AMALGAMATION OF CONCRETE WITH COCONUT SHELL AS A COURSE AGGREGATE, A SUSTAINABLE APPROCH

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Abstract

The coconut shell-cement composite is compatible and no pre-treatment is required. Coconut shell concrete has better workability because of the smooth surface on one side of the shells. Compared with conventional concrete, the impact resistance of coconut shell concrete is high. Water absorbing and moisture retaining capacity of coconut shell are also higher than conventional aggregate. Recently in the environmental issues, restrictions of local and natural access or sources and disposal of waste material are gaining great importance. Today, it becomes more difficult to find a natural resource. Use of the waste materials not only helps in getting them utilized in cement, concrete and other construction materials.

In the present work, coconut shell as partial replacement for coarse aggregate in concrete is studied. The concrete with ground coconut shell was found to be durable in terms of its resistance in water, acidic, alkaline and salty. Density of coconut shell is in the range of 550 - 650 kg/m3 and these are within the specified limits for lightweight aggregate. The characteristic properties of concrete such as compressive strength, flexural strength, impact resistance, bond strength & split tensile strength using the mix made by replacing coarse aggregate with crushed coconut shell aggregate were investigate in the present work.

The compressive strength of concrete are tested. The replacement of coarse aggregate by coconut shell by 40% and 60%. The tests were carried out and the results obtained suggested that the replacement at 60% leads to lightweight aggregate concrete. The compressive strength found out to be increases as the percentage replacement increased. Similarly the density is reduced as the percentage replacement increased. The compressive strength found to be increase as the percentage replacement increases.

Keyword: *concrete, course aggregate, cement, coconut shell, compressive strength test.*

1. Introduction

In India, coconut is the important industrial crop after sugar cane, rubber and paddy in term of total planted area. Most of the cultivation is focused on rural areas and near the beach. In year 2010, coconut plantation area was about 150,000 hectares. Nevertheless, the coconut shells are often discarded or burned. Therefore, this agriculture waste should be managed properly or reused to produce another product. Reduction of natural stone deposits due to high demand for concrete in the construction using normal weight aggregates such as gravel and granite has damaged the environment and causing ecological imbalance (Short and Kinniburgh, 1978). It reveals that,

natural raw materials that become more limited such as aggregate. It can be outlined that, the need for other alternative materials from the waste industrial product as an alternative material to replace natural materials. To face this problem, it is essentials to study the effectiveness of this waste industrial or agricultural product as an aggregate replacement within the suitable percent of coconut shell. However, it must fulfil the engineering requirements in term of physical properties and strength of concrete. Besides that, natural raw materials that become more limited have caused the need for other alternative materials to replace natural materials.

Concrete is the only engineering material used in civil engineering structures which can mould into any shape and size. Preparation of raw materials of concrete is not only causing the extension of materials but also leading to great air pollution by their production. Coarse aggregate are two main ingredients used for the production of concrete and has no alternative in the civil construction industry. Hence it is inevitable either to search for another material or partly replace them by some other materials. The search for any such materials, which can be used as an alternative or as a supplementary for coarse aggregate should lead to global sustainable development and lowest possible environmental impact.

The high cost of conventional building materials is a major factor affecting housing delivery in world. This has necessitated research into alternative materials of construction. The project paper aims at analysing flexural and compressive strength characteristics of concrete produced using crushed, granular coconut as substitutes for conventional coarse aggregate with partial replacement using M30 grade concrete. Beams are casted, tested and their physical and mechanical properties are determined. The main objective is to encourage the use of these 'seemingly' waste products as construction materials in low-cost housing. It is also expected to serve the purpose of encouraging housing developers in investing these materials in house construction.

Concrete can be defined as a stone like material that has a cementitious medium within which aggregates are embedded. According to ACICommittee 116, the binder is composed of a mixture of hydraulic cement and water in hydraulic cement concrete (ACI Committee 116).In recent years, there are many efforts have been made to reduce the use of raw materials in concrete. Most of the studies are using waste materials to replace the aggregate or cement. The excessive amount of coconut shell that might be burnt or thrown away without usage can be used in the making of concrete as a replacement for the original materials in making concrete such as aggregate and so on. There are three general categories for concrete based on its compressive strength which is low strength concrete (less than 20MPa), moderate strength concrete (20-40MPa) and high strength concrete (more than 40MPa). Moderate strength concrete or the other name for it, ordinary concrete is used for most structural work. The use of high strength concrete is for special application. (Metha et al, 2006) It has been established that in some pozzolanic materials which is amorphous silica reacts with lime more readily than those of crystalline form. Use of such pozzolan can lead to increased compressive and flexural strength. (Utsev et al, 2012).

2. Materials and Methods

Materials:

Course Aggregate:- Normal stone aggregate was used in the present study with the size passes from 10mm sieve and retained on 4.75 mm sieve.

Fine Aggregate:- core sand is used in the present investigation for making concrete

Cement:- Ordinary Portland cement is used as a binding material in the concrete. It is easily available in the market.

Coconut Shell:-Coconut shell is the hard strata of coconut which is a organic waste.

Methods

Sampling:- In the present study the coconut shell which has been used is been collected from coconut sellers on daily basis for 3 days from Mahmudabad main market and about 20 kg of coconut shell has been collected for the use in the research work. After the collection of the coconut shell they were washed properly and dried in sunlight.

Crushing of Coconut Shell: - After bringing the Coconut Shell to the concrete technology laboratory of R. R. Institute of Modern Technology. It was cleaned than as it may contain lots of dirt and unwanted material and coco pit was attached with so cleaning becomes very necessary. Cleaning was done by tap water by spraying over coconut shell. Then it was crushed in order to make it into small pieces with the help of rammer and sieve through 20 mm sieve to maintain the uniformity of the size of course aggregate.

Mixing of Coconut Shell: - After cleaning and crushing of coconut shell then arrives a very important part of the study and it is the mixing of crushed coconut shell with course aggregate. The coconut shell was mix in the course aggregate in the ratio of 40% & 60% then the mixture of coconut shell and course aggregate will be treated as course aggregate on whole.

Cube Casting & Curing: - After proper mixing of coconut shell and course aggregate, now concrete was prepared of grade M20 in the ratio of 1:1.5:3 (Cement: Sand: Course aggregate) then it is subjected to the casting of cube. About 20 cubes will be casted and then it will be immerse in the curing tank for 3, 7, 14, 21 & 28 days. The cube casting was done with the help of metallic mould of 15 cm X 15 cm size and these mould were fasten with nut and bolt and shuttering oil was applied before placing the concrete in the mould and then tempting rod was used for compacting and removing of air voids.

Testing on cubes: - Compressive strength test will be performed on the casted and cured cube on the specified days. On the casted cube this is the only test which will provide the strength gain by the cube at specified days,

3. Results

The sample preparation as well as analysis of the cured concrete cubes were done according to the IS 456:2000.

The results for compressive strength test are:-

Coconut Shell ratio / Testing days	40%	60%
3 day	6.32 N/mm^2	7.93 N/mm^2
7 day	11.59 N/mm^2	12.89 N/mm^2
14 day	16.75 N/mm^2	17.42 N/mm^2
21 day	16.81 N/mm^2	18.23 N/mm^2
28 day	17.53 N/mm^2	18.98 N/mm^2

4. Conclusion-

In our study, we replaced coarse aggregate with coconut shell, by volume. Specimens were cast by replacing 40% and 60% of coarse aggregate with coconut shells. Tests were conducted on the cast specimens at 3, 7, 14, 21 & 28 days as mentioned in the IS code. Tests for compression strength was conducted and results were obtained.

- Upto 60% of aggregate replaced by coconut shell is good according to strength and cost wise.
- Increase in percentage replacements by coconut shells increase the strength and density of concrete.
- It helps in reducing up to 60% pollution in environment.
- 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.
- Trying to replace aggregate by coconut shell partially to make concrete structure more economic along with good strength criteria.
- From one cube calculation bulk amount of shell replacement can be evaluated & reduces over all construction cost.
- This can be useful for construction of low cost housing society.

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