



Development of Construction Bricks Using Coconut Shell Powder as an aggregate Material

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ABSTRACT

Construction bricks are one of the most widely used construction material. In a developing country like India increasing industrialization and urbanization, requires huge amounts of natural resources. This means that large amount of soil is being used for brick production. To minimize the negative environmental impact of this and promote environmental sustainability of the brick makers, the use of wastes from agriculture and industry as materials for brick making is to be considered as an alternative solution. The wide availability of coconut shell which is an agricultural waste makes it a suitable and dependable alternative for aggregate in construction bricks, wherever available. Construction bricks having coconut shell powder (CSP) as aggregate material are developed. In this paper the process of making construction bricks with the use of coconut shell powder (CSP) as aggregate material. Further the mechanical properties of these bricks are to be tested and comparison with those of the conventional bricks will be done

Keywords— Coconut, Coconut Shell Powder, Construction Bricks, Waste management.

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I. INTRODUCTION

India is the third largest producer of coconut in the world. Annual production of coconut is 21.89 billion nuts (2012-13).Coconut contributes more than Rs.10000 crores annually to GDP [1].

TABLE I
TOP FIVE COCONUT PRODUCER COUNTRIES

Sr. No.	Country	Coconut Production (Metric tons)	% of World Total
1	Indonesia	18,000,000 m/t	30.0%
2	Philippines	15,862,386 m/t	26.4%
3	India	10,560,000 m/t	17.0%
4	Brazil	2,888,532 m/t	4.8%
5	Sri Lanka	2,000,000 m/t	3.3%

Coconut shell (CS) which is the waste from coconut is having serious disposal problem. It is available in large quantities throughout the coastal part of India. It represents more than 60% of the domestic waste volume [2]. Bamgboye and Jekayinfa [3] regretted that 90% of coconut (empty fruit bunches, fibers, fronds, trunks, shell)

was discarded as waste and either burned in the open air or left to settle in waste ponds. This way the coconut processing industries waste according to him contributed significantly to CO₂ and methane emissions. The wide availability of coconut shell makes it a suitable and dependable alternative for aggregate in construction bricks. This will have double advantage of waste management as well as pollution control.

II. LITERATURE REVIEW

The work started with the selection of keywords. Coconut, Coconut Shell Powder, Construction Bricks, Waste management these key words are used for extracting data related to the topic from various Journal papers and Conference papers. Coconut Development Board of India helped for getting statistical data regarding coconut production, current development in relation with waste management and our topic.

Thus various Journal papers, Conference papers, Project reports etc. having data related to our need were extracted. The criterion behind of selection was made on the basis of scope and objective of the work. Using this criterion, the papers were divided according to their objectives and only those having the objective of using coconut shell in construction and in mechanical engineering purposes and waste management were selected. Then from those papers, the next basis of classification was methodology used in the work. From this analysis of the literature following data was selected for the use in present work.

The properties of concrete using CS as coarse aggregate were experimentally investigated. In this study, Crushed coconut shell pieces were coarse aggregate, Ordinary Portland Cement (OPC) 53 Grade was binder and river sand was used as fine aggregate. Concrete was made by mixing these three in various ratios based on volume. The concrete with mixing ratio (cement: fine aggregate: coconut shell) 1:1.60:0.8, 1:1.60:0.7 and 1:1.47:0.65 satisfies the requirement of strength as per ASTM. The experiments proved that CS fulfills the requirements for use as lightweight aggregate [4].

Experimental assessment on coconut shells as aggregate in concrete is done by Daniel Yaw Osei. Here the materials used were Portland cement, sand, granite and coconut shells. A concrete mix of ratio of 1:2:4 by volume, with a water cement ratio of 0.6 was used as control, to which the properties of all other mixes were compared. Coconut shells were used to replace 20%, 30%, 40%, 50% and 100% of the granite by volume. Experimental results show that 18.5% replacement of granite by coconut shell gave maximum compressive strength 20 Nmm⁻² whereas the compressive strength of concrete produced by 20%, 30%, 40%, and 50% replacement were higher than 15Nmm⁻², the minimum recommended for use in reinforced lightweight concrete construction [5].

In the Experimental Analysis of the use of Coconut Shell as Coarse Aggregate properties of coconut shell aggregate concrete is examined and the use of coconut shell aggregate in construction is tested. Portland Cement (OPC) 53 Grade, Coconut shell, crushed blue granite and river sand were used for making concrete. They replaced coarse aggregate with coconut shell, by volume. Specimens were cast by replacing 25%, 50%, 75% and 100% of coarse aggregate with coconut shells. Tests were conducted on the cast specimens after 28 days as mentioned in the IS code. Their experimentation results that in 25% replacement of the coarse aggregate showed properties similar to the nominal mix and 50% replacement showed properties similar to light weight concrete which can be used as filler materials in framed structures, flooring tiles, thermal insulating concrete etc. [6].

A technical review is performed on Combination of coconut shell and grained palm kernel as lightweight aggregate in concrete. The review concludes that Combination of coconut shell and grained palm kernel has potential to be used as lightweight aggregate in concrete. Also, using the combination of coconut shell and grained palm kernel shell as aggregate in concrete can reduce the material cost in construction because of the low cost and abundant availability of these agricultural wastes [7].

III. METHODOLOGY

From literature review it is clear that coconut shell has potential to be used as a coarse aggregate in concrete. This initiated to check its potential for construction bricks. For development of bricks soil and coconut shell powder were used.

Soil used for making bricks is a mixture of Red soil and Black soil with a ratio 4:1 by volume. It was obtained from farms near Malegaon (Nashik) this soil is being used for making conventional red bricks. Density of the soil used is 2.67 gm/cm^3 .



Fig. 1 Kiln Site near Malegaon

The coconut shell powder was directly obtained from supplier at Tamilnadu, India. Fine coconut shell powder of 60 mesh size and density 1.57 gm/cm^3 was used. The potable water supplied by Malegaon Municipal Corporation was for mixing and curing.

In an experimental investigation, [8] found out that replacement of granite with palm kernel shells by volume produced a better performance concrete than replacement by weight. Similarly in experimental assessment [5] replacement of granite with coconut shells by volume is used. If coconut shell powder would be used as aggregate with soil by weight for making bricks, due to its low density it would have reduced the share of soil. Hence with reference to [5] and [8] coconut shell powder is added as aggregate with the soil by volume.

For conventional red bricks, 50 kg soil is required to make 15 bricks. Hence 50 kg (18726.9 cm^3) soil is taken as base.

1. For 1st Sample (5% CSP and 95% soil), 5% Coconut shell powder is added in soil by volume. The volume of Coconut shell powder to be added is based on the volume of 50 kg soil. 5% that means 936.32 cm^3 of coconut shell powder was required to be added on the other hand 936.32 cm^3 of soil was required to be removed from 50 kg soil. This volume is converted into mass of coconut shell powder and soil. For ease in measurement of material the volume is converted into mass coconut shell powder and soil. It resulted in 1460.67 gm of coconut shell powder to be added and 2500 gm of soil to be removed. Thus 1st Sample is made using 1.46 kg coconut shell powder and 47.5 kg soil. Electronic measuring device is used for measurement of mass. Similarly the following mixtures are made.



Fig. 2 Mixture samples for bricks

2. 2nd Sample (10% CSP and 90% Soil) is made with 2.92 kg of coconut shell powder and 45 kg of soil.



Fig. 3 Electronic Measuring Gauge

3. 3rd Sample (15% CSP and 85% Soil) is made with 4.48 kg of coconut shell powder and 42.5 kg of soil.
4. 4th Sample (20% CSP and 80% Soil) is made with 5.84 kg of coconut shell powder and 40 kg of soil
5. 5th Sample (25% CSP and 75% Soil) is made with 7.3 kg of coconut shell powder and 37.5 kg of soil.
6. 6th Sample (30% CSP and 70% Soil) is made with 8.76 kg of coconut shell powder and 35 kg of soil.

From all these samples bricks are made. To identify the bricks of appropriate mixture, every sample of bricks has given different identification numbers,

- a. '1' for mixture of 5% CSP and 95% Soil,
- b. '2' for mixture of 10% CSP and 90% Soil,
- c. '4' for mixture of 15% CSP and 85% Soil,
- d. '5' for mixture of 20% CSP and 80% Soil,
- e. '6' for mixture of 25% CSP and 75% Soil,
- f. '7' for mixture of 30% CSP and 70% Soil.

Thus sample bricks are made from each of the mixtures. Figure below shoes the sample bricks.



Fig. 4 Samples Bricks

IV. FUTURE SCOPE

Construction bricks using coconut shell powder as an aggregate are developed. Further to this the bricks will be tested for their strength and the results will be compared with the standards to check their feasibility.

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