregate due to its concave and convex shape in inner and outer surfaces. By minimizing the size below 12 mm the flakiness effect will not appear and affect the bonding of concrete.

4 Compressive Strength Test

Cubes of size 100 mm were cast for testing the compressive strength at the end of 28 days. The cubes were tested as per IS 516-1959. The load was applied without shock and was increased until

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the specimen failed, and the maximum load applied to the specimen during the test was recorded. The appearances of the fractured faces of concrete failure were noted in fig 2 and the test results are presentedin Table 4. The Compressive Stress relation between CSAC and CGAC of Trial Mix I and II shown in fig 3.

Fig.2: Compressive Strength Test Setup

Table. 4: Compressive Strength Test Results

Mix No	Type of Concrete	Load (kN)	Compressive strength (N/mm^2)	Average compressive strength (N/mm^2)
1	CSAC	226	22.60	21.33
		218	21.80	
		196	19.60	
	CGAC	338	33.80	31.87
		326	32.60	
		292	29.20	
2	CSAC	176	17.60	17.73
		180	18.00	
		187	18.70	
	CGAC	258	25.80	26.40
		262	26.20	
		272	27.20	

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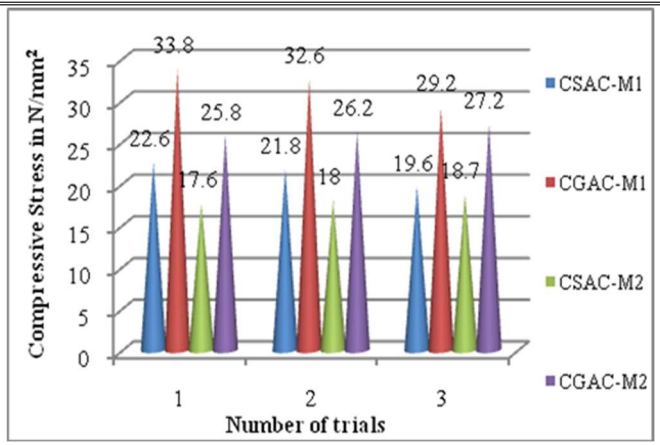

Fig.3: Compressive Stress relation between CSACand CGAC of Trial Mix I and I

5 CONCLUSIONS

The use of coconut shell as coarse aggregate in concrete provides an alternate for the crushed granite aggregate. This study established that coconut shell can be used as coarse aggregate in the production of concrete with lesser density The test results obtained from this study also provide significant understanding on basic Material properties and Mechanical properties of coconut shell aggregate concrete. This study gives suggestions for the proper use of coconut shell which will hopefully lead topromotion of sustainable development in theconstruction industry for the greener environment.Based on the experimental investigation, thefollowing conclusions were arrived.

- The amount of cement content used is same when coconut shells are used as an aggregate in the production of concrete compared to conventional aggregate concrete to produce approximately equal strength.
- To satisfy the criteria of structural concrete by trial mix 1 and 2, coconut shell requires the cement content of (450 and 400) kg/m^3 in the production of concrete using coconut shell as aggregate.
- Coconut shell aggregate concrete has better workability because of the smooth surface on one side of the shells and the size of coconutshell used in this study.
- The 28-day average densities of coconut shellaggregate concrete (CSAC) were (1678 and 1758) kg/m^3 for trial mix 1 and 2and these are less than the conventional granite aggregate concrete (CGAC) density of (2325 and 2544)kg/m^3. From these results the coconut shell aggregate concrete is defined as structural lightweight concrete.
- The 28-day compressive strength of coconut shell aggregate concrete (CSAC) were (21 .33 and 17.73) N/mm^2 for trial mix 1 and 2 and these are merely less than conventional granite aggregate concrete (CGAC) strength of (31.87 and 26.40) N/mm^2.

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