International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 4, July-Aug-2020, ISSN (Online): 2395-566X

Experimental Investigation on Strength and Flexural Strength of Concrete by Partially Replacement of Cement by Coconut Endocarp Ash

PG Student Aravind G , Asst. Prof. C. Gurumoorthy
Sri Ramakrishna Institute of Technology, Coimbatore, Tamil Nadu,
Aravindns2916@Gmail.Com, Gurumoorthy.Ce@Srit.Org

Abstract –Conservation of natural resources and prevention of environment should be considered predominant along with any kind of continuous technological and industrial development by minimizing quantity of waste disposal. If some of the waste materials are found suitable in concrete making, the cost of construction can be cut down, but also safe disposal of waste materials can be achieved. So, an attempt has been made to access the suitability of different replacement materials in the concrete production. The project is implemented by using coconut endocarp ash as a partial replacement material for cement. The experimental investigation is done on M30 grade concrete and its engineering properties were analysed using OPC cement along with coconut endocarp ash following standard mix design procedure. The compressive strength and tensile strength at 7 days ,14 days and 28 days of conventional concrete and concrete prepared using cement replaced in ranges of 5% with coconut endocarp ash to be measured. Finally, the results and graphs to be plotted. The flexural strength on beams using conventional concrete and concrete with partial replacement has to be studied and results will be compared.

Keywords– Compressive strength, Construction, Flexural strength, Conventional concrete, Coconut Endocarp ash.

I. INTRODUCTION

1. General

The cost of cement used in concrete works is on the increase and unaffordable, yet the need for housing and other constructions requiring this material keeps growing with increasing population, thus the need to find alternative binding materials that can be used solely or in partial replacement of cement. Agricultural waste material, in this case, coconut endocarps, which is a most available, are collected and burnt in the open air to make it as ash (coconut endocarp ash), which in turn was used to partial replacement of cement in concrete structure. Concrete cubes and beam were casting, using various replacement levels of 0, 10, 15, 20& 25% percent of OPC with coconut endocarp ash. A total of 9 cubes and 2 beams were casting in each percentage. Check and compare their strength on 7,14 & 28 days respectively.

2. Cement

Cement have been known and used for at least two hundred years. The romans used a great deal of the material in their construction projects, many of which still standard. Cement they will used were natural and pozzolan cements, made from naturally occurring mixtures of lime stone and clay and form a mixture of slacked lime and volcanic ash containing silica.

It is fine power, which when mixed with water and allowed to set and harden can join different components or members together to give a mechanically strong structure. All though the % of cement in concrete is around 15% the rate of cement is very important in the strength and durability of concrete. Selection of good quality of cement is therefore essential.

Portland cement was not until 1824 that the first step was made in producing the type of cement with which we are familiarly today. The inventor, joseph asp din, produced a powder made from the calcined mixture of lime stone and clay. He called it Portland cement because when it hardened it produced a material resembling stone from the quarries. Modern cement is made materials which contain a proper portion of alumina, lime, silica and iron with minor amounts of magnesia and Sulphur trioxide. These may be presented in one or more of the ores or other raw materials. Depending on the location of the cement manufacturing plant, available raw materials are pulverized and mixed in the proportions such that the resulting mixture will have the desired chemical composition.

3. Aggregate

Concrete can be considered to be an artificial stone made by binding together particles of some inert materials with paste made of cement and water. These inert materials are the aggregate. Among the materials used for this purpose are sand, gravel, crust stone, air cooled blast furnace slag, expended clay, shale, slate and slag, vermiculite, perlite, pumice, scoria and diatomite, barite and iron and steel punching's. All of these vary in weight and strength. These strength, durability and weight of the concrete depend on the types of aggregate used. Sand, gravel crushed stone and air-cooled blast furnace slag produce what are called normal weight concrete, weighing from 2160 to 2560kg/m. Specification for these aggregates are contained in ASTM C33 and coconut endocarp ash A23.1 Properties of aggregates are sand, gravel, crushed stone fall into this category and make up a large % of the aggregates used in concrete since they constitute from 60 to 80 % of the volume of concrete, their characteristics.

4. Water

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to from the strength giving cement gel, the quantity and quality of water is requiring to be looked into very carefully.

5. Quality of Water

A popular yard-stick to the suitability of water for mixing concrete is that, if water is fit for drinking it is fit for making concrete. This does not an appear to a true statement for all condition. Some water containing a small amount of sugar would be suitable for drinking but not for mixing concrete and conversely water suitable for making concrete may not necessarily be fit for drinking.

Some specification required that if the water is not obtained from source that has provide satisfactory, the strength of concrete or mortar made with questionable water should compared with similar concrete or mortar made with pure water. Some specification also accept water for making concrete if the PH value of water lies between 6 and 8 and the water is free from organic matter. Instead of depending upon pH value and other chemical composition, the best course to find out whether a particular source of water is suitable for concrete making or not, is truly make concrete with this water and compare its 7days and 28days strength with comparison cubes made with distilled water. If the compression strength is up to 90% the sources of water may be accepted.

6. Coconut Endocarp Ash

Coconut is grown in more than 90 countries. In which, India is the third largest, having cultivation on an area of about 1.8 million hectares for coconut production in the world. Annual production is about 10,560,000 tones Coconut However, it is also the main contributor to the nation's pollution problem as a solid waste in the form of endocarps. This waste can be utilized as a substitute for either fine or coarse aggregate or cement in concrete production. Concrete obtained using coconut endocarp as a coarse aggregate satisfies the minimum requirements for concrete. Coconut endocarp aggregate resulted in acceptable strength which is required for structural concrete. Coconut endocarp may present itself as a potential material in the field of construction industries. The coconut endocarp is compatible with cement and no need to pre-treatment for using it as coarse aggregate. Because of the smooth surface on one side of the endocarps concrete made with coconut endocarp presents better workability. Coconut endocarp concrete shows good impact resistance.

As compared to conventional aggregate water absorbing and moisture retaining capacity of coconut endocarp is high. The presence of sugar in the coconut endocarp, does not affect the setting and strength of concrete because it is not in a free form. Research indicates that most materials that are in rich can be used in partial replacement of cement. It has also been established that amorphous silica found in some pozzolanic materials which react with lime more readily than those of crystalline form. Use of such pozzolana can lead to increase in compressive and flexural strengths. The raw materials used for the manufacturing of cement consist mainly of lime, silica, alumina, and iron oxide. Generally, the chemical analysis of coconut Endocarp ash reveals that it contains some quantities of these elements. Hence coconut endocarp ash can be used effectively as a supplementary cementitious material.

Fig 1. coconut Endocarp ash

II. OBJECTIVE OF THE STUDY

The objective of this project is to study the structural behavior, analyse the compressive strength & flexural strength of coconut endocarp ash added concrete and utilization of waste material (coconut endocarp) in efficient manner.

To find a non-conventional concrete system and it should easily available, accessible, strength enough and also cheap in cost when compare to the conventional concrete. Understand the various advantages and applications involving partial replacement of cement. Compare the performance of conventional concrete and cubes which are partial replacement of ash 0%, 10%, 15%, 20% and 25%. partial replacement of ash 0%, 10%, 15%, 20% and 25%. Performance of laboratory tests are materials testing and comparison of compressive strength.

1. Experimental Programme

- Selection of type of grade of mix, mix design by an appropriate method, trial mixes and final mix proportions
- Estimating total quantity of concrete required for the whole project work
- Estimating quantity of cement, fine aggregate, coarse aggregate, coconut endocarp ash for this project work
- Testing of properties of cement, fine aggregate, coarse aggregate and coconut endocarp ash

2. Experimental Works And Test On Specimen

2.1. Mixing

The following mix proportions were adopted. In addition to the various mix proportions listed in the table below, the conventional concrete specimens were also casted for comparing results. Mixing of concrete may be done by any one of the conventional methods of hand mixing (or) machine mixing External vibration may preferable to prevent segregation, the mixing was done by hand as the specimen mould was small and quantity of mix was less. Correct quantity of cement, sand, coconut endocarp ash, aggregate and water required for batched were weighted accurately. Cement coconut endocarp ash and sand were mixed with coarse aggregate. In dry state, Water was added finally and mixing was done gradually.

2.2. Casting

The concrete cubes of size 15cm x 15cm x 15cm, the concrete cylinders of size 30cm in length and 15cm in diameter and the concrete beams of size 50cm x 10cm x 10cm were casted in both conventional and also in glass powder. The full compaction of the concrete is filled into the moulds in layers. After the top layer has been compacted the surface is brought to the finished level with the top of mould using a trowel.

2.3. Curing

The specimens are remoulded after 24 hours. Necessary identification marks were made and kept under water in a curing tank. The concrete specimens were kept under water for 7 days, 14 days and 28 days. After curing, they were taken out from the curing tank and air dried before testing.

3.1. Testing Procedure

The various tests that are to be carried out on hardened concrete are Compressive Strength Test Flexural Strength Test The specimens were tested for three different periods of curing such as 7 days curing, 14 days curing 28 days curing.

3.2 Compressive Strength Test

One of the important properties of concrete is its strength in compression. The strength in compression has definite relationship with all other properties of concrete i.e. these properties are improved with the improvement in compression strength. The aim of this experimental test is to determine the maximum load carrying capacity of test specimens. Cubes of size 150 mm. 150 mm . 150 mm were cast. Three numbers of specimens in each proportion were tested at 7th day, 14th day and 28th day. The compression test specimens were tested in a compressive testing machine.

The specimen was placed on machine in such a way that its position is at right angles to its own position which it had at the time of casting. Load was applied gradually. All the specimens were loaded to failure and the corresponding failure loads were recorded. The compressive strength of the specimen is calculated by dividing the maximum load applied to the specimen during the test by the cross-sectional area of the specimen. The mean value of the three specimens of each type is taken as final compressive strength & finally they were compared with conventional concrete.

Compressive strength = [Failure load (N) / Sectional area (mm2)

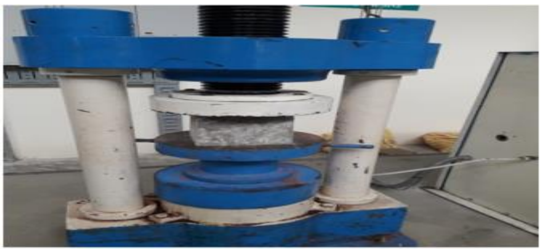

Fig 2. Compression Test Cube

Table: 1. Compressive Strength Test Results

%OF REPLACEMENT	CURING DAYS	CUBE I	CUBE II	CUBEIII	AVERAGE STRENGTH (N/mm^2)
0 %	7 days	16.18	17.24	17.86	17.09
	14 days	20.16	22.48	23.18	21.94
	28 days	36.24	37.16	37.86	37.08
10%	7 days	13.78	12.86	13.16	13.26
	14 days	18.82	19.12	19.64	19.19
	28 days	31.76	31.18	31.84	31.59
15%	7 days	12.11	12.96	13.12	12.73
	14 days	15.89	16.12	16.18	16.06
	28 days	24.23	24.86	25.12	24.73
20%	7 days	9.66	10.12	10.24	10.02
	14 days	13.12	13.24	13.18	13.18
	28 days	19.75	19.16	19.82	19.57
25%	7 days	7.16	7.24	7.86	7.42
	14 days	10.16	10.19	10.24	10.19
	28 days	17.16	17.84	17.92	17.64

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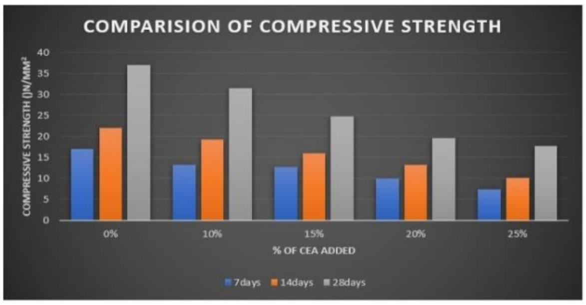

Fig.3 Comparision Of Compressive Strength

4.1. Experimental Setup For Beam

The test setup for reinforced beam for static loading. The testing of the beams specimens was conducted in the loading frame of 100-ton capacity. The test setup consists of the rollers for providing the simply supported condition. The load was applied to the specimen using to measure the applied load. A dial gauge is placed at the midpoint in the bottom side of the beam to measure the midpoint and deflection.

Fig.4 Beam Test

Table:2 Ultimate Load &Defelection For Different Percentages(Cea)Of Beam

%Of Replacement	Curing Days	Ultimate Load(Kn)	Defelection (Mm)
0%	7 days	168	7.95
	14 days	175	8.30
	28 days	185	9.15
10%	7 days	161	7.50
	14 days	169	8.45
	28 days	178	8.95
15%	7 days	154	7.95
	14 days	162	8.35
	28 days	169	8.39
20%	7 days	141	8.15
	14 days	148	8.50
	28 days	152	8.95
25%	7 days	130	8.65
	14 days	137	8.95
	28 days	143	9.45

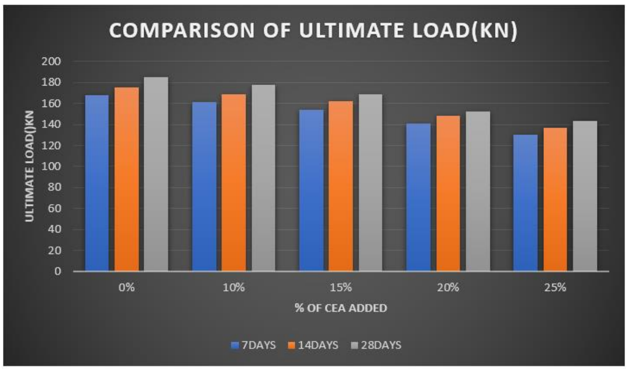

Fig. 5 Comparision Of Ultimate Load

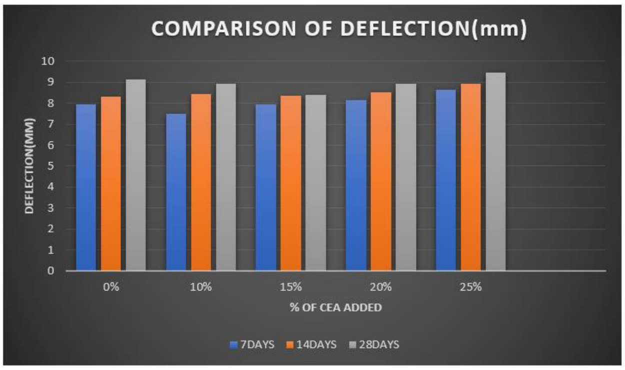

Fig.6 Comparision Of Defelection

V. CONCLUSION

The use of CEA as a partial replacement for cement in concrete, at lower volume of replacement, will enhance the reduction of cement usage in concretes, thereby reducing the production cost and the environmental pollution caused by the dumping of the agricultural waste. In conclusion, the study reveals that 10 to 15% partial replacement of OPC with CEA using W/C ratio of 0.5 are suitable for production of both heavy weight and light weight concrete.

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