A PARTIAL REPLACEMENT OF CEMENT WITH CORN COB ASH IN CONCRETE PRODUCTION

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ABSTRACT

This paper presents a study of partial replacement of cement with corn cob ash (CCA) in cement, aiming to reduce the CO_2 emission into the atmosphere. Corn cob ash was obtained and used to replace cement partially in specified ratios of 1%, 2%, 3%, 4% and 6%. Concrete cubes were cast and cured in ages of 7 and 28 days respectively. Compressive strength test was carried out on the cubes, split tensile strength on cylinder and the flexural strength on beam. The results showed that the concrete strength decreased with increasing replacement with the corn cob ash (CCA). Physical properties of the aggregates and mechanical properties of CCA cement concrete at 0.5 water–cement ratio and mix ratio of 1:1:2 were examined. The specific gravity of corncob ash was 2.16, while a twenty eight (28) day compressive strength of 29.77N/mm2 was obtained at 3% replacement level, which shows that the 3% CCA replacement for cement is the optimum. While 6% CCA replacement for cement offers the lowest strength (26.6N/mm2).It was concluded that CCA can be used as partial replacement for cement in concrete production as well as for walls of building units and other mild construction works, and replacement should not exceed 3% as strength produced above this replacement level may not be adequate for strength requirements.

INTRODUCTION

Concrete is one of the engineering materials commonly used in building component such as slabs, columns, beams, staircase, foundation, retaining wall, dams etc. the Concrete is a very strong and versatile moulded construction material. Its consists of cement, sand and aggregate (e.g., gravel or crushed rock) mixed with water. The cement and water form a paste or gel which coats the sand and aggregate. When the cement has chemically reacted

with the water (hydrated),it hardens and binds the whole mix together. The initial hardening reaction usually occurs within a few hours. It takes some weeks for concrete to reach full hardness and strength. Synthetic construction material made by mixing cement, fine aggregate, coarse aggregate and water in a specified proportion. in all stages of irrigation development through to operation and maintenance and is implemented in many developing countries. The overall cost of concrete production depends on the cost of ingredients in concrete. Because of the negative impact due to the environmental pollution, degradation of natural resources such as limestone and high cost of Portland cement, there is, therefore, need for cheaper and available substitute for cement in concrete production. One of the practical and economical solution is through the utilization of agricultural and industrial waste such as rice husk ash, coal fly ash (pulverized fuel ash), granulated blast furnace slag, silica fume, met-kaolin (calcium clay), rice husk ash, palm kernel shell ash, and Shea nut shell ash. In addition, corncob is the hard thick cylindrical central core of maize, however, corn cob is describe as the agricultural waste product obtained from maize or corn, which is the most important cereal crop in sub-Sahara Africa.

It is desirable to obtain cheap, environmentally friendly substitutes for cement that preferably by projects. The problem arising from continuous technological and industrial development is the disposal of waste material. If some of the waste material are found suitable in concrete making, not only cost of construction can be cut down, but also safe disposal of waste materials can be achieved.

NEED FOR THE REPLACEMENT OF CEMENT

- To reduce the CO_2 emissions into the atmosphere.
- To reduce the problem of disposal of agro waste.
- To prove that the agro waste can be replacement for cement.
- To effectively utilize the waste material from the agro waste.

METHODOLOGY

Cement

Cement is a binder, a substance used for construction that sets, hardens and adheres to other materials, binding them together.

Fine Aggregate

It consists of naturally sand or crushed stone with most particles passing through 4.75 mm sieve.

Coarse Aggregate

The particles which are retained in 4.75 mm sieve. The maximum size up to 40 mm is used for coarse aggregate, while for mass concreting purposes such as dams, sizes up to 150 mm may be used.

Water

Portable water from college campus is used for this project work.

Corn Cob Ash

The Corn cob Ash has high silica and amorphous content, making them subject to consideration as supplementary material for partial replacement of Ordinary Portland Cement (OPC)

CORN COB ASH

CHEMICAL COMPOSITION CORN COB ASH

NO	COMPONENT	MASS (%)
1	SiO_2	67.33
2	Al_2O_3	7.34
3	Fe_2O_3	3.74
4	CaO	10.29
5	M_gO	1.82
6	SO_3	1.11
7	Na_2O	0.39
8	K_2O	4.20
9	SiO_2+ Al_2O_3	74.67

FRESH CONCRETE

Fresh concrete or plastic concrete is freshly mixed material which can be moulded into any shape. The potential strength and durability of concrete of the given mix proportion is very dependent on the degree of its compaction

TESTS ON FRESH CONCRETE

- Slump test
- Compacting factor test
- Flow table test

WORKABILITY

Workable concrete signifies much wider and deeper meaning than consistency often used their workability

SLUMP TEST

Slump test is used to determine the workability and consistency of fresh concrete. The slump test as per IS: 1199-1959 is followed in India.

Sample	% of CCA	SLUMP (mm)
1	0	50
2	1	80
3	2	100
4	3	140
5	4	170
6	6	210

SLUMP CONE

COMPACTION FACTOR TEST

Compacting factor on fresh concrete is done to determine the workability of fresh concrete by compacting factor test as per IS: 1199-1959.

SAMPLE	% OF CCA	COMPACTION FACTOR
1	0	0.95
2	1	0.96
3	2	0.96
4	3	0.96
5	4	0.97
6	6	0.98

COMPACTION FACTOR TEST APPARATUS

FLOW TABLE TEST

Flow table Test on fresh concrete is done to determine the workability of fresh concrete by Vee Bee Consistometer Test as per is: 1199-1959

SAMPLE	% OF CCA	% OF FLOW
1	0	90
2	1	92
3	2	91
4	3	94
5	4	93
6	6	91

HARDENED CONCRETE

Maximum stress it can resist or the maximum it can carry. The flexural tensile test is used to estimate the load at which the concrete members may crack. Compressive strength taken as the maximum compression load it can carry per unit area

TESTS ON HARDENED CONCRETE

- Compressive strength of concrete
- flexural strength of concrete
- Split tensile strength of concrete

Compressive strength on concrete

For compressive strength test, the specimens are cast of size 150mm x 150mm x 150mm. Compression tests are made at recognized ages of the test specimens, the most usual being 7,14 and 28 days

COMPRESSIVE STRENGTH TESTING MACHINE

Flexural strength on concrete

For flexural strength of concrete, the specimens in the form of beam 10cm x 10cm x 50cm in size

FLEXURAL STRENGTH TESTING MACHINE

Split tensile strength on concrete

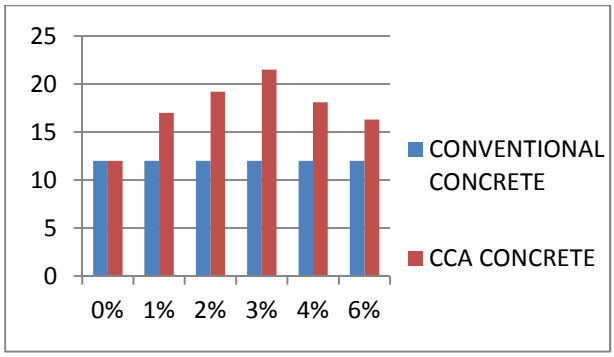
The specimen shall be cylindrical in shape 15cm diameter, 30cm long. The test is made at edges, most usual being 7days and 28days

RESULTS AND DISCUSSION

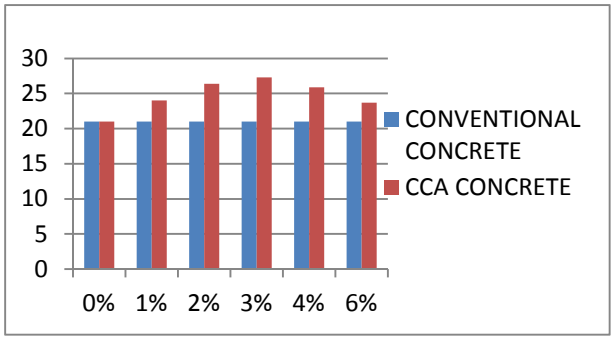
Compressive Strength Test

COMPARISON OF COMPRESSIVE STRENGTH FOR CONVENTIONAL CONCRETE AND CCA CONCRETE AT 7, 14 AND 28DAYS

DAYS	WITH OUT CCA	1 %	2%	3%	4%	6%
7	12	17	19.2	**21.5**	18.1	16.3
14	21	24	26.4	**27.3**	25.9	23.7
28	25	26	28	**29.7**	28.8	26.6



THE COMPARISON OF RESULT BETWEEN COMPRESSIVE STRENGTH OF CONVENTIONAL CONCRETE AND CCA CONCRETE AT 7 DAYS



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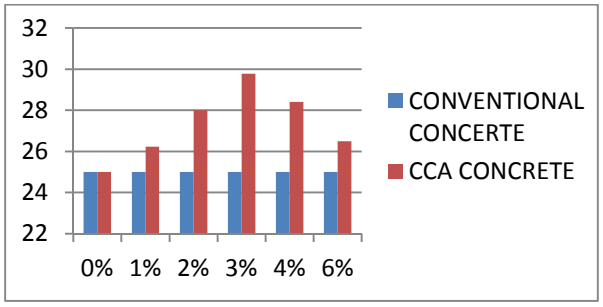
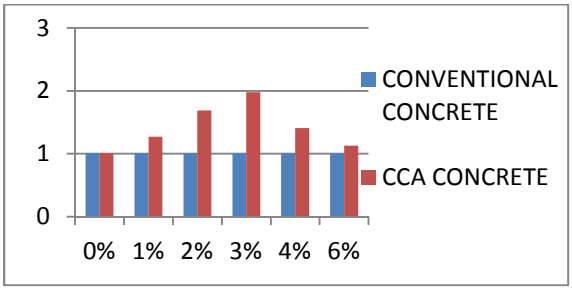


THE COMPARISON OF RESULT BETWEEN COMPRESSIVE STRENGTH OF CONVENTIONAL CONCRETE AND CCA CONCRETE AT 28 DAYS

SPLIT TENSILE STRENGTH TEST

COMPARISON OF SPLIT TENSILE STRENGTH FOR CONVENTIONAL CONCRETE AND CCA CONCRETE AT 7, 14 AND 28 DAYS

DAYS	WITH OUT CCA	1%	2%	3%	4%	6%
7	1.01	1.2	1.69	**1.98**	1.41	1.13
14	1.40	1.6	2.16	**2.59**	2.03	1.78
28	1.55	1.8	2.4	**2.82**	2.26	1.98



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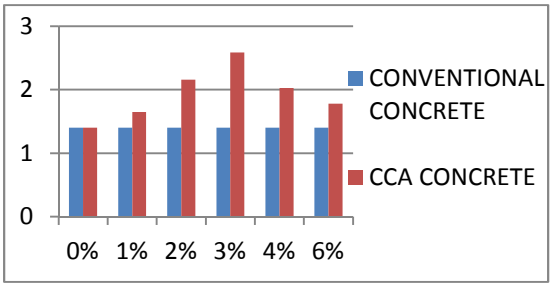

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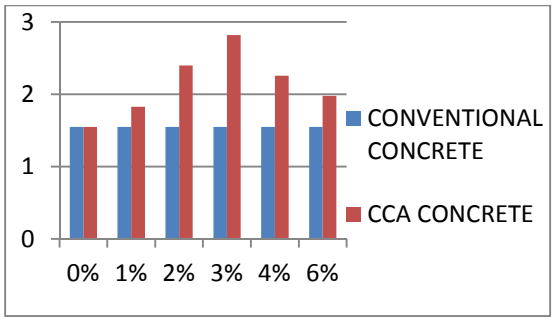
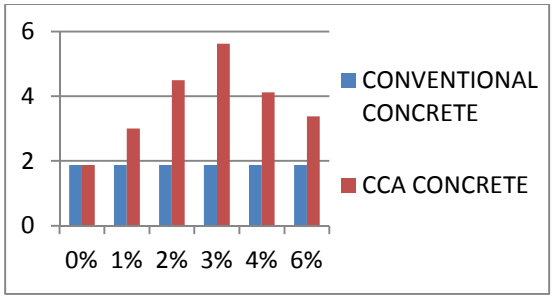


THE COMPARISON OF RESULT BETWEEN SPLIT TENSILE STRENGTH OF CONVENTIONAL CONCRETE AND CCA CONCRETE AT 28 DAYS

FLEXURAL STRENGTH TEST

COMPARISON OF FLEXURAL STRENGTH FOR CONVENTIONAL CONCRETE AND CCA CONCRETE AT 7, 14 AND 28 DAYS

DAYS	WITH OUT CCA	1%	2%	3%	4%	6%
7	1.87	3	4.5	**5.62**	4.12	3.37
14	3.05	4.1	6.42	**7.43**	5.74	5.07
28	3.37	4.5	7.12	**8.25**	6.37	5.63



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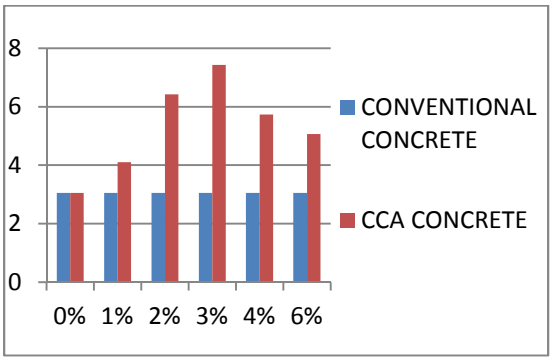

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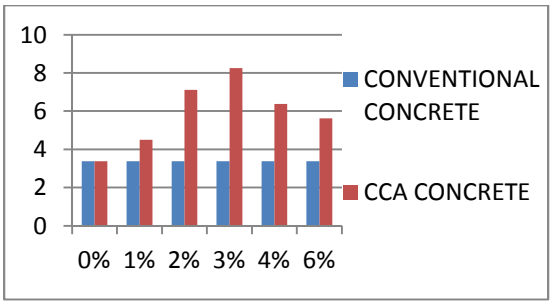

THE COMPARISON OF RESULT BETWEEN FLEXURAL STRENGTH OF CONVENTIONAL CONCRETE AND CCA CONCRETE AT 28 DAYS

CONCLUSION

- From the result of experimental investigations conducted it is concluded that the waste material from agro waste can be used as a partial replacement for cement.

- It is found that the cement could be advantageously replaced with CCA up to maximum limit of 3%.
- These cement replacements by Corn Cob ash (CCA) as mainly reduce the CO_2 emissions into the atmosphere and also CCA improves the quality and reduce the cost of construction materials.

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