

A Review on Use of Agricultural Waste Coconut Shells As Replacement to Coarse Aggregate In Production of Lightweight Concrete

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Abstract- *The cost of construction materials in developing countries is showing exponential rise which has forced us to use the alternative materials in civil engineering construction. Different waste materials have already proven to be employed in producing various materials for building construction. Aggregate is a major ingredient for making concrete which occupy almost 70-80 % of concrete. Conventionally crushed rocks are used as coarse aggregate and river sand as fine aggregate. Both are naturally available materials. Due to rapid growth of construction activities, conventional aggregate sources are depleting very fast leading to significant increase in cost of construction and increasing environmental concern. For sustainable development these materials should be used wisely and alternative materials need to be searched to replace conventional aggregate. At the same time due to rapid industrialization, production of waste material and its disposal problem is increasing day by day. We can think of using these waste materials as substitute for depleting construction materials and which serves both purposes i.e waste materials acting as substitute for depleting construction materials which saves the cost of disposal. India is third largest coconut producing country. Hence, we are focusing on waste coconut shell used to replace conventional coarse aggregate.*

Keywords- Concrete, Coconut Shell, Lightweight Aggregate, Recycle Waste, Cost

I. INTRODUCTION

Increase in waste is directly proportional to increase in population. Advancement in infrastructure created demand for construction material, concrete is premier construction material and among all aggregate form a major part. Lightweight aggregate concrete is an important and versatile material in modern construction. Structural light weight concrete offers design flexibility and cost savings due to self weight reduction, improved seismic structural response and lower foundation costs. More environmental and economic

benefits can be achieved if waste materials can be used as lightweight aggregates in concrete.

Coconut shell being a hard and not easily degradable material and if crushed to size of aggregate can be a potential material to substitute aggregate. The density of coconut shell concrete is low and hence can be used as light weight aggregate. Coconut shell aggregate can also prove economical replacement for conventional aggregate as coconut shell is easily available and no complex process is needed for its preparation for further replacement of aggregate.

Coconut shell are crushed in size of coarse aggregates (20mm- 4.75mm). coconut shell aggregates have potential for partial replacement of coarse aggregates in various proportions. Specific gravity of coconut shell when crushed in size of coarse aggregates has specific gravity 2.83.

II. OBJECTIVE

1. To study concept of replacement of coconut shell instead of coarse aggregates.
2. To study various properties of coconut shell concrete as well as conventional concrete.
3. To study feasibility of coconut shell concrete by comparing cost analysis of conventional concrete and coconut shell concrete.

III. LITERATURE REVIEW

In 2011, K. Gunasekaran et.al [12] studied the availability, production of coconut to further study on coconut shell for replacement as coarse aggregate. Overall 11 mix design were tried with varying water cement ratio, quantities of cement, fine aggregate, coarse aggregate, coconut shell as coarse aggregate. Density, compressive strength of concrete decreased with increase in content of coconut shell aggregate. Experiments prove that coconut shell fulfill requirements for use as lightweight aggregate.

In 2012, Amarnath Yerrmala et.al [03] studied characteristics of concrete with 10, 15, 20 % replacement of coarse aggregate with coconut shell. Further for 20% of replacement of coarse aggregate they also replaced cement with fly ash by 25%. Performance of conventional concrete and coconut shell concrete was assessed through compression and split tensile test. Specimens were tested for compression and split tensile test at 7, 28 days. They concluded that increase in coconut shell percentage decreased densities of concrete. Addition of coconut shell increases 7 day strength with corresponding 28 day strength. Concrete density decreases with increase in percentage replacement. Permeable voids increase with increase in percentage replacement.

In 2013, Vishwas Kulkarni et.al[20] studied various strengths of concrete of M20 grade with 10, 20, 30% replacement of coarse aggregate. Density of coconut shell concrete was less than 2000Kg/m^3 and therefore coconut shell concrete can be grouped under lightweight concrete. Flexural behaviour is same as that of conventional concrete. There is no need to treat coconut shell before use as an aggregate except for sun drying.

In 2013, Daniel yaw Osei et.al[07] experimented properties of concrete using coconut shell as replacement to crushed granite. In this experimental work crushed granite was used instead as coarse aggregate and coconut shell aggregate was replaced with this crushed granite by 20%, 30%, 40%, 50% and 100%. From above experimental work compressive strength of concrete decreased with increase in replacement of crushed granite (coarse aggregate). The density of concrete decreased with increase in replacement of crushed granite. It was also observed that density of concrete increased with increase in age of concrete. As coconut shells are lighter than granite, when replaced the mass of mix reduced resulting in decrease in density of concrete.

In 2014, Dewanshu Ahlwat et.al[08] both researched and studied characteristics of coconut shell concrete of M20 Grade with 0%, 2.5%, 5%, 7.5%, 10% replacement of coarse aggregate. The test results were analysed and compared with theoretical values, obtained from various codes. They concluded that increase in percentage replacement by coconut shell increases workability of concrete. The compressive strength of concrete reduced as percentage replacement increased.

In 2015, Kalyanapu Venkateswara Rao et.al[11] studied various strengths of coconut shell concrete with varying replacements of coarse aggregate and cement. Overall five mixes were designed and casted (a) 0% replacement (conventional concrete), (b) 10% replacement of coarse

aggregate, (c) 20% replacement of coarse aggregate, (c) 10% replacement of coarse aggregate with 10% replacement of cement, (d) 10% of replacement of coarse aggregate with 20% replacement of cement. Compressive strength and split tensile strength at 7 days for coconut shell concrete increases with increase in percentage of replacement but decreases at 28 days as compared with conventional concrete. But compressive strength and split tensile strength for coarse aggregate and cement replacement increases at both 7 and 28 days compared with conventional concrete.

In 2015, Anjali S. Kattire et.al[04] experimented compressive strength and split tensile strength of concrete (M20 grade) in which coconut shell were replaced with coarse aggregate by 0%, 10%, 15% and 20%. From above experimental work both compressive strength and split tensile strength decreased with increase in percentage of replacement of coarse aggregate with coconut shell. But reduction in compressive strength is more than reduction in split tensile strength.

In 2015 Chandraul Kirti et.al[06] carried out experimental work on M20 grade concrete with replacement of coarse aggregate by coconut shell by 0%, 20%, 40%, 60%, 80% and 100%. Compressive strength and split tensile strength increased with increase in age of concrete but Compressive strength and split tensile strength decreased with increase in replacement of coarse aggregate with coconut shell. Cost of concrete also decreased with increase in replacement of coarse aggregate with coconut shell. It was concluded that coconut shell are more suitable as low strength lightweight aggregate and also enhances economic production of concrete.

In 2016, Abdullah Anwar et.al[01] investigated strengths of concrete at 7, 14, 28 days for M20 grade concrete with replacement of coarse aggregate with coconut shell by 0%, 5%, 10%, 20%, 30%, 40% and 50%. Compressive strength of coconut shell concrete at 7, 14 and 28 days decreased up to 33%, 21% and 30% for 50% replacement. From above experimental work coconut shell concrete can be grouped under lightweight concrete and coconut shell aggregate can be grouped under lightweight aggregate.

In 2016, Shrikant M. Harle et.al[18] studied various research papers having experimental work partial replacement of coarse as well as fine aggregate with coconut shell. Conclusion from this study was compressive strength decreases with increase in replacement of coarse and fine aggregate. It was also concluded that density of coconut shell concrete decreases with increase in replacement of fine and coarse aggregate. Cost of coconut shell concrete decreases

with increase in replacement of coarse aggregate with coconut shell.

III. CONCLUSION

From the experimental results and discussion of above research papers and review papers we concluded that coconut shell has ability and potential to replace coarse aggregates without complex initial treatment before its use as aggregate. Coconut shell exhibits more resistance against crushing, impact and abrasion compared to crushed granite aggregate. The 28 day density of coconut shell aggregate is less than 2000 Kg/m³ and these are within range of light weight aggregate concrete. Coconut shell can be economical replacement for coarse and fine aggregate as coconut shell aggregate is easily available and available in abundance in India. Coconut shell aggregate is useful where low strength economical concrete is required.

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