Concrete Using Coconut Shell As A Coarse Aggregate

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Abstract*:* There were many experimental work conducted to improve the properties of the concrete by putting new materials, whether it is natural materials or recycle materials or synthetic materials in the concrete mix. The most affecting factor in construction is its cost. In most of the construction work concrete is used which consist cement, sand, coarse aggregate and water. In present day the coarse aggregate is obtained from natural resources for example natural rocks etc. But now a days artificial aggregate are also in practice.

In India coconut is widely used for various purposes like worship, industries etc. By use of coconut its shell remains as by-product which can be useful for construction work in place of coarse aggregate. Coconut shell is hard in nature and does not deteriorate easily once bound in concrete and therefore, it does not contaminate or leach to produce toxic substances. In our experiment coarse aggregates of concrete are partially replaced by coconut shell as 10%, 15%. All the tests of cement, sand, aggregate and concrete was done as per IS code. The concrete blocks with coconut shells of grade M20 were examined for compressive strength, water absorption and compared with conventional concrete of same grade and the cost is also compared.

Key words: Cocnut Shells, Concrete, Aggregate, Strength.

INTRODUCTION

Now-a-days many engineers and scientists are in process to find various natural as well as modernized ways for the production of construction materials especially concrete. They are also keen in maintaining its quality and strength and therefore various other materials are used as a replacement of a particular material in the making of concrete.

Construction engineers have long recognized the long term benefits of improving the strength and durability of concrete by mixing in a cementations binder during reconstruction or construction. There were many experimental work conducted to improve the properties of soil, by adding new materials whether it is a natural, recycle, or synthetic material in the soil. Large amount of agriculture waste was disposed in most of tropical country especially in Asia. If the waste cannot be disposed properly it will lead to social and environmental problems. Hence, by making use of coconut shell in concrete to increase its engineering properties for better use in different construction works according to requirements.

Need To Use Waste In Concrete :

- Research efforts has been done to match the society's need for safe and economic disposal of waste materials.
- The use of waste materials saves the natural resources and dumping ground and helps to maintain a clean environment.
- The current concrete construction is unsustainable.
- Experiments has been conducted for waste materials like rubber tyre, e-waste, waste plastic, waste water etc.
- Presently in India , about 960 million tonnes of solid waste are produced per year as a by product of agricultural, mining, municipal and other source.
- About 600 million tonnes of waste have been generated in India from agricultural source alone.
- The major quantity of agricultural waste are sugarcane baggase , paddy and wheat straw and husk , jute fibres, groundnut shells , coconut husk etc.
- Annually, 12,280 hectares of land are cultivated for coconut trees, from which 62.8 billion tones nuts are harvested
- Coconut shell occupies 15% of a total weight of a coconut.
- According to reports in 2018, India is producing 11.9 million tonnes of coconut. So amount of coconut shells produced are 1.78 million tonnes.
- The degradation process of coconut shells is very very slow due to presence of lignocelluloses in them. So we can use it in making concrete.

OBJECTIVES

1. To study the effect of coconut shells in concrete and its benefits.
2. To approach towards the use of an alternative material as concrete aggregate.
3. To compare cost, test results of compressive strength, water absorption, slump cone between plain concrete and concrete added with coconut shells.
4. To improve the overall durability and long term performance of concrete structures.

LITERATURE REVIEW

B.Damodhara Reddy, S.Aruna Jyothy & Fawaz Shaik reported that, Coconut shell aggregate is a potential construction material and simultaneously reduces the environmental pollution.

Vijay Kumar Shukla, Bharti Sharma & Amarnath Gupta reported that, the coconut shell concrete can be used for low strength structure and use of this make light weight concrete.

Tomas U. Ganiron Jr reported that, replacement of appropriate coconut shell content able to produce workable concrete with satisfactory strength. Integration of coconut shell enhanced the strength of concrete making it to be the highest as compared to conventional concrete mixture.

METHODOLOGY

Material Used :-

Cement:- The cement used in the experimentation was 53-grade Ordinary Portland Cement(OPC),which satisfies the requirements of IS:12269-1987 specifications. . It consists of a mixture of calcium silicates (alite, belite), aluminates and ferrites - compounds which combine calcium, silicon, aluminum and iron in forms which will react with water.

SR NO	Property	Value
1	Specific Gravity	3.15
2	Fineness test	5.35%

Properties Of Cement

GGBS:- Ground granulated blast-furnace slag (GGBS) can increase the abilities to prevent water penetration and chloride penetration, and it can improve the durability of concrete structure. Also the use of GGBS for concrete material contributes to the saving the natural resources and energy in cement manufacturing process and to reduce CO2 emission and environment impact.

Crushed Sand :- The source of crushed sand is a Quarry. It is manufactured by crushing rocks, quarry stones or larger aggregate pieces into sand size particles in a factory or quarry. The shape of the crushed sand is cubical and angular and has tough texture and hence better for concrete. It causes less damage to the environment as compared to natural sand. The specific gravity of crushed sand is 2.73.

Coarse Aggregates:- The crushed stone aggregates of size 10mm and 20mm used in experimentation.

Water :-Ordinary water free from organic content, turbidity and salts were used for mixing and for curing throughout the experiment.

Coconut Shells:- Coconut shells used in the experiment was dried in the sunlight for 29-30 days. We collected coconut shells from temples and from neighborhood. The size of the shells is between 4.75mm – 20mm.

MIX DESIGN

Concrete Mix Design For M20 Grade Concrete

Mix ratio is **1 : 1.55 : 3.09**

PREPARATION OF CUBE SPECIMENS:

This portion specified the procedure for making and curing compression test specimen of concrete. In laboratory where accurate control of the quantities of materials and test conditions are possible and where the maximum nominal size of aggregates does not exceed 20 mm. The method is especially applicable to the making of preliminary compression test to ascertain the suitability of the available materials or to determine suitable mix proportions.

Sampling Of Materials:-
Representative samples of the materials of concrete for use the particular concrete construction work shall be obtained by careful sampling. Test samples of cement shall be made up of a small proportion of taken from each of a number or bags,on the site. Test samples of aggregates shall be taken from larger lots by quartering.

Preparation Of Materials :-
All materials shall be brought to room temperature, preferably 27˚ to 30˚ C before commencing of tests. The cement samples , on arrival at laboratory, shall be thoroughly mixed dry either by hand or in a suitable machine in such a manner as to ensure the greatest possible blending and uniformly in the materials, care being taken to avoid the intrusion of foreign materials . The cement shall be stored in a dry place. Samples of aggregates for each batch of concrete sall be of the desired grading and shall be in air dried conditions.

Proportioning:-
The proportioning of the materials, including water in concrete mixes used for determining the suitable of the materials available, shall be similar in all respects to those to

be employed in the work. Where the proportion of the ingredients of the concrete are used on the site are to be specified by volume, they shall be calculated from the proportion, by weight used in the test cubes and the unit weights of the materials.

Weighing:-
The quantities of cement each size of aggregate and water for each batch shall be determined by weights to an accuracy of 0-1% of total weight of the batch.

Mixing Concrete:-
The concrete shall be mixed by hand, or preferably in laboratory batch mixer, in such a manner to avoid loss of water or other materials.

Machine Mixing:-
When the mixing drum is changed by a power loader, all the mixing water shall be introduced into the drum before the solid materials the skip shall be loaded with about one – half of the coarse aggregates, then with the fine aggregates, then with the cement and finally with the remaining coarse aggregates on the top. The period of mixing shall be not less than 2 min after all the materials are in the drum, and shall continue till the resulting concrete is uniform in appearance.

Workability:-
Each batch of the concrete shall be tested for consistency immediately after the mixing, by one of the methods described in IS code. Provided that care is taken to ensure that no water or other materials is lost, the concrete used for consistency tests may be remixed with the remainder of batch before making the test specimens.

Size Of Test Specimen:-
The specimen cubical in shape shall be 15*15*15 cm if the largest nominal size of the aggregates does not exceed 2 cm, 10 cm cubes may be used as an alternative. Cylindrical tests specimens shall have a length equal to twice the diameter.

Moulds:-
Metal moulds preferably steel or cast iron , thick, enough to prevent distortion is required. They are made in such a manner as to facilitate the removal of the moulded specimen without damage and are so machined that, when it is assembled ready for use, the dimensions and internal faces are required to be accurate within the following limits.

Compaction :-
The test cubes specimens are made as soon as practicable after mixing and in such a way as to produce full compaction of the concrete with neither segregation nor excessive laitance. The concrete is filled into the mould in three layers approximately 5cm deep. Each layer is compacted either by hand or by vibration. After the top layer is compacted the surface of the concrete is brought to the finished level with top of the mould using a trowel.

Compacting By Vibration :-
In this each layer is vibrated by means of an electric or pneumatic hammer or vibrator or by means of suitable vibrating table until the specified condition is attained. Care must be taken to avoid segregation taking place in the mould, which results in low strength when cubes are crushed.

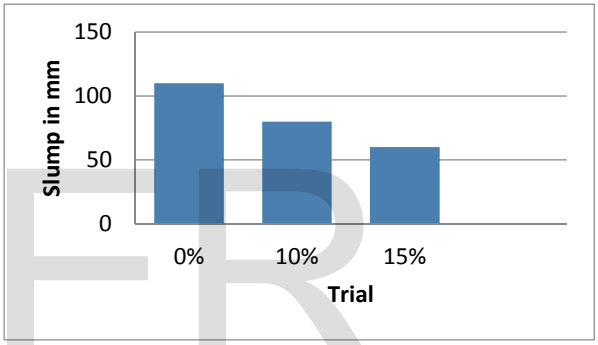
Curing :-
The test specimen are stored in a place free from vibration, in moist air of at least 90% relative humidity and at temperature of 27˚ to 2˚C for 24 hours to ½ hours from the time of addition of water to the dry ingredients. After this period, the specimens are marked and removed from moulds and kept submerged in clear fresh water until taken out prior to test.

CONCRETE TEST

Slump Cone Test :-

Trial	0%	10%	15%
Slump (in mm)	110	80	60

Slump Cone Test Results



Compression Test On Cubes :-

compressive strength of cubes after 7 days.

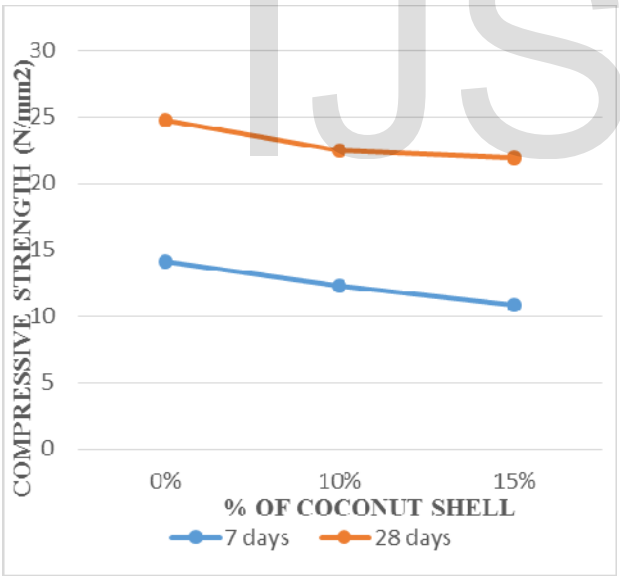
Sr No	% of Coarse Aggregate replaced by CS	Age of Specimen (days)	Weight of Specimen (Kg)	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	0%	7	8.432	320	14.22	14.07
			8.429	320	14.22	
			8.445	310	13.77	
2	10%+GGBS	7	8.294	270	12	12.3
			8.242	280	12.4	
			8.208	280	12.4	
3	15%+GGBS	7	8.130	250	11.1	10.8
			8.122	240	10.7	
			8.09	240	10.7	

Compression Test Results (7 Days)

Compressive Strength Of Cube After 28 Days.

Sr No	% of Coarse Aggregate replaced by CS	Age of Specimen (days)	Weight of Specimen (Kg)	Load (KN)	Compressive Strength (N/mm^2)	Average Compressive Strength (N/mm^2)
1	0%	28	8.495	550	24.44	24.74
			8.884	560	24.89	
			8.912	560	24.89	
2	10%+ GGBS	28	8.342	520	23.1	22.5
			8.342	500	22.2	
			8.318	500	22.2	
3	15%+ GGBS	28	8.184	500	22.2	21.9
			8.272	500	22.2	
			8.174	480	21.3	

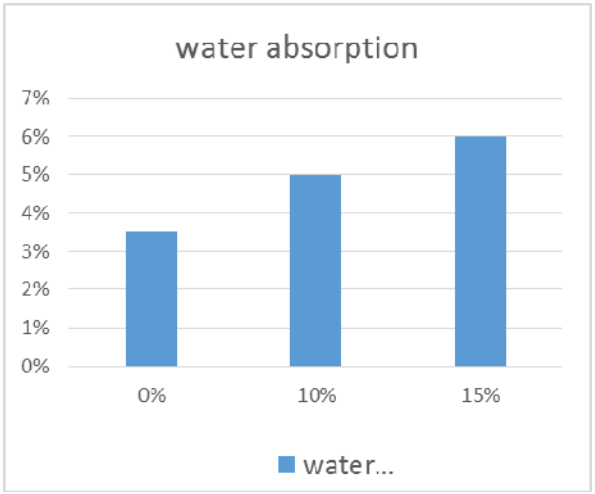
Compression Test Results (28 Days)



Water Absorption Test :-

Trial	Wet Weight	Dry Weight	Water Absorption
0%	8.65	8.35	3.5%
10%	8.621	8.208	5%
15%	8.583	8.09	6%

Water Absorption Test Results



CONCLUSION

- From the experimental results Coconut shell concrete can used in rural areas and places where coconut is abundant and may also be used where the conventional aggregate are costly.
- It is concluded that the coconut shells are more suitable as a lightweight aggregate when used to replace common coarse aggregate in concrete production.
- Moreover it reduces cost construction by reducing the cost of coarse aggregate and also reduces environmental pollution due to coconut shell.
- From slump cone test, the slump value of conventional concrete was 110 mm and that of coconut shell concrete for 10% and 15% was 80mm and 60mm respectively.
- The 28 days compressive strength of conventional concrete was found to be 24.74 MPa and of coconut shell concrete was found to be 22.5MPa and 21.9 MPa for 10% and 15% replacement by coconut shell aggregate. So we concluded that,we can not use this concrete for big structures but we can use this in small structure.

FUTURE SCOPE

- Coconut shell can be used as partial replacement of coarse aggregate in concrete.
- We can also study about the use of coconut shell aggregates along with other non-conventional aggregates like palm kernel shells, volcanic debris, etc.

REFERENCES

- B. Sandeep Reddy, CH. Gopichand, B. Anusha (2017) "Experimental Investigation Of Concrete using Coconut Shell as a Coarse Aggregate Replacement"
- B. Damodhara Reddy, S.Aruna Jyothy, Fawaz Shaikh (2014) "Experimental Analysis of the Use of Coconut Shell as Coarse Aggregate"
- Vijay Kumar Shukla, Bharti Sharma, Amarnath Gupta (2017) "Properties of Concrete by using Coconut Shell as Coarse Aggregate"
- Tomas U. Ganiron Jr (2013) " Sustainable Management of Waste Coconut Shells as Aggregate in Concrete Mixture"
- S. A. Kakade, Dr. A. W. Dhawale (2015) "Light Weight Aggregate Concrete By Using Coconut Shell"
- Sravika. V, G. Kalyan (2017) "A Study on the Partial Replacement of Coarse and Fine Aggregate by Coconut Shell and Quarry Dust Mix"
- R. Ranjith (2017) "Study on Properties of Concrete with Agricultural Waste"
- Manpreet Kaur and Jaspal Singh "Agricultural Waste Utilization in Civil Engineering"
- Ajim S Shaikh, Sagar B Thorat, Rahul V Unde, Prasad S Shirse (2015) "Advance Concrete-Aggregate replaced by Coconut Shell"