# EXPERIMENTAL STUDY ON PARTIAL REPLACEMENT OF FINE AGGREGATE USING COCONUT SHELL POWDER IN CONCRETE: A LITERATURE REVIEW

**Ms. M.Sivagami[1], Ms. Amulya .P. J[2]**

*[1]Assistant Professor, Department of Civil Engineering, RVS .Technical Campus, Coimbatore-600025, India,*
*[2]PG student, Department of Civil Engineering, RVS .Technical Campus, Coimbatore-600025, India*

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**Abstract -** *Versatility of making concrete with locally available materials, ease in moulding it into any shape and size and economy in its making has made concrete the second most consumed material in the world. Concrete is produced than any other man-made material. The negative consequences of increasing demand for concrete include depletion of natural deposits of aggregates. This project is to check the scope of using coconut shell as an alternative for fine aggregate in concrete. India contributes about 20% of total world's coconut production. Aggregates made by crushing coconut shell can be in concrete by partially replacing fine aggregate. This will also reduce the unit weight of concrete.*

***Key Words***: **Coconut Shell, Coarse Aggregate, Compression Testing Machine, Universal Testing Machine, Ordinary Portland Cement**

## 1. INTRODUCTION

### 1.1 General

Concrete is a building material which is made up of broken stone or gravel, sand, cement and water. Versatility of making concrete with locally available materials, ease in moulding it into any shape and size and economy in its making has made concrete the 2nd largest consumed material on earth. Far more concrete is produced than any other man-made material. Annual production represents one ton for every person on the planet. It is incredibly versatile, and is used in almost all major construction projects. Aggregates are used in concrete for very specific purposes. Aggregates typically make up about 60 % to 75 % of the volume of a concrete mixture, and as they are the least expensive of the materials used in concrete, the economic impact is significant. 80 % of buildings $CO_2$ emissions are generated not by the production of the materials used in its construction, but in the electrical utilities of the building over its life-cycle. Compared to other comparable building materials, concrete is less costly to produce and remains extremely affordable.

A research effort has been done to match society need for safe and economic disposal of waste materials. The use of waste materials saves natural resources and dumping spaces, and helps to maintain a clean environment. The current concrete construction practice is thought unsustainable because, not only it is consuming enormous quantities of stone, sand and drinking water, but also two billion tons a year of Portland cement, which releases green-house gases leading to global warming. Experiments has been conducted for waste materials like-rubber tyre, e-waste, coconut shell, blast furnace slag, waste plastic, demolished concrete constituents, waste water etc. Construction waste recycle plants are now installed in various countries but they are partly solution to the waste problems. The negative consequences of increasing demand for concrete include depletion of aggregate deposits; environmental degradation and ecological imbalance. The possibility of a complete depletion of aggregate resources has rendered continued use of aggregates for construction unsustainable. Rapid growth in construction industry leads to very fast depleting of conventional natural aggregate source.

Normal concrete is known to be weak in tensile strength, brittle and easily erodible by chemicals and high velocity water flow. Epoxy resin has found a position in the concrete construction field because of its high compressive and tensile strengths as well as excellent adhesive properties. In recent years most of the applications have been in bonding concrete to concrete in repairing damaged or deteriorated construction. Although epoxy concrete, in which epoxy resin compound added with concrete materials, possesses high compressive and tensile strengths.

## 2. LITERATURE REVIEW

**Yogesh Narayan Sonawane *et al*. (2016)** On their journal discussed about various factors. It was observed that Coconut shell concrete has superior workability because of the smooth surface on one side of the shell. The presences of sugar in the CS as long as it is not in a free sugar form, will not the affect the setting strength of concrete. Due to tough made tissue, shell is not decomposed easily and remains as solid waste for years.

**Apeksha Kanojia, *et al*. (2015** In this journal says that Coconut shell has added advantage of high lignin content. It makes the composites more weather resistant and Coconut shell has low cellulose content due to which it absorb less moisture as compare to other agriculture waste. Coconut

shell being naturally available since its shells are non-biodegradable and because of its smooth surface on one side of the sells concrete made with coconut shell presents better workability. It is substitute for aggregates in developing concrete hollow blocks.

**Dr. B. Rajeevan *et al*. (2015)** In this journal says that the coconut shell exhibit more resistance against crushing, impact and abrasion compared to conventional aggregate. So there is no need to treat the coconut shell before use as an aggregate and Coconut shell has potential as light weight aggregate in concrete. Also, using the coconut shell as aggregate in concrete can reduce the material cost in construction. Because of low cost &its availability.

**S A Kakade *et al*. (2015)** Says that the presence of sugar content in the coconut shell, does not affect the setting and strength of concrete as long as it is not in a sugar free form and the conventional increase in strength indicates that the coconut shell aggregate does not deteriorate once coconut shell aggregates are capsulated into the concrete matrix. Also the coconut shell aggregate have higher water absorption because of higher porosity in its shell structure. The aggregate impact value of coconut shell aggregates are much lower compared to crushed stone aggregate which indicates that aggregates have good absorbance to shock. The study concluded that cost of producing concrete can be reduced up to 48%.

**Akshay S. Shelke *et al*, (2014)** In this study he presents that coconut shell provides more resistance to crushing, impact and abrasion compared to crushed granite aggregate. And the coconut shell can be grouped under light weight aggregate. The 28-day air dry densities of coconut shell aggregate are less than 2000kg/$m^3$ and these are within the range of structural light weight concrete. Coconut shell concrete satisfies the requirements of ASTM C 330.

**B. Damodhara Reddy *et al*, (2014)** In this paper presents the properties of coconut shell and coconut shell aggregate concrete is examined and the use of coconut shell aggregate in construction is tested. Moisture content and water absorption wre 4.20% and 24% respectively and these values are more compared to conventional aggregate. Density of coconut shell is in the range of 550-650 kg/$m^3$ and these are within the specified limits for light weight aggregate.

**Dewanshu Ashlawat *et al,* (2014)** In their study they states that coconut shell is categorized as light weight aggregate. The coconut shell when dried contains cellulose content, lignin, pentosans and ash. The materials are proportioned by their weights. The water cement ratio is obtained by conducting various workability tests. Due to high water absorption of coconut shell, they were presoaked in water for 24 hours, prior to mixing. As per their experimental setup, it was concluded that, at 10% replacement, concrete attained 18.91 n/$mm^2$ marginally less than 20n/$mm^2$ ,the minimum recommended for use as structural concrete according to the requirement. The strength was decreased as the percentage replacement increased. As the coconut shell increased, the surface area increased, thus requiring more cement for proper bonding. Since cement content was constant, there was no extra bonding and strength reduced.

**Parag S.Kambli *et al*, (2014)** Makes the findings that; Oil palm shell is a waste from agricultural sector and available in large quantities. It aims at analyzing the compressive strength characteristics of concrete produced using crushed, granular coconut as substitute for conventional coarse aggregate with partial replacement. The experimental programme was to investigate the best mix proportion of combination of CS as coarse aggregate in concrete and feasibility of combination of CS as CA in concrete. As per experimental analysis it was concluded that coconut shell can reduce the material cost, and it is more suitable as low-strength giving light weight aggregate in concrete production.

**S. Prema et.al., (2017)** Makes the findings that; Oil palm shell is a waste from agricultural sector and available in large quantities. It aims at analyzing the compressive strength characteristics of concrete produced using crushed, granular coconut as substitute for conventional coarse aggregate with partial replacement. The experimental programme was to investigate the best mix proportion of combination of CS as coarse aggregate in concrete and feasibility of combination of CS as CA in concrete. As per experimental analysis it was concluded that coconut shell can reduce the material cost, and it is more suitable as low-strength giving light weight aggregate in concrete production.

**Daniel Yaw Osei *et al*,(2013)** In his journal they found that a potential exists for the use of coconut shell as replacement of conventional aggregate in both conventional reinforced concrete and light weight reinforced concrete . Coconut shell concrete contributes to resource conservation.

**Amarnath Yerramala *et al.* (2012)** Studied the strength of coconut shell (CS) replacement and different and study the transport properties of concrete with CS as coarse aggregate replacement. They concluded that increase in CS percentage decreased densities of the concrete and with CS percentage increased the 7 days strength gain also increased with corresponding 28 days curing strength.

**Maninder Kaur *et al*. (2012)** On their journal discussed about various factors. It was observed that Concrete using coconut shell aggregates resulted in acceptable strength required for structural concrete. The coconut shell-cement composite is compatible and no pre-treatment is required. The impact resistance of coconut shell concrete is high. Moisture retaining and water absorbing capacity of coconut shell are high.

## 3. PROPERTIES AND MATERIAL USED

### 3.1 Cement

ISI marked OPC 53 Grade cement was used in this work with specific gravity of 2.74 and 2% fineness.

### 3.2 Fine aggregate

Sand used in his work confirming to Zone-II, with fineness modulus of 4.091, specific gravity 2.57 and bulking as 47.5%.

### 3.3 Coarse aggregate

Crushed stone with a maximum size of 10mm and uniform quality having impact value 22.9% .

### 3.4. Coconut shell powder

**Table 3.1-** Physical properties of coconut shell powder

| Properties | Value |
|---|---|
| Specific gravity | 1.33 |
| Fineness modulus | 3.8% |
| Bulking | 35% |

## 4. MIX DESIGN

### 4.1 Mix Proportion

| | | |
|---|---|---|
| Cement | = | 394.8 Kg |
| Fine aggregate | = | 642.5 Kg |
| Coarse aggregate | = | 875.67 Kg |
| Water | = | 0.35 |
| **Mix proportion** | **=** | **1:1.63:2.95** |

## 5. CONCLUSIONS

This paper presents the effective way of utilizing crushed coconut shell powder as fine aggregate in concrete. Now a days, coconut shell is available at a low price in most of the tropical countries. Also the concrete obtained using coconut shell powder as fine aggregate satisfy the minimum requirements of lightweight concrete. Hence it is possible to make lightweight concrete, making use of coconut shell powder as fine aggregate in concrete. Based on this investigation, the conclusions were made.

- The specific gravity under SSD condition of CS and crushed granite was found to be 1.33 and 2.57 respectively, hence being ideal for making lightweight concrete.
- The fineness modulus of coconut shell powder was found to be 3.8% which is almost equal to that of normal fine aggregate having a fineness modulus of approximately 4.0%.
- Bulking obtained for crushed stone aggregate was 47.5% while for coconut shell powder bulking was around 35% which is much lower to that of crushed stone aggregate.
- These tests were carried out as per IS 2386:1983 and we have found that it satisfies the requirement for structural lightweight concrete.

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