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The Strength Behaviour of concrete containing fiber development of coconut fiber concrete

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Abstract

This study investigates the effects of adding coconut fiber to concrete. The results shows that coconut fiber does not affect the compressive strength of concrete. The percentages of coconut fiber added to the concrete are 0.1%, 0.15% and 0.5% of the concrete sample weight. The ratio of w/c is varied in the trial mix design, and the best ratio is 0.5. The standard cube size is 150 mm3 and the cubes are cured for 7 days, 14 days and 28 days

The first aim of this study is to identify the workability of fresh concrete containing additional coconut fiber. The second aim is to determine the ideal amount of coconut fiber added to the concrete mix. The third aim is to investigate the effect of the additional coconut fiber to the compressive strength of the concrete. The compressive strength of the 0.10% coconut fiber concrete recorded the highest compressive strength with 43.63N/mm2 after 28 curing days. The lowest compressive strength of coconut fiber concrete was 25.50N/mm2 for the 0.5% coconut fiber concrete. Concrete with 0.5% generally resulted in the lowest strength compared to 0.10% and 0.15%.

Keywords: Concrete, fine aggregate, coconut fiber, waste materials.

Introduction:

There are many advantages of concrete mix with plant fiber. Some of the advantages are low cost, low density, acceptable specific strength, good thermal insulation properties, reduced tool wear, renewable resource and recycling possible without affecting the environment. Coconut fiber is extracted from the outer shell of a coconut. The common name, scientific name and plant family of coconut fiber is Coir, respectively. There are two types of coconut fibers, brown fiber extracted from matured coconuts and white fibers extracted from immature coconuts. Brown fibers are thick, strong and have high abrasion resistance. White fibers are smoother and finer, but also weaker. Coconut fibers are commercial available in three forms, namely bristle (long fibers), mattress (relatively short) and decorticated (mixed fibers). These different types of fibers have different uses depending upon the requirement. In engineering, brown fibers are mostly used.

In this study, the coconut fiber will added into the concrete to observe the effect of the coconut fiber on the concrete's compressive strength and drying shrinkage. The predicted result from this study is that coconut fiber will increase the compressive strength of the concrete, decrease drying shrinkage and minimize cracking effect. The fiber in the concrete is expected to provide more support within the concrete sample.

Materials and methods:

Materials:

All the materials that will used in these study are fine, coarse aggregate, cement, and water and coconut fiber as components of coconut fiber concrete. Till now there no standard about the mix design for adding coconut fiber to the concrete, so since this method is a new born method. The mix design in this study will be

based on some of trail mixing that will be carried out. 150 x 150 x 150mm the tests for the cubes will be used for determination the compressive strength. After casting the specimens, it will be in the casting room for 24 hour. Then, the cubes will be released from the moulds and placed in the curing tank, for 7,14and 28days depends on the testing day.

Method:

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Casting:

For each percentage of adding the fiber, nine concrete specimens will be casted. The total number of specimens is 36 samples. The dimensions of concrete specimens are 150 mm x 150 mm x 150 mm. The details of the specimens are shown in Table (1)

Table (1): shows the total numbers of concrete specimen.

Mixture Designation	Percentage adding of coconut fiber	Nos. of Concrete Specimens		
		7 Days	14 Days	28 Days
Grade 25	0%	3	3	3
	0.10%	3	3	3
	0.15%	3	3	3
	0.5%	3	3	3
Total Numbers of Concrete Specimens		36		

Curing:

Immediately after molding the specimens, the cubes will be stored in a place where it is free of any vibration and in an environment which will prevent loss of moisture. The cubes will be stored for 24 hours in room temperature to ensure a relative humidity of higher than 90%. After that, the specimens will be released from molds and will be cured in water in a curing tank before testing. This curing process ensured the continuous hydration of the specimen by maintaining the temperature and moisture. The curing process followed the method of normal curing of test specimens (20ºC method) BS1881: Part III: 1983. Concrete properties improve with age as long as conditions were favorable to obtain the designed concrete strength.

Slump Test:

The main purpose of slump test is to determine the degree of workability for concrete mix. The strength depends on how the concrete is being poured. Therefore, the concrete that is to be used must be easily poured and compacted. Factors that affect the workability are the water content, size and shape of aggregates and the water cement ratio. The cone for the slump test as specified in ASTM specification C143-78 has a height of 12 in, a bottom

diameter of 8 inch and a top diameter of 4 inch. The slump test will be performed according to ASTM C 143. Figure 3.4 explains the fundamentals of slump test.

Compressive Strength:

The compressive strength of the concrete specimens will be tested at the ages of 7, 14 and 28 days. The compressive strength will be tested as accordance to BS 1881: Part 116: 1983.

Results and discussion:

The data collected from slump test provides a pattern to evaluate the consistency of concrete. Table (2) shows the measurements for each mix of 0.1%, 0.15%, and 0.5%.

Table (2): shows the slump test result.

	Batch	Slump(mm)
1	0.10%	100
2	0.15%	140
3	0.5%	140
4	0%	80

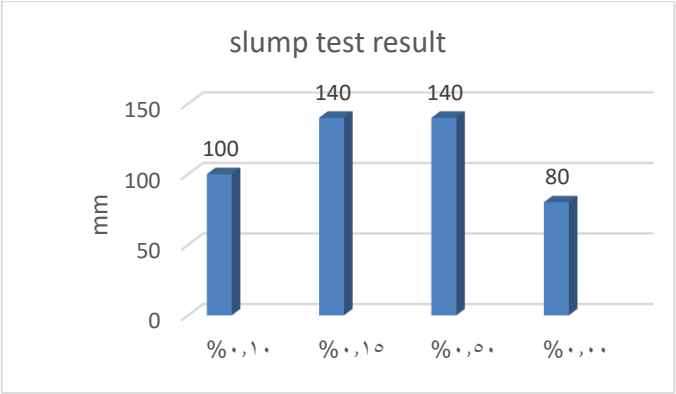

Figure: (1)

The results of slump test were shown in Table (2) and analysis data in Figure (1). The measurement of concrete slump for control sample 0% additional coconut fiber was 80 mm, and it is much lower than the cubes containing 0.10%, 0.15%, and 0.5%

additional coconut fiber. That makes it very low in the perspective of degree of workability. On the other hand, the highest slumps were 140mm for additional coconut fiber concrete containing 0.15% and 0.5% additional coconut fiber respectively. However, the best slump was achieved by the batch concrete containing 0.10% additional coconut fiber which was measured as 100mm where that makes it in medium degree of workability.

Compressive Strength:

In this study the compressive strength result has been realized at UNIESL Lab faculty of engineering, the cube test has been applied for the all the cubes which are 36 cubes for 7, 14 and 28 days with deferent percentages which are 0.1%, 0.15%0.5% of adding coconut fiber to the concrete table (3) shows the compressive strength for the average cubes.

Table (3): shows the compressive strength for the average cubes.

Curing age	Compressive strength (N/mm2)			
	0.00%	0.1%	0.15%	0.5
7 days	15.74	24.59	22.29	20.39
14 days	22.74	30.59	30.95	20.39
28 days	28.08	43.63	34.12	25.58

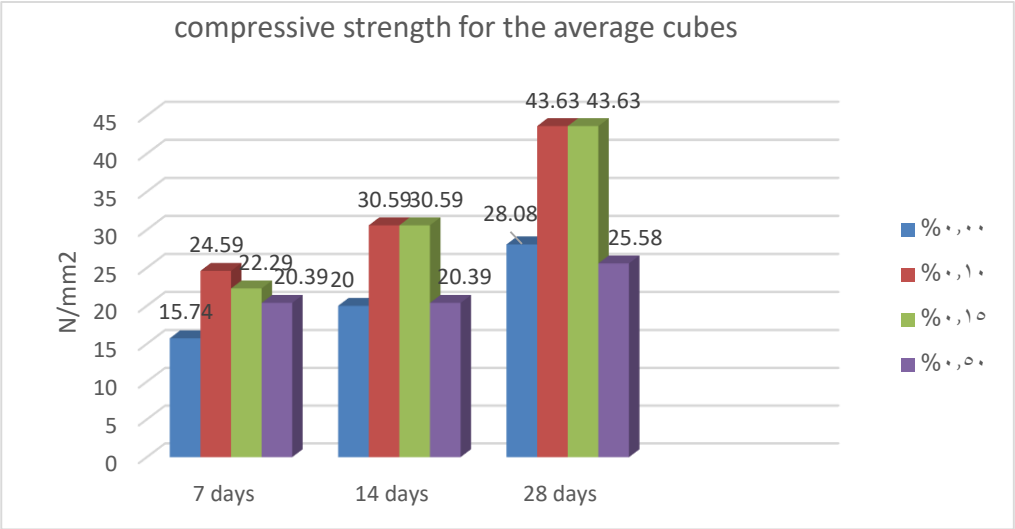

Figure (2): shows the compressive strength for average cubes

The results of slump test were shown in Table 4.1 and analysis data in Figure 4.1. The measurement of concrete slump for control sample 0% additional coconut fiber was 80 mm, and it is much lower than the cubes containing 0.10%, 0.15%, and 0.5% additional coconut fiber. That makes it very low in the perspective of degree of workability. On the other hand, the highest slumps were 140mm for additional coconut fiber concrete containing 0.15% and 0.5% additional coconut fiber respectively. However, the best slump was achieved by the batch concrete containing 0.10% additional coconut fiber which was measured as 100mm where that makes it in medium degree of workability.

Compressive strength is the main aim for this study, and it has been obtained at Concrete Laboratory using compressive strength machine. The results have been tabulated in Table 4.4, 4.6 and 4.8 Moreover, the results have represented the compressive strength of additional coconut fiber concrete.

By observing the results of compressive strength for the 4 batches, it have been shown homogeneous results and it shows that the way of mixing the properties of additional coconut fiber concrete has been done correctly and in good technique.

By looking at the results, we can observe that the cubes containing 0.10% additional coconut fiber had the highest strength among the cubes containing0.0% additional coconut fiber, where the highest average strength 43.63 $N/mm2$ at 28 curing age. That increase in the strength happened because of that the fiber that added to the concrete it was just enough to fit in the concrete's air void so by avoiding the air voids it gave the concrete strength and that's the reason of increasing the strength when that percentages used.

By looking at the results, we can observe that cubes contacting 0.5% coconut fiber had that the lowest strength which was 25.58N/mm2 after 28 curing age. That decrease of the strength happened because of the an controlling of mixing the materials during mixing period in the Lab, so the concrete loose some of the materials such coarse aggregate and the coconut fiber has been taken the place of that materials so from additional it becomes replacement.

Recommenation:

Lab Work:

Lab work is the most important stage during a work period, in this stage a lot of works have been done, so it's important to in this stage to be careful during the lab works period to avoid some mistakes that will affect the results after that.

In this study some recommendation have been recorded in the following lines:

1. To make sure that the materials mixed evenly.
2. To use the proper equipment and machine such as mixer concrete machine.
3. To make sure that each patch has the same percentage according to the mixing design.
4. To measure each sample density.
5. To ensure that all the samples are completely dry before weigh them for example some of the precast concrete company dray the samples under the sun at least for 8 hours.

Result:

Additional coconut fiber concrete is sustainable technology, and it is helpful and useful to be used in construction sites, that regarding to it is advantages and benefits, as it is less costly, and reduce the usage of natural fiber recourses. Some of the recommendations have been recorded in the following lines:

1. To try same partial replacement percentages of Coconut fiber as coarse aggregate in concrete to compare its results with the results of this study.
2. To try partial replacement of coconut fiber as fine aggregate in concrete.
3. It is also recommended to use concrete containing coconut fiber concrete in construction site, that because that it doesn't affect the strength of the concrete but in low percentages

Conclusion:

From the experiment and the works that have been done in UNISEL lab and also from the analysis and the results of the experiments the following conclusions were made:

1. The objectives of this study have been achieved, and done successfully and completely at the Concrete Laboratory.
2. Determination of w/c ratio is important to have a good condition of workability and flow ability by adding super-plasticizer type of water reducer.
3. Coconut fiber concrete has a good workability.
4. The compressive strength of coconut fiber concrete with 0.10% was the highest compressive strength 43.63N/mm2 after 28 curing age.
5. The lowest compressive strength of coconut fiber concrete was 25.50N/mm2 for 0.5%addional. Concrete in fact in this percentage the result was the lowest strength comparing to 0.10% and 0.15%. in this percentage during mixing the materials were not mixing well as the mixing was quite hard to control specially by using hand, so in this percentage during putting the materials in the mould the fiber was took some of the other materials place such as aggregate so it become replacement.

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