

Light Weight Concrete Using Coconut Shells

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Abstract- There is a major problem of aggregate depletion due to its vast use. In order to cope up with the same, there is a need to find a substitute material such that the resulting concrete is feasible to be used in construction as well as the problem of aggregate is dealt with. Coconut shell is one such material. In this research, coconut shells has been tested for its properties to be used as an aggregate and then it has been replaced in varying percentages with conventional aggregates so as to check the strength of resulting concrete.

Keywords- Coconut shells, ecological concrete, compressive strength, light weight concrete, ecological concrete.

I. INTRODUCTION

Concrete is a composite material made from various materials like cement, coarse aggregate, fine aggregate & water. The growing demand for concrete has made the need for development of concrete with varying properties. Also, with the immense use of materials, there has been a huge impact on the availability of materials which are used in making concrete. Coarse aggregate is usually made from crushed granite, stone and other such type of rocks. But these materials have found immense use in the world and are being extracted and used not only for making concrete but also for finishing purposes. These materials are available on the mercy of nature. This has led to a question that with the growing rate of use of these materials and the limit to which they are available, what would happen after they become extinct. Hence, there developed a need to search for the alternatives to conventional aggregates which could be used in place of them to make concrete.

Coconut is grown worldwide, to be precise, in about 86 countries. The annual production of the same is 56 billion nuts per annum. Once the coconut is used, its shell is discarded as waste. This shell takes 110-120 years to decay in the environment. Coconut is widely used here in India. With such immense use daily, the amount of waste generated is too gigantic.

In ancient days, these coconut shells were used as fuels and burnt to cook food, or for heat generation purposes. With the modernization, there has been development in various methods of fuels and heat generation. With this development, the use of coconut shells as fuels saw a

downfall. Now, this coconut shells which were earlier used as fuels started getting accumulated posing environmental concern regarding the same. But these coconut shells are really good in fire resistance, crushing and impact resistance. This has led into the research of the same to be used in construction industry.

In this study, tests on coconut shells were done as the same on coarse aggregates and the results were analyzed to confirm whether the same can be used in making concrete or not.

II. WHAT IS ECOLOGICAL CONCRETE?

Ecological concrete is the concrete which has less harmful impact on the environment. It is so designed that it is less harmful to the environment. It creates less pollution. It also helps in curbing other environmental problems. It is sustainable and provides better alternative. It is designed using materials which are easily available and are environment friendly while not impacting the quality of concrete.

Usually such a concrete is made using waste materials from other activities like fly ash, bottom ash, recycled aggregates, foundry sand, china clay sand, crumb rubber, broken glass.

A .WHY TO USE COCONUT SHELLS?

Coconut shells being widely used, generates a lot of waste. But they have various good properties like hardness, resistance to abrasion, water absorption, fire resistance, etc which make them suitable to be used as an aggregate in making concrete. Some of the other advantages of coconut shells can be listed as below:

EASY AVAILABILITY

India is the third largest producer of coconut. India produces 13 million nuts per annum. Coconut being produced here in India and also being highly consumed leads to higher availability of its shells.

DURABILITY

These shells are durable almost as the same as aggregates. It takes almost 100-120 yrs for them to degrade. The concrete made from them lasts anywhere between 50-60 yrs.

SUSTAINABILITY

The concrete made by using coconut shells can sustain loads marginally less than that by conventional concrete. Their hardness, resistance to abrasion makes them suitable to be used in making concrete. The researches done previously have shown that the concrete made by using coconut shells have shown an increase in strength even after 365 days, which means that they do not decay inside the concrete.

ECONOMY

Conventional concrete is comparatively costly. The cost of conventional concrete cannot be expected to fall because of the ingredients of concrete, i.e, aggregates have become scarce. Also the harmful effect of river sand extraction has led to the regulations by the country's laws to stop them from being extracted. Here coconut shells come to the rescue. The coconut shells can be used as an aggregate and also the powder of the same can be used in place of fines.

FIRE RESISTANCE

Coconut shells cannot be termed as bad conductors of fire but they can resist fire up to a long time. They can resist fire for up to two hours.

LOW COST

The concrete made by using coconut shells is economical. The fluctuations in rates were found to be from 5-20% of cost of conventional concrete. This is because of the easy availability of the material.

ELIMINATES WASTE DISPOSAL PROBLEM

The biggest problem of disposal of coconut shells is eliminated by this type of use. The waste which would pollute the air if burnt, or would take 100-120 years to degrade, can now be used to make structures as well as eliminate the problem of scarcity of natural aggregates.

ECOLOGICAL

The concrete made by using coconut shells as an aggregate is an eco friendly concrete. Such a concrete helps in

proper disposal of waste and reduce the effect on environment. It also curbs the dependency on natural aggregates to be used for construction.

III. PROBLEM STATEMENT

Coconut has been widely used in India and other parts of the world. In India, as per 2014-15 statistics, South India altogether accounts for 90% of coconut production in our country. Generation of wastes from coconut is high here in India due to its widespread use. They are widely consumed in the southern part of India. They are an essential part of South Indian cuisines. The waste generated by coconut contains its fibers and its shells. These waste materials were widely used as a fuel but due to the availability of other methods of fuels, the coconut waste started getting accumulated. Hence there is a need to find an effective solution. Fibers have found their use in making brushes.

On the contrary, materials used to make concrete have started depleting. This has led to an increase in their cost. their non-availability may pose a threat to construction, environment and basically halt the development. Coconut shells are pretty hard. They also resist fire effectively and are abrasion resistant. So if the concrete and the coconut are combined, we can get a product which is ecological, economical and can be an alternative to the conventional concrete.

IV. OBJECTIVES

The main objective is to prove that the waste material of coconut is better alternative to conventional aggregate. Coconut shells are hard, abrasion, crushing and fire resistant, hence prove to be of better use in making concrete.

Various tests were done on these shells. These coconut shells were tested for their water absorption, moisture content, crushing value, impact value, specific gravity, etc. The results of these tests were studied to analyze the need of any alternations to be done. The mix proportion was decided and the coarse aggregates were replaced in varying percentages by volume with coconut shells.

The objectives can be briefly summarized as, to study the properties of coconut shells, to produce concrete with coconut shells as an aggregate and to determine its strength.

V. METHODOLOGY

The first step was survey regarding the use of coconut shells. The various places which were visited include

temples, eateries and houses. The temple suggested that about 100-200 coconuts are offered each day. The eatery had a consumption of 80 kgs of coconuts, i.e, 100-110 nuts a day. The household use of coconuts was comparatively less as to 1 nut per 2-3 days. Also, none of the places visited reused the coconut shells.

The coconut shells were then prepared for testing. They were cleaned and made free from fibers and husks. They were then into required sizes. The various tests done and the results of the same are as follows:

Properties	Coarse agg	Coconut shells
Agg crushing value	7.10%	5.69%
Agg impact value	11.52%	10.37%
Bulk density (loose)	1.54 kg/l	0.54 kg/l
Bulk density (packed)	1.71 kg/l	0.68 kg/l
Water absorption	1.10%	22%
Moisture content	0.90%	4.20%
Specific gravity	2.76%	1.71

The coconut shells were found fit to be used as aggregates except for water absorption. The water absorption of coconut shells was high, hence pre-treatment was required. Pre-treatment given was that the coconut shells were soaked in water for 24 hours prior to mixing and they were brought to saturated surface dry condition before mixing. The cubes were casted and they were tested for their compressive strength after 7 days, 14 days and 28 days. Also their weight at 28 day was noted down. The results of the compressive strength are as follows:

Percentage replacement	0%	10%	20%	25%	30%	35%
7 days	13.78	13.04	12.59	12.29	12.15	12
14 days	18.02	17.93	17.33	17.04	16.74	16.44
28 days	20.44	19.85	19.11	18.82	18.67	18.37

The weight of coconut shell concrete taken is as follows:

Percentage	0%	10%	20%	25%	30%	35%
Weight (kg)	8.7	8.4	8	7.8	7.65	7.55

VI. CONCLUSION

Increase in the coconut shell replacement showed a decline in the strength of concrete. The strength achieved up to 25% replacement was marginally less hence acceptable. Increase in the replacement of coconut shells also caused a decrease in the weight of concrete. The deduction in the weight of concrete was about 10-11%.

Hence it can be concluded that coconut shells can be used in making concrete up to some extent.

REFERENCES

- [1] Kalyanappu V. Rao, International Journal Of Civil Engineering And Technology, ISSN0976-6308
- [2] K. Gunasekaran, Proceeding Of International Conference On Advances In Concrete And construction, ICACC 2008
- [3] P.S. Kumar, Materials And Structures (2015) 481253-1264
- [4] Dewanshu Ahlawat, IOSR Journal Of Mechanical And Civil Engineering e-ISSN-2278-1684. p-2320-334X
- [5] B Damodhara Reddy, S. Arjuna Jyothy, Fawaz Shaikh, IOSR Journal Of Mechanical And Civil Engineering e-ISSN 2278-1684, p-2320-334X
- [6] Alif Syazani Leman, Shahiron Shahidan, Mohd Yazid Yusuf, Sharifa Salwa, Mohd Zuki, MATEC Web Of Conferences, 01017 (2017)
- [7] Shahiron Shahidan, Alif Syazani Leman, Mohd Syamir Senin, Nurul Izzari Raihan, Ramwi Rehman, 01005 (2017)
- [8] Daniel Yaw Osei, International Journal Of Engineering Size System, ISSN 2319-6734, ISSN : 2319-6726