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# A STUDY ON EXPLOITATION OF COCONUT SHELL AS COARSE AGGREGATE IN CONCRETE

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**ABSTRACT**

**The high cost of conservative construction material affects wealth of structure. With increasing concern over the extreme utilization of natural aggregates, synthetic trivial aggregate produced from environmental waste is a feasible new resource of structural aggregate material. The uses of structural grade lightweight concrete lessen considerably the dead-load of a arrangement and allow larger precast units to be handled. Newly in the environmental issues, limitations of local and natural access or sources and removal of waste material are gaining great importance. Use of the waste materials not only helps in receiving them utilized in concrete ,cement and other construction materials, but also has numerous oblique benefits such as reduction in earth fill cost, saving in power, and protecting environment from possible pollution effect. It also helps in falling the cost of concrete developed. In the current work, coconut shell as partial exchange for coarse aggregate in concrete is studied. The actual with coconut shell was established to be durable in terms of its resistance in water, alkaline, acidic and salty. Thickness of coconut shell is in the range of 550 – 650 kg/m3 and these are within the particular limits for lightweight aggregate. The feature properties of concrete such as compressive strength & split tensile strength using the merge made by replacing crude aggregate with compressed coconut shell aggregate at 7 and 28days will be reviewed in the current work. Test results of compressive strength and split tensile strength of replace concrete 5% to 30% coarse aggregate replacement (C.A.R) by coconut shell at the end of 7 and 28days.**

## 1. INTRODUCTION

Concrete is a usually used construction material that consists of a mixture of cement, aggregates, water and admixtures. Static grainy materials such as sand, crushed stone or gravel form the major part of the aggregates. Therefore, there is a growing demand to find alternate materials that can be used as coarse aggregate in concrete. India produces about 20% of the coconut produced in the world. Within India, Kerala produces 45% of it. Disposal of coconut shells poses environmental issues as it is not easily degradable. This huge demand of natural collective raises a serious question about protection of natural aggregate sources for sustainable development. Extraction and processing of aggregates is also a most important concern for surroundings. Therefore consumption of alternative waste stuff in place of natural aggregate in concrete production not only protects atmosphere but also makes concrete a sustainable and atmospheric friendly construction material. Different waste material like fly ash, rubber, bottom ash, glass, synthetic sand etc has been used as alternative for replacing normal aggregates. Apart from the above point out waste material, a few studies shows that farming waste coconut shield can also be used as coarse aggregate for concrete.

## OBJECTIVES

This investigation aims at,

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1. To learn the physical and chemical properties of concrete materials.
2. To appear a mix design digest for concrete using IS code method.
3. To determine the workability of fresh concrete like slump cone and compaction factor test.
4. To find out the various strength of hardened concrete such as compressive strength of concrete cubes at 7 & 28 days and Split tensile strength of cylinder at 28 days and Flexural power of prism at 7 & 28 days.
5. To compare the workability and a variety of strength for different percentage of partial replacement of coarse aggregate with coconut shell.
6. To find efficient solution for high cost construction material.
7. To prepare lightweight concrete by using coconut shell as crude aggregate.

**A. RELATIVE STUDY GOING ON COCONUT SHELL AGGREGATE WITH CONSERVATIVE CONCRETE**

Vishwas P. Kukarni, Sanjay kumar B. Gaikwad, India, May 2013

Aggregates supply volume at low price, comprising 66 percent to 78 percent of the concrete. Conservative coarse aggregate that is gravel and fine aggregate is sand in concrete will be used as organize. While natural material is coconut shell as course aggregate will be scrutinize to change the aggregate in concrete. In this studies, three unlike concrete mixes with different the mixture of natural material content that is 0%, 10%, 20%, 30%.Three sample specimen will be organized for each concrete mixes. The aspire behind this is to utilize low cost material like coconut shell and thus taking close to the idea of low cost housing. All precaution is in use to maintain serviceability, strength and durability of the members. Coconut shell exhibits more confrontation against crushing, impact and abrasion, compared to compressed granite aggregate. Coconut shell can be grouped under insubstantial aggregate. There is no necessitate to treat the coconut shell before use as an aggregate apart from water absorption. Coconut shell is companionable with the cement. The flexural behaviors of resistant coconut shell aggregate concrete beams are similar in comparison to other lightweight concrete. All beams exhibited characteristic failure in flexure with vertical flexural cracks appearing in the pure bending area. No bond failure was observed, confirming that there was sufficient bonding between the coconut shell aggregate concrete and the steel bars. Although coconut shells aggregate concrete has a low modulus of elasticity. The average moisture content and water assimilation of crushed coconut shell was found to be 4.20% and 24% correspondingly.

**B. A STUDY ON THE UTILIZATION OF COCONUT SHELL AS COARSE AGGREGATE IN CONCRETE**

Dr. B. Rajeevan , Department of Civil Engineering ,Government College of Engineering Kannur, Shamjith K M, Undergraduate Student

Natural resources such as river sand and coarse aggregate are depleting at an alarming level in developing countries like India. The possibility of utilizing recycled coconut shell aggregates in concrete as coarse aggregate is examined in the present study. Coarse aggregate made from coconut shells were used in proportions of 5%, 10%, 15%, 20%, 25%, 30% and 35% to replace coarse aggregate in conventional concrete. A constant water to cement ratio of 0.5 was used throughout the study. Based on the limited number of experimental examination carried out to determine the automatic properties of concrete namely, compressive strength, split tensile strength and flexural strength of concrete, an optimum replacement of coarse aggregate with coconut shell aggregate, corresponding to the mix ratio 1: 1.63: 3.13, was determined as 15%. Cement content for 15% replacement was kept at 387 kg/m3. The observed value of 28 day compressive strength, split tensile strength and flexural strength were 24.6 N/mm2, 2.57 N/mm2 and 2.89 N/mm2 respectively.

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**DETAILS OF WASTE MATERIAL:**

In our project, we use coconut shell as coarse aggregate. A coconut shell is a waste material and it is collected from bharathiyar women's hostel at deviyakurichi, attur. Coconut shell is one of the most important natural fillers produced in humid countries like Thailand, Indonesia ,India, Malaysia. Many works have been committed to use of other natural fillers in composites in the current past years and coconut shell filler is a probable candidate for the advance of new composites because they have high strength and modulus properties the length of with the added benefit of high lignin content. Coconut shell flour is also widely used to make products like furnishing materials, cable etc. The shells also absorb less moisture due to its low fiber content the details focuses on studying the efficiency of coconut shell particles as a source of ordinary material.

**MATERIALS USED**

**1. FINE AGGREGATES**

**Sand:** stream sand was used as fine aggregate. The dimension of the sand is used as 4.75mm. The properties of fine aggregate investigated are accessible in table 1.

**Table 1 : Properties of well aggregate**

| Sl .No | Property | Value |
|---|---|---|
| 1 | Water absorption | 0.5% |
| 2 | Fineness Modulus | 3.1 |
| 3 | Specific Gravity | 2.8 |
| 4 | Surface Texture | Smooth |

**Table 2: Properties of soil particle size**

| properties | Sand | Silt | Clay |
|---|---|---|---|
| Porosity | frequently large pores | small pores prevail | small pores predominate |
| Permeability | fast | Low to moderate | Slow |
| Water holding capability | partial | average | very large |
| Soil particle surface | small | average | very large |

**2. CEMENT:** Portland Pozzolanic Cement of 20 grade was purchased from the local seller and used throughout this project. Low heat Portland cement conforming to IS 12600 shall be used with adequate precautions with observe to removal of formwork, etc. The properties of cement used in the investigation are presented in table 3.

**Table 3: Properties of Cement**

| Sl.No | Property | Value |
|---|---|---|
| 1 | Specific severity | 3.15 |
| 2 | Fineness | Not less than 225 $m^2/kg$ |
| 3 | Initial setting time | Not less than 30 min |
| 4 | Final setting time | Not greater than 600 min |
| 5 | standard consistency | 30% |
| 6 | Fineness modulus | 6 |

**3. COARSE AGGREGATE**

The nominal maximum size of coarse aggregate should be as large as possible within the restrictions specified but in no case greater than one-fourth of minimum thickness of the member , provided to the concrete can be placed lacking difficulty so as to surround all reinforcement thoroughly and fill the corner of the form. For most work, 20mm aggregate is suitable. The properties of the coarse aggregate are shown in table 4.

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**Table 4: Properties of crude (coarse) Aggregate**

| Sl. No | Property | Value |
|---|---|---|
| 1 | Water absorption | 0.5% |
| 2 | Fineness Modulus | 7.5 |
| 3 | Specific Gravity | 2.8 |
| 4 | Particle form | Angular |
| 5 | Impact Value | 15.2 |
| 6 | Crushing value | 18.6 |

**A. COCONUT SHELL:**

The properties of concrete using coconut shell as coarse aggregate were investigated in an investigational learn. Compressive, flexural, splitting tensile strengths, impact resistance and bond strength were calculated and compared with the hypothetical values as recommended by the standards. The results showed that the investigational bond strength of coconut shell concrete is much superior than the bond strength as projected by BS 8110 and IS 456:2000 for the mix selected.

**Table 5: Properties of coconut shell**

| Sl. No | Physical and mechanical properties | Coconut shells |
|---|---|---|
| 1 | Maximum size (mm) | 12.5 |
| 2 | Moisture content (%) | 4.20 |
| 3 | Water absorption (24 h) (%) | 24.00 |
| 4 | Specific gravity | 1.05–1.20 |

**4. WATER**

Water used for integration and curing shall be fresh and free from injurious amounts of acids , alkalis, oils, salts, sugar, natural materials or other substances that may be toxic to concrete or steel. Portable water normally careful acceptable for mixing concrete.PH value of water shall be not less than 6.

**Table 6: Density of water molecules at various temperatures**

| Sl. No | Temperature (degree Celsius) | Density ($g/cm^3$) |
|---|---|---|
| 1 | 0 (solid) | 0.9150 |
| 2 | 0(liquid) | 0.9999 |
| 3 | 4 | 1.0000 |
| 4 | 20 | 0.9822 |
| 5 | 60 | 0.9832 |
| 6 | 80 | 0.9718 |
| 7 | 100 (gas) | 0.0006 |

**PREPARATION OF SPECIMENS**

Based on the above results the cement, coarse aggregate and water , fine aggregate , quantity required for design mix of M15 were calculated based on the practice given in IS code method in IS : 2009. The final mix ratio was 1: 2: 4 with water cement ratio of 0.45. The measurement of equipment was done by weight in weighing machine is used. Water was measured by measuring jars in litres. Concrete was placed in mould in layers. The cast specimens were removed from moulds behind 24 hours and the specimens were kept for water curing at 7 and 28 days.

**TESTING OF THE SPECIMEN:**

For every batch of concrete, 2 cubes of 150mm x 150mm x 150mm size were tested to determine compressive strength of concrete, 2 cylinders of 150mm thickness and 300 mm length were tested to establish split tensile strength of concrete and two prisms of 100mm x 100mm x 500mm were experienced to determine flexural strength of concrete.

**RESULTS AND DISCUSSIONS**

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We are observed values of compressive Strength, split tensile strength and modulus of rupture of concrete when coconut shell aggregate(CSA) was added to control concrete of grade M15. The cement content was kept at 383kg/m3.

**Table 7: results with 0% replacement of coconut shell aggregate**

| Mechanical properties | 7 days | 28 days |
|---|---|---|
| Compressive strength(N/mm$^2$) | 18 | 26 |
| Spilt tensile strength (N/mm$^2$) | 1.43 | 2.82 |
| Flexural strength (N/mm$^2$) | 2.05 | 3.17 |

**Chart 1 : After 7 days curing for compressive strength test**

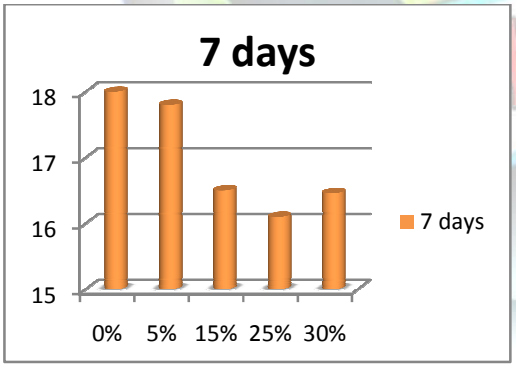


**Table 8 : results with 5% replacement of coconut shell aggregate**

| Mechanical properties | 7 days | 28 days |
|---|---|---|
| Compressive strength(N/mm$^2$) | 17.8 | 25.1 |
| Spilt tensile strength (N/mm$^2$) | 1.03 | 2.63 |
| Flexural strength (N/mm$^2$) | 1.97 | 2.36 |

**Chart 2 : After 7 days curing for spilt tensile strength test**

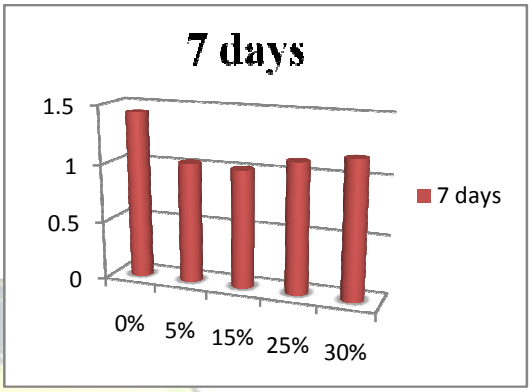


**Table 9: results with 15% replacement of coconut shell aggregate**

| Mechanical properties | 7 days | 28 days |
|---|---|---|
| Compressive strength(N/mm$^2$) | 16.5 | 24.5 |
| Spilt tensile strength (N/mm$^2$) | 1.01 | 2.58 |
| Flexural strength (N/mm$^2$) | 1.86 | 2.91 |

**Chart 3 : After 7 days curing for flexural strength test**

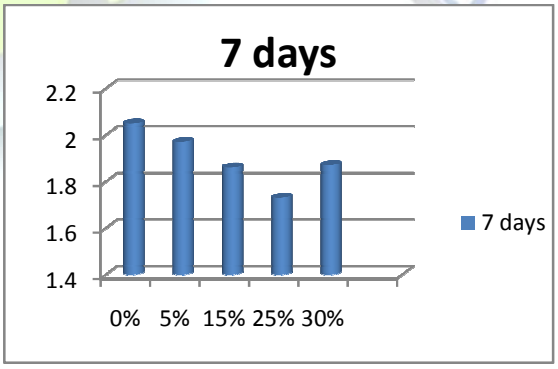


**Table 10: results with 25% replacement of coconut shell aggregate**

| Mechanical properties | 7 days | 28 days |
|---|---|---|

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| | | |
|---|---|---|
| Compressive strength(N/mm$^2$) | 16.1 | 20.9 |
| Spilt tensile strength (N/mm$^2$) | 1.11 | 2.47 |
| Flexural strength (N/mm$^2$) | 1.93 | 3.1 |

**Chart 4 : After 28 days curing for compressive strength test**

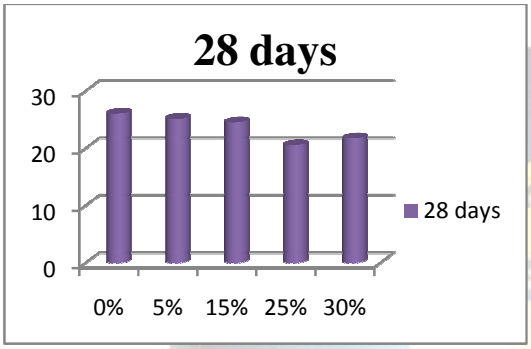



**Table 11: results with 30% replacement of coconut shell aggregate**

| Mechanical properties | 7 days | 28 days |
|---|---|---|
| Compressive strength(N/mm$^2$) | 16.46 | 21. 7 |
| Spilt tensile strength (N/mm$^2$) | 1.03 | 2.5 |
| Flexural strength (N/mm$^2$) | 1.87 | 3.36 |

**Chart 5 : After 28 days curing for spilt tensile strength test**

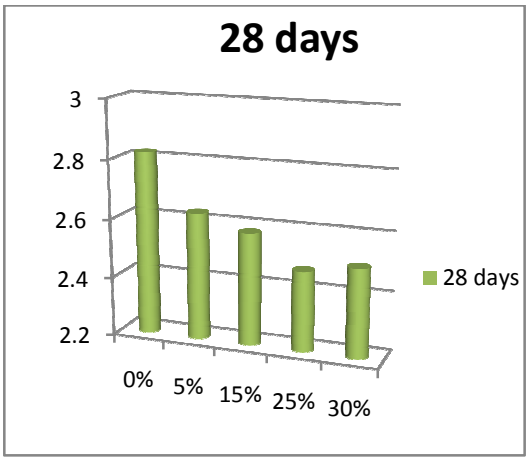
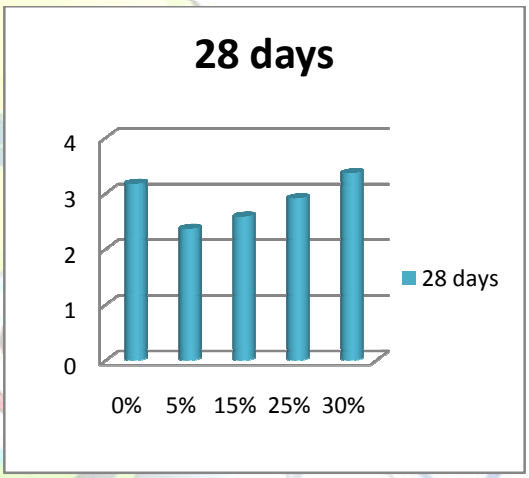



**Chart : After 28 days curing for flexural strength test**




## CONCLUSION

From the results of experimental investigations conducted it is concluded that the coconut shell can be used as a replacement for coarse aggregate. It is found that 30% replacement of coarse aggregate by agricultural waste give maximum result in strength and quality aspects than the conservative concrete. The results are proved that the replacement of 30% of coarse aggregate by the agricultural waste induced compressive strength, split tensile strength and flexural strength is higher. Thus the environmental possessions from the agricultural waste can be extensively reduced and also reduce the cost of the coarse aggregate.

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