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Research Article

EXPERIMENTAL INVESTIGATION ON CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH INDIGENOUS WASTE

Ms. R.Devaki[1] and Ms. R.Malathi[2]

[1]Assistant Professor, [2]Assistant Professor(Sr.Gr) Department of Civil Engineering, Sri Ramakrishna Institute of Technology Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu, India

A R T I C L E I N F O

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A B S T R A C T

In India maize is the third most cereal crop. The total quantity of Corn Cob waste in India is 5 million tonnes per year. The total quantity of waste in Tamilnadu is 2700 tonnes per year. Conventional concrete is one of the expensive when compared to concrete consists of Corn Cob Ash (CCA).
Therefore use of agricultural waste for the partial replacement of cement increases substantially and it is to be a suitable replacement for the cement in the form of waste-to-wealth. Corn Cob is the hard cylindrical core that bears the kernels of an ear of corn, usually an agricultural by-product found after removal of Corn. Here Concrete mix of M30 grade is prepared for various concrete mixes by varying percentage replacement of cement with corn cob ash by 0%, 5%, 10%, 15%, and 20%. Concrete cubes were cast and cured between the ages of 7 and 28 days. A compressive strength test was carried out on the cubes, split tensile strength between a cylinder and the flexural strength on beam. The outcome showed that the strength of concrete decreased with increasing replacement with the corn cob ash (CCA).

INTRODUCTION

Concrete is a most versatile heterogeneous and synthetic construction material that consists of Portland cement, fine aggregates, coarse aggregates and water in proper proportions. Concrete is the second most-consumed substance in the world and low-cost material which is used for the construction of any type of structure. During cement production, there may be an emission of carbon-di-oxide which causes serious environmental damages. CO_2 emissions are becoming a serious issue that affects the environment adversely. Hence cement can be partially replaced by various pozzolanic materials such as fly ash, rice husk, silica fume, and corn cob ash (CCA) the use of the agricultural waste product in cement production is an environmentally friendly method of disposal of large quantities of materials that would otherwise pollute land, air, and water

The overall cost of concrete production largely depends on the availability and cost of its constituents. The main input of CO_2 emissions from cement manufacture results from the process of creating Calcium Oxide (CaO) from limestone commonly known as the calcination process. Corn cob is the cylindrical central core of maize. Corn Cob is described as the agricultural waste product obtained from maize or corn.

Corresponding author:* **Ms. R.Devaki
Assistant Professor Department of Civil Engineering, Sri Ramakrishna Institute of Technology Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu, India

The third most important cereal crop in India after rice and wheat is Maize. It accounts for around 10 % of total food grain production in the country.
Appropriate utilization of CCA as a partial replacement for cement will bring economic benefits to our country.

Corn Cob ASH

Corn cob ash (CCA) is a suitable material for use as a pozzolana since it satisfied the requirement for such a material having a combined SiO2 and Al2O3 of more than 70%. The addition of Corn cob ash (CCA) as a pozzolan in cement increases marginally the oxide composition of SiO2 and Al2O3; and decreases slightly that of CaO, in lime. Corn cob ash (CCA) cement has higher setting times than the control thus they are most applicable where the low rate of heat development is required such as in mass concreting.

ASH Production Procedure

The Corn cobs used for this project were obtained from Anthiyur, Erode District. The obtain corn cobs were washed with distilled water and sundried for 1 week to remove the moisture content. The collected samples were burnt into ash by open burning. After that burnt ashes were the sieved through sieve of 75 µm.

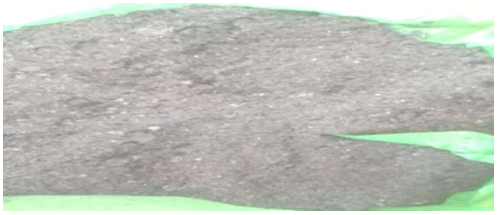

Fig 1 Corn Cob Ash (CCA)

To achieve the objectives of this study, an experimental plan was developed to produce ash replacement concrete. Here M30 grade concrete is used for concrete production. Corn ash added as partial replacement 5% to 20%. The chemical composition of CCA is given below.

Table 1 chemical composition of cca

Constituents	Percentage of CCA
SiO_2	56.39
Al_2O3	17.57
Fe_2O_3	9.07
CaO	11.45
MgO	0.98
SO_3	0.55
K_2O	1.98
Na_2O	1.91

Experimental Work

The experimental work includes the laboratory testing of materials used for concrete production to find the efficiency.

Laboratory Test

Various test been conducted has per IS standards to find their material property.

Specific gravity test

From the test result, the specific gravity of fine aggregate and corn cob ash is 2.60 and 2.70. The test result show that the value of CCA is higher than the normal fine aggregate

Table 2 Specific gravity of fine aggregate

Details	Values
Empty weight of Pyconometer (W1)	620g
Pyconometer +1/3 sand (W2)	1120g
Pyconmeter + Sand+ water (W3)	1770g
Pyconometer +water (W4)	1460g
Specific gravity $\frac{W2-W1}{(W2-W1)\times(W3-W1)}$	
The specific gravity of fine aggregate = 2.60	

Crushing value Test

The crushing value of an aggregate is 29.5%. This type of aggregate is used for concrete pavement works and also permitted for other structural works.

Aggregate Impact value Test

The impact test is the property of Resistant to impact or Toughness of an aggregate. The results showed that the impact value of a coarse aggregate is 8.84%.

Fig 2 Aggregate Impact value Test

The impact test is the property of Resistant to impact or toughness of an aggregate. The most successful is the one in which a sample of the standard of aggregate kept in a mould is subjected to fifteen blows of a metal hammer of the weight of 14kgs falling from a height of 38cms. According to IS 283-1970 specifies that aggregate impact value shall not exceed 45% weight for aggregate used for concrete

Table 3 aggregate impact value test

Details of the Sample	Trail
Total Weight of aggregate sample filling the cylinder measure = W1 g	0.713
Weight of aggregate passing 2.36 mm sieve after the test =W2 g	0.063
Weight of aggregate retained 2.36mm sieve after the test = W3g	0.641
(W1-W2+W3)	1.291
Impact value = (W1-W2+W3)*100%	8.84%

Compressive strength Test

Cubes of size 150*150*150mm should be cast. The Specimens should be given sufficient time for Hardening (approx.24 hrs) and then it should be cured for 7 and 28 days. The compressive strength of concrete at 10% replacement is higher than conventional concrete at 7 days and 28 days.

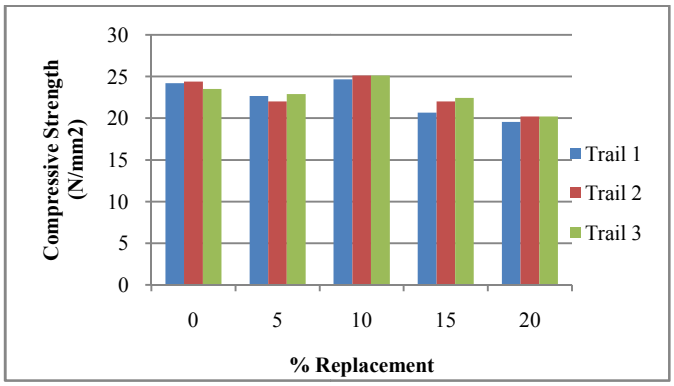

Fig 3 7th Day Compressive Strength

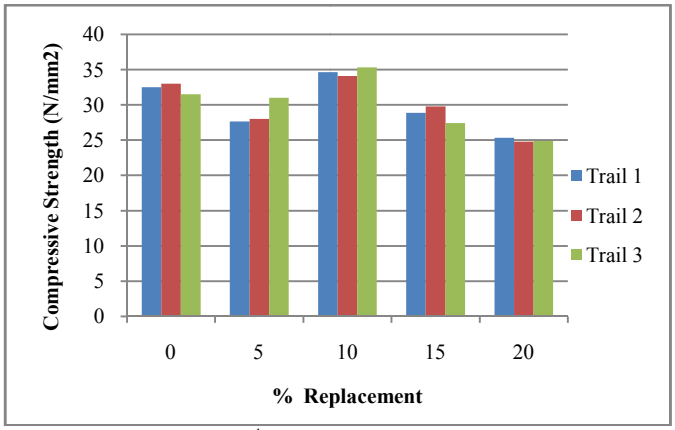

Fig 4 28th day Compressive Strength

Split Tensile Strength Test

Split tensile strength tests were carried out on Specimens of size 150mm diameter and 300mm height at the age of 7 and 28 days curing using compression testing machine. The split tensile strength of concrete at 10% replacement is higher than conventional concrete at 7 days and 28 days.

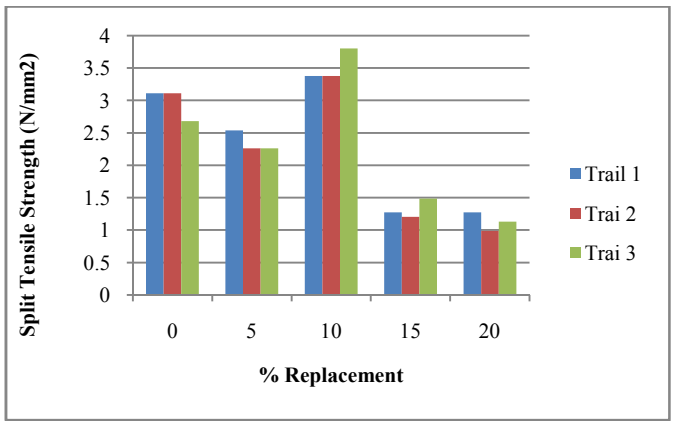

Fig 5 7th day Split Tensile Strength

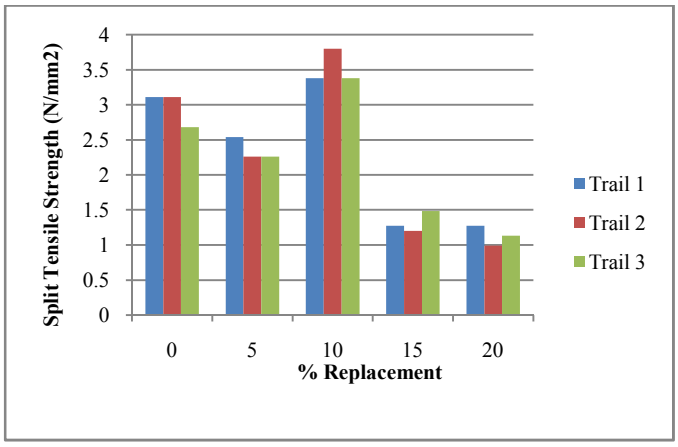

Fig 6 28th day Split Tensile Strength

Flexural Strength Test

Flexural strength test were carried out on specimen of size 50cm*10cm*10cm at the age of 7 and 28 days curing using flexure testing machine.

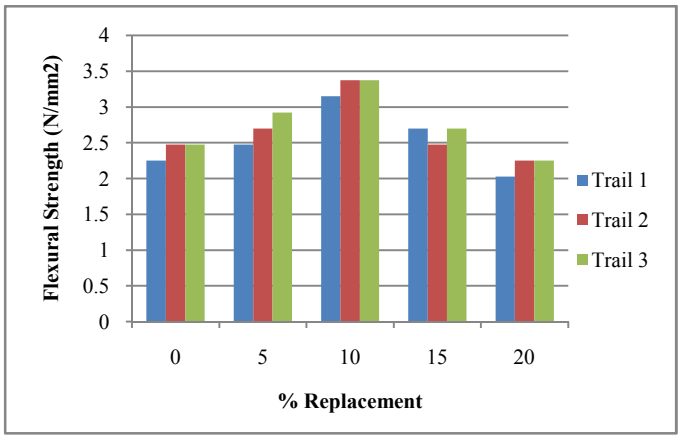

Fig 7 7th day Flexural Strength

From fig 4.7 the Flexural strength of concrete at 10% replacement is higher than conventional concrete at 7 days.

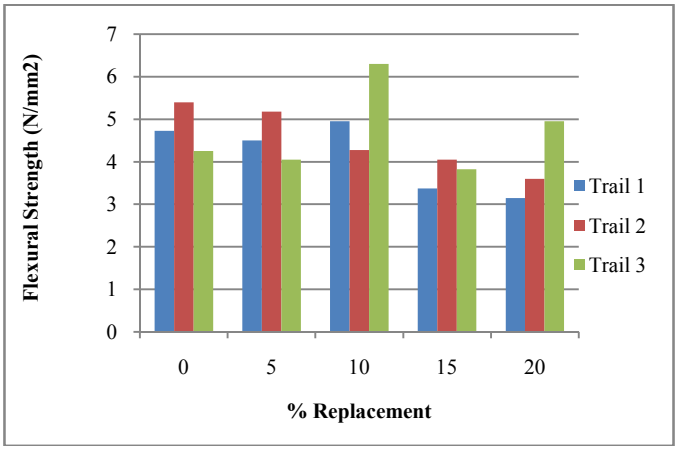

Fig 8 28th day Flexural Strength

From fig 4.4 the split tensile strength of concrete at 10% replacement is higher than conventional concrete at 28 day

RESULTS AND DISCUSSION

The above test results show that the Corn Cob Ash is very suitable for replacement of cement in concrete production. They have been found to improve the compressive, tensile and flexural strengths especially at later days of curing. CCA can be used to partially replace cement in the production of concrete to a maximum of 10% because replacement beyond this reduced the concrete strength beyond the control.

CONCLUSIONS

Most agricultural waste products are generally pozzolanic with good prospects as partial replacements to cement in concrete and other areas of applications. The compressive strength, Split Tensile strength and Flexural strength of specimen with corn cob ash replacement at the end of 7th and 28th-day results increased in 10% replacement of ash. CCA is a suitable material for the replacement of cement in concrete production. Despite the decrease in the mechanical strength of the specimen, this type of concrete is greatly employed in secondary structural element works such as floorings, mortar, and mass concrete. The strength decreased with an increase in CCA content and increased with an increase in the curing period. Corn Cob Ash replacement concrete has played an important role in achieving improvement in percentage replacement of PPC in the concrete mix of M30 grade concrete and it useful in mass concrete works.

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