International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-8, June 2020

# Assessment on Influence of Corncob Ash as a Partial Replacement of Cement in Concrete

**Selina Ruby.G, Dinesh.S, Bharath Raj.P, Kishorenandha.S**

***Abstract*: In an attempt to renovate waste product into constructive material for the building purpose, this research considered the use of corn cob ash (CCA) as a partial replacement of cement. Hence, in this research, we have proposed an eco-friendly solution by investigating the utilization of corncob ash with 0, 5, 10 and 15% replacement for cement in M30 grade of concrete Mechanical Properties such as compressive strength, Split tensile strength and Flexural strength at 7,14,28 days are examined in laboratory. The results reveal that Corn Cob Ash can be used as a partial replacement for cement which in turn reduces the emission of greenhouse gases.***

***Key words: Agricultural waste, Corncob Ash, Mechanical Properties, Replacement of cement.***

## I. INTRODUCTION

Cement, a major constituent of concrete is produced by almost all countries. Cement is deemed to have a considerably high carbon footprint, contributing immensely to global warming. Industrial and agricultural waste products such as CCA unnecessarily occupy space when stored or create environmental hazards when dumped in landfill. Their utilisation in the construction industry reduces the overall cost of construction, mitigates on the technical and environmental nuisance[7,8].The benefits of using pozzolanic materials are both economic and technical. Replacing a portion of cement with other pozzolanic material reduces the cost of the fresh concrete [1].Corncob is the hard cylindrical core that bears the kernels of an ear of corn, usually an agricultural by-product found after removal of the corn.(2) described corn cob as the agricultural waste product obtained from maize or corn;Therefore the utilization of corncob ash reduces cost of production of cement. Ndububa et.al., observed the Effects of Guinea Corn Husk Ash as partial replacement cement in Concrete and found that chemical analysis of ash gave favourable result for uses as an pozzolana[2]. CCA is a suitable material for use as a pozzolan material as it satisfied the requirement[3] The acquired corn cob were dryed and burned at an uncontrolled temperature, so that the ash can be collected.

**Revised Manuscript Received on June 30, 2020.**
***** Correspondence Author
**Selina Ruby.G***, Department of Civil Engineering, Sri Krishna College of Technology, Coimbatore, India. Email: selinaruby.g@skct.edu.in
**Dinesh.S**, Department of Civil Engineering, Sri Krishna College of Technology, Coimbatore, India, Email: dineshsd227@gmail.com
**Bharath Raj.P,** Department of Civil Engineering, Sri Krishna College of Technology, Coimbatore, India, Email: raj1999perumal@gmail.com
**Kishorenandha.S**, Department of Civil Engineering, Sri Krishna College of Technology, Coimbatore, India, Email: kishoreroshna@gmail.com



The collected ash is sieved accordingly and they were used for the partial replacement of cement in the concrete.

## II. EXPERIMENTAL PROGRAM

The materials used to prepare concrete specimen were tested in laboratory and the properties were found. Mix design was done as per IS 10262:2019.Four sets of concrete specimens are made to study the behavior of CCA concrete. To make different sets of concrete, corn cob ash is used as a replacement of cement at different ratios (0%,5%,10%15%).

## III. PROPERTIES OF MATERIALS

### A. Cement

Ordinary Portland cement of 53 grade was used in this testing conforming to I.S.12269: 2013

**Table- I: Properties of Cement**

| Properties | Values |
|---|---|
| Specific Gravity | 3.15 |
| Fineness Modulus | 2.3 |
| Consistency | 30% |
| Initial Setting Time | 29 mins |

### B. Fine Aggregate

M Sand passing through IS 4.75 mm sieve and as per IS: 383:2016 was used for all the specimens.

**Table- II: Properties of M Sand**

| Properties | Values |
|---|---|
| Specific Gravity | 2.58 |
| Zone | II |
| Fineness Modulus | 2.3 |

### C. Coarse Aggregate

Locally available, aggregate passing through 20 mm sieve and retained on 12.5 mm sieve and as given in IS: 383 – 2016 was used for all the specimens.

**Table- III: Properties of Coarse Aggregate**

| Properties | Values |
|---|---|
| Specific Gravity | 2.46 |
| Size | 20mm |

### D. CornCob Ash

A corncob, also called cob of corn, the part of the maize plant on which the grain grow.

Corn Cob was burnt and the ash obtained was sieved. Specific gravity was found as 2.08

### E. Water and Super Plasticizer

Potable water was used for the experimentation.
Chemical Admixture Type: Super Plasticizer with specific gravity 1.21 was used.

## IV. MIX PROPORTION

Mix design was adopted from IS 10262:2019 to design for M30 grade of concrete with a W/C ratio of 0.38

Table- IV: Mix Proportion

| Materials | By weight (kg/ $m^3$) |
|---|---|
| Fine aggregate | 771 |
| Coarse aggregate | 1036 |
| Cement | 449 |
| Water | 155 |
| Chemical admixture | 0.0037 |

Corn Cob Ash was replaced at 5%,10% and 15% as partial replacement for cement and control specimen were casted.

## V.HARDENED PROPERTIES

### A. Compressive Strength Test

Compressive strength tests were carried out on concrete cubes of 150mm×150mm×150mm. Remove the specimen from water after specified curing time and allow it to dry for 1 day. Testing is carried out as per the codal provisions given in IS 516:1959[12]
Compressive Strength = P/a x a ($N/mm^2$)

### B. Split Tensile Strength Test

Split tensile strength tests were carried out on concrete Cylinders of d=150mm h=300mm. Testing of specimen is done by adopting the procedure furnished in IS 5816:1999[13]
Split Tensile Strength = $2P/\pi$ x d x h ($N/mm^2$).

### C. Flexural Strength Test

Flexural strength tests were carried out on concrete prism of l=280mm b=75mm h=75mm. The test is conducted as given in IS 516 :1959[12]

## VI. EXPERIMENTAL RESULTS

Average of three specimen were calculated for each property and the experimental results are presented in Table V.

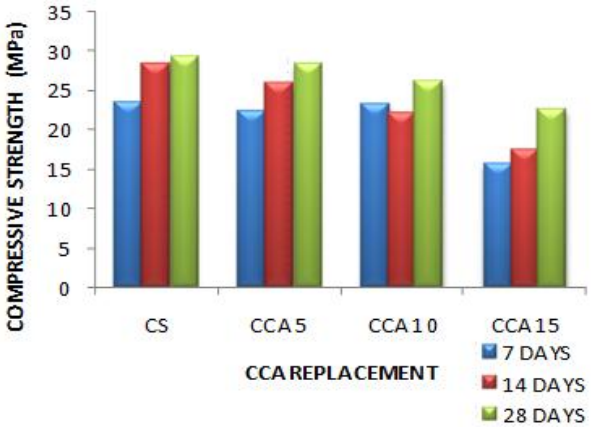


**Fig. 1. Compressive strength test result**

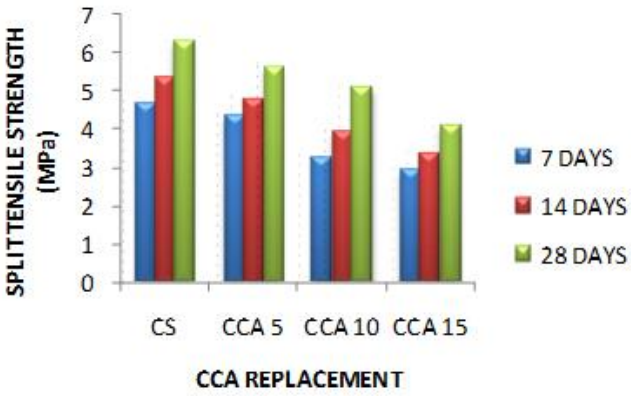


**Fig. 2. Split tensile strength test result**

| Specimen | Average Compressive Strength(MPa) | | | Average Split tensile Strength(MPa) | | | Average Flexural Strength(MPa) | | |
|---|---|---|---|---|---|---|---|---|---|
| | 7 Days | 14 Days | 28 Days | 7 Days | 14 Days | 28 Days | 7 Days | 14 Days | 28 Days |
| CS | 23.55 | 28.44 | 29.33 | 4.66 | 5.37 | 6.3 | 9.33 | 10.66 | 13.77 |
| CCA 5 | 22.5 | 26.07 | 28.40 | 4.38 | 4.81 | 5.65 | 8.88 | 10.22 | 12.88 |
| CCA 10 | 23.21 | 22.14 | 26.22 | 3.25 | 3.96 | 5.09 | 7.55 | 9.33 | 11.55 |
| CCA15 | 15.82 | 17.41 | 22.60 | 2.97 | 3.39 | 4.10 | 7.11 | 8.44 | 9.77 |

Table- V: Results of Mechanical Properties

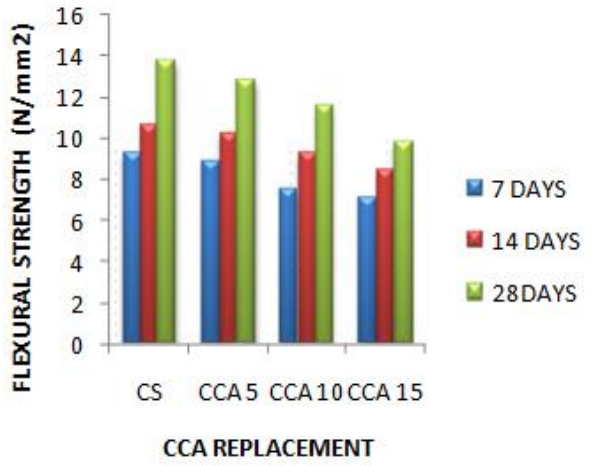


**Fig. 3.Flexural strength test result**

## VII. CONCLUSION

Different ratios of CCA are replaced for the weight of cement and concrete specimen is tested for mechanical properties. The experimental result shows that compressive strength of cube at 5% CCA replacement increases to 8% when compared to CCA10 and CCA15 specimen. Split tensile strength of cylinder at 5% CCA replacement increases when compared to the other replacements. Also the experimental result proves that flexural strength of prism of CCA5 increases when compared to 10% and 15% CCA replacement. It can be concluded that CCA can be used to partially replace cement in the manufacture of concrete to a maximum of 5%, because replacement further than this reduces the concrete strength. The strength of concrete produced from replacement revealed that partial replacement of cement with CCA can be used to withstand some structural loads.

## REFERENCES

1. D.A.Adesanya, A.A.Raheem, Development of Corn Cob ash blended cement, Construction and Building Materials, 2007, 2(3), 347-352.
2. Ndububa, Emmanuel, Nurudeen Yakubu, Effects of Guinea Corn Husk Ash as partial replacement cement in Concrete, IOSR Journal of Mechanical and Civil Engineering, 2015, 12(2), 40-45.
3. Owolabi T.A., Oladipo I.O., Papoola O.O., Effects of Corn Husk Ash as partial substitute for cement in Concrete, New York Science Journal, 2015, 8(11), 1-4.
4. Oluborode K.D., Olofintuyi I.O., Strength evalution of corn cob ash in a blended portland cement, International Journal of Engineering and Innovative Technology (IJEIT), 2015, 4(12), 14-17.
5. P. Suwanmaneechot, T. Nochaiya, P. Julphunthong , Improvement of characterization and use of waste corn cob ash in cement based material, Global Conference on Material Science and Engineering, 2015, 10(3), 1-11.
6. Kayote Oluborode, Ilesanmi Olofintuyi , Self compacting concrete: Strength evaluation of CCA in blended portland cement, American Scientific Research Journal for Engineering Technology and Science, 2015, 13(1), 123-131.
7. John Kamau, Ash Ahmed, Paul Hirst, Joseph Kangwa, Viability of using CCA as pozzolonic in concrete, International Journal of Science Environmental Technology, 2016, 5(6), 4532-4544.
8. Ahangba Augustine, Tiza Michael, Partial Replacement of cement with corn cob ash, China Civil Engineering Construction Corporation – Nigeria Limited, 2016, 2(7), 159-169.
9. Gradinaru C.M., Barduta M., Babor D., Serbanoice A.A., Corn cob ash as sustainable puzzolanic material for an ecological concrete, 2018, 3(1),61-66.
10. Emeka Segun Nnochiri, Oluwaseun Adedapo Adetayo , Geotecnical properties of lateritic soil stabilized with corn cob ash, ACTA TECHNICA CORVINIENSIS – Bulletin of Engineering, 2019, 12(3), 73-76.
11. IS 10262:2019, Concrete Mix Proportioning - Guidelines ( Second Revision )
12. IS 516:1959 Methods of Tests for Strength of Concrete (Eighteenth revision). Reaffirmed- May 2013
13. IS 5816 (1999): Splitting Tensile Strength of concrete- Method of Test

## AUTHORS PROFILE

**Selina Ruby G** currently working as Assistant Professor in Department of Civil Engineering, Sri Krishna College of Technology, Coimbatore. And, completed B.E.,Civil Engineering from Sri Ramkrishna Institute of Technology, M.E., Structural Engineering from Sri Krishna College of Technology and have experience for 5 years in teaching. Published 04 papers in national and International journals and conferences. Her area of research is Nanomaterials in Concrete.

**S.Dinesh** studying B.E.Civil Engineering in Sri Krishna College of Technology, Coimbatore, Tamil Nadu, India. Completed higher secondary in the year of 2016. Completed mini project on Design of Resort and Estimation of Residential Building.

**P.Bharath Raj** studying B.E.Civil Engineering in Sri Krishna College of Technology, Coimbatore, Tamil Nadu, India. Completed higher secondary in the year of 2016. Completed mini project on Design of Resort and Estimation of Residential Building.

**S.Kishorenandha** studying B.E.Civil Engineering in Sri Krishna College of Technology, Coimbatore, Tamil Nadu, India. Completed higher secondary in the year of 2016. Completed mini project on Design of Resort and Estimation of Residential Building.