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Coconut Shell as Partial Replacement for Coarse Aggregate: Review

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Abstract

The high cost of conventional construction material affects economy of structure. With increasing concern over the excessive exploitation of natural aggregates, synthetic lightweight aggregate produced from environmental waste is a viable new source of structural aggregate material. The uses of structural grade lightweight concrete reduce considerably the self-load of a structure and permit larger precast units to be handled. 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, but also has numerous indirect benefits such as reduction in land fill cost, saving in energy, and protecting environment from possible pollution effect. It also helps in reducing the cost of concrete manufacturing. 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/m^3 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 reviewed in the present work.

Keywords: Coconut shell, coarse aggregate, light weight concrete.

1. Introduction

Infrastructure development across the world created demands for construction material. Concrete is the premier civil engineering material. Concrete manufacturing involve consumption of ingredients like cement, aggregates, water & admixtures. Among all the ingredients, aggregates form the major parts. Two billion of aggregate are produced each year in the United States. Production is expected to increase to more than billion tons per year by the year similarly; the consumption of the primary aggregate was 110 million tones in the UK in year 1960 and reached nearly 275 million tones by 2006. Use of natural aggregates in such a rate leads to a question about the preservation of natural aggregates sources. In addition, operation associated with aggregates extraction and processing is the principal causes environmental concern. In light of this in the contemporary civil engineering construction, using alternative materials in place of natural aggregate in concrete production makes concrete as sustainable and environmentally friendly construction material.

Coconut shell being a hard and not easily degrade material if crushed to size of sand can be a potential material to substitute sand. At present, coconut shell has also been burnt to produce charcoal and activated carbon for food and carbonated drink and filtering mineral water use. However, the coconut shell is still under utilized in some places. The chemical composition of the coconut shell is similar to wood. It contains 33.61% cellulose, 36.51% lignin, 29.27% and ash at 0.61%.

2. Objective

- To find economical solution for high cost construction material.
- To prepare lightweight concrete by using coconut shell as course aggregate.

3. Literature Review

J.P. RIES (2011) studied that Lightweight aggregate (LWA) plays important role in today's move towards sustainable concrete, Lightweight aggregates contributes to sustainable development by lowering transportation requirements, optimizing structural efficiency that results in a reduction in the amount of overall building material being used, conserving energy, Reducing labor demands and increasing the survive life of structural concrete.

AMARNATH YERRMALLA (2012) et al studied the strength of coconut shells(CS) replacement and different and study the transport properties of concrete with CS as coarse aggregate replacement. They concluded that

a. Increase in CS percentage decreased densities of the concrete.
b. With CS percentage increased the 7 days strength gain also increased with corresponding 28 days curing strength.

VISHWAS P. KULKARNI (2013) studied that Aggregates provide volume at low cost, comprising 66 percent to 78 percent of the concrete. Conventional coarse aggregate namely gravel and fine aggregate is sand in concrete will be used as control.

While natural material is coconut shell as course aggregate will be investigate to replace the aggregate in concrete.

Lightweight concrete is typically made by incorporating natural or synthetic lightweight aggregates or by entraining air into a concrete mixture. Coconut shell exhibits more resistance against crushing, impact and abrasion, compared to crushed granite aggregate. Coconut shell can be grouped under lightweight aggregate. There is no need to treat the coconut shell before use as an aggregate except for water absorption. Coconut shell is compatible with the cement. The 28-day air-dry densities of coconut shell aggregate concrete are less than 2000 kg/m3 and these are within the range of structural lightweight concrete. Coconut shell aggregate concrete satisfies the requirements of ASTM C 330.

4. Conclusıon

To increase the speed of construction, enhance green construction environment we can use lightweight concrete. The possibility exists for the partial replacement of coarse aggregate with coconut shell to produce lightweight concrete. Coconut shell exhibits more resistance against crushing, impact and abrasion, compared to crushed granite aggregate. Coconut shell can be

grouped under lightweight aggregate. There is no need to treat the coconut shell before use as an aggregate except for water absorption. Coconut shell is compatible with the cement. The 28-day air-dry densities of coconut shell aggregate concrete are less than 2000 kg/m3 and these are

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