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A STUDY ON PROPERTIES OF CONCRETE WITH COCONUT SHELL AS COARSE AGGREGATE REPLACEMENT

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ABSTRACT

The demand of concrete as a construction material is increasing on a global scale, leading to tremendous rise in cost of construction material. The tremendously rising cost of construction material is a matter of concern. The reason for increase in cost is due to high demand of concrete and scarcity of raw material. Hence the concrete technologists must search for some economical alternative to the coarse aggregate. Utilizing Coconut Shell as coarse aggregate in concrete production not only solves the problem of disposing this solid waste but also helps conserves natural resources. Its utilization is cost effective and eco friendly. In this paper, the physical properties of crushed coconut shell aggregate were presented .The fresh concrete properties such as density, slump and 28 days compressive strength of light weight concrete made with coconut shell as coarse aggregate is also presented. Thus, this paper reveals the significant properties of concrete with crushed coconut shell as a coarse aggregate replacement alternative.

Keywords— Coarse Aggregate, Coconut Shell, Compressive Strength, Density, Waste Utilization.

I.INTRODUCTION

There were many experimental work conducted to improve the properties of the concrete by putting new materials, whether it is natural materials or recycle materials or synthetic materials in the concrete mix. The additional material can be replacing the aggregate , cement or just as additive and one form of the additive is natural material . A large amount of agricultural waste was disposed in most of tropical countries especially in Asia for countries like Thailand, Philippine and Malaysia. Also, India is the third largest producer of coconut products in the world. Coconut trees are widely cultivated in the southern India, especially Kerala. The name Kerala is derived from a word, 'kera' meaning 'coconut tree'. The Kerala state is densely populated and major population uses coconut or it's by products in their daily activities.

Concrete is world's most widely used construction material. The utilization of concrete is increasing at a higher rate due to development in infrastructure and construction activities all around the world. Researchers are in

search of replacing coarse aggregate to make concrete less expensive and to lead sustainable development. This environmental reason has generated a lot of concern in the construction world . The use of sugarcane bagasse , wooden chips , plastic waste , textile waste, polyethylene , rice husk ash, rubber tyres, vegetable fibers, paper and pulp industry waste, groundnut shell, Bamboo pieces, waste glass, broken bricks are some examples of replacing aggregates in concrete. Coconut shell is categorized as light weight aggregate. Coconut shells are not commonly used in construction industry and are often dumped as agricultural waste. The aim of this research is to spread awareness of using coconut shell as partial replacement of coarse aggregate in concrete and determining its compressive strength and density. Until now, Industrial by products and domestic wastes has been utilized in concrete, but the use of agricultural waste in concrete is in its infancy stage. Coconut shell is an agricultural waste . The materials are proportioned by their weights . The water cement ratio is obtained by conducting various workability tests. The obtained results are compared with that of conventional mix. Tests are as per the specified procedure of Indian Standard Codes.

II.LITERATURE REVIEW AND MATERIALS

A. Literature Review

Concrete is a mixture of mainly four components: cement, coarse aggregate, river sand and water. The raw materials used in this experimentation were locally available and these included Portland Pozzolana Cement (P.P.C) as binding agent, river sand as fine aggregate, crushed stone and coconut shell as coarse aggregate. Potable tap water was used for mixing and curing throughout the entire investigation. The permissible and tolerance limits of water were checked as per the I.S 456-2000.

B. Materials

Cement: In this experiment, Portland pozzolana cement was used. Cement must develop appropriate strength. It must represent the appropriate rheological behavior.

Table: 1 Properties of Cement

Sr. No.	Physical properties	Test result
1	Fineness test	7%
2	Specific gravity	3.03
3	Normal consistency	35%
4	Initial setting time	30 min
5	Final setting time	8h 30min
6	Soundness value	4mm

Coarse Aggregate: Coarse aggregate consists of 50% of self weight of concrete and 70% of volume of concrete. In this experiment, coarse aggregate are used below 20 mm size. The physical properties of coarse aggregate are presented below.

Table 2: Properties of coarse aggregate

S. No	Physical Property	Test Results
01	Specific Gravity	2.68
02	Impact Value	8.4
03	Bulk Modulus(kg/m^3)	1560
04	Particle Shape	Angular

Fine Aggregates: River sand was used as the fine aggregate, conforming to Zone-II as per I.S 383- 1970.The sand was air dried and sieved to remove any foreign material, prior to mixing. The specific gravity test was conducted by the use of

Table: 3 Physical properties of fine aggregate

S. No	Physical Property	Test Results
01	Specific Gravity	2.65
02	Fineness Modulus	2.62
03	Bulk Density(kg/m^3)	1600

Coconut Shell: Coconut shells are naturally available material throughout the world. Coconut shell exhibits more resistance against crushing, impact and abrasion compared to conventional aggregate. The density of coconut shell is in the range of 550-660 Kg/m^3 and this is within the specified limits for light weight aggregate. So there is no need to treat the coconut shell before use an aggregate except for water absorption The present of sugar content in the coconut shell as long as it is not in a free sugar form does not affect the setting and strength of concrete. The flexibility behavior satisfies all serviceability requires as per IS 456-2000 and BIS 8110. W n coconut shell aggregate concrete is subjected to 1000C for 4 hrs and 2000C for 2 hrs, its residual strength are 18N/mm^2 and 18.40 N/mm^2 respectively.

III.PREPARATION OF SPECIMEN

A.Concrete Mix Design

M-20 grade of concrete was designed by I.S 10262-1982 method. The natural coarse aggregates were replaced as 0%, 10%, 20%, 30%, 40%.The test results were analyzed and compared with theoretical values, obtained from various codes. Since, coconut shells are absorbing high water, hence they were pre soaked in water for 24 hours, prior to mixing.

B. Batching and Mixing

Weigh Batching was practiced with the help of electronic weigh balance . Batching was done as per the mix proportions. Mixing was done in tilting mixer. It was mixed for 2-3 minutes, after addition of water.

C. Placing and Compaction

Cubes are cleaned and oiled to prevent the formation of bond between concrete and moulds. Place the fresh concrete in cubes in 3 layers, tamping each layer 25 times. The entrapped air in concrete is removed by table vibrator. Anything kept on the table gets vibrated.

D. Demoulding

After placing fresh concrete in moulds, it was allowed to set for 24 hours. It was marked with some permanent identification mark i.e. A1, A2, A3, etc. Concrete cubes are now kept in curing tank for 7, 14 and 28 days. After 28 days, concrete cubes were removed from curing tank to conduct tests on hardened concrete.

IV.METHODOLOGY

A. Calculation of Quantities of cement, Sand and Aggregate in 1 m^3

As per IS 456-2000 M20 Concrete proportion is=1:1.5:3

Volume of dry concrete = 1.57 times volume of wet concrete

***A.1.* Cement Quantity**

Volume of Cement = 1.57*cement/(cement +sand +aggregate)

= (1.57*1)/(1+1.5+3)

=0.28m^3

Mass of cement in 1m^3 concrete

= density*volume=1440*0.28=403.2Kg

A.2. Sand Quantity

Volume of sand =0.28*1.5=0.42m^3

Density of sand =1600Kg/m^3

Mass of sand in 1 m^3 concrete=0.42*1600=672Kg

A.3. Coarse Aggregate Quantity

Volume of Coarse aggregate in 1m^3 concrete=0.28*3=0.84m^3

Take density of Coarse aggregate =1560Kg/m^3

Mass of coarse aggregate in 1m^3 concrete =0.84*1560=1310.4Kg

A.4. Water Quantity

Water cement ratio is 0.5 so water is used for 1m^3 concrete is 201.6 litre for better workability of slump value 20mm to 40mm.

Table 4: Quantities of materials for 1m^3 concrete production.

Cement	Fine aggregate	Coarse aggregate	water
403.2Kg	672Kg	1310.4Kg	201.6 litre

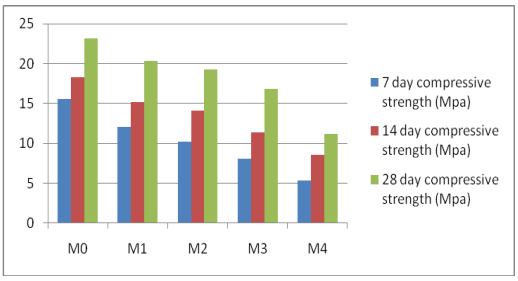
V.RESULTS

Compressive Strength:

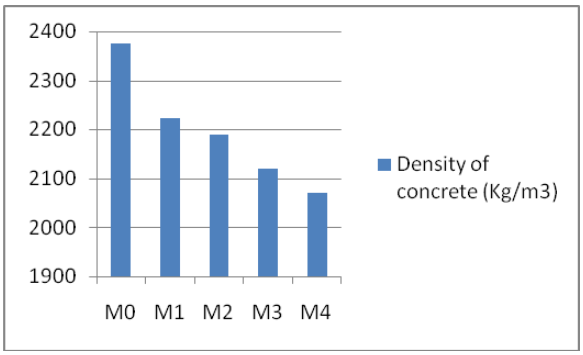
Compressive strength is defined as resistance of concrete to axial loading. In this experiment, cubes of concrete size 150mm*150mm*150mm is made with coconut shells by partial replacement of coarse aggregate at 0%, 10%,20%,30% and 40% and determining the compressive strength of these cubes at 7,14 and 28 days. These values are in Mpa. The maximum compressive strength of 23.2 N/mm^2 was attained at 0% replacement while the minimum compressive strength of 11.2 n/mm^2 was attained at 40% replacement. 10 to 20% replacement, concrete attained 20.37 N/mm^2 and 19.3 N/mm^2 respectively. The strength decreased as the % replacement increase.

Table 5: Compressive strength of concrete

Curing Days	0%	10%	20%	30%	40%
07	15.6	12.1	10.2	08.1	05.33
14	18.3	15.17	14.15	11.4	08.6
28	23.2	20.37	19.3	16.84	11.2



Graph1: for compressive strength of concrete



Graph 2: for density of concrete

VI.CONCLUSIONS

This paper presents the effective way of utilizing crushed coconut shell aggregate in concrete. Presently, coconut shell is available at a low price in most of the tropical countries. Also the concrete obtained using coconut shell aggregates satisfy the minimum requirements of lightweight concrete. Hence it is possible to made lightweight concrete making use of coconut shells as an aggregate in concrete. The following conclusions were made.

A. Increase in percentage replacement by coconut shell reduces compressive strength of concrete.

B. Increase in percentage replacement by coconut shell increases workability of concrete.

C. Coconut Shell can be used as partial replacement of coarse aggregate in R.C.C concrete.

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