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RESEARCH ARTICLE

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DEVELOPMENT OF CORN COB ASH CEMENT CONCRETE

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ABSTRACT

The strength characteristic of Corn Cob Ash (CCA) cement concrete was evaluated in this paper. M20 mix design and 0.42 water-cement ratio was used based on the properties of materials used. Various percentage of corn cob ash (CCA) at 0%, 10%, 20% and 30% replaced for Ordinary Portland cement with and without super plasticiser (ConplastSP430) at 2% replacement. Specimens for each percentage replacement of OPC with CCA and the normal concrete are tested for compressive strengths, split tensile strengths and flexural strength at 7,28 and 60 days of curing. The compressive strength of concrete cubes as increasing with respect to the curing days increased. The compressive strength of Corn Cob Ash cement concrete was lower at early stages but improves at 60 days. From this result, the compressive strength of the concrete with 10% CCA replacement at 60 days is increased by 3.3% than conventional concrete and it is also noted that, with the effect of 2% SP the 28 days compressive strength of concrete with 10% CCA replacement increased by 7% than conventional concrete with SP . The CCA cement concrete would take more curing days to achieve its designed strength and it require less water. Hence, superplasticizer is used to reduce the substantial water content and increase the compressive strength.

Keywords: concrete, Corn Cob Ash, Ordinary Portland Cement, Plasticizer, Compressive strength

I. INTRODUCTION

Corn is grown widely throughout the world. Perambalur, Ariyalur, Cuddalore, Dindigul and Tirupur are the major maize growing areas in Tamilnadu. The worldwide production is estimated to reach 979.02 million metric tons for 2014/2015. Corn cob is the hard thick cylindrical central core of maize and it is one of the main agricultural waste. Corncobs are collected from agricultural land were air-dried for one week. Then the collected samples are burnt into ash.

Two methods are used to burning the corn cob into ash such as open burning method burning by furnace method. Open burning method is the easy and simple method. In this method the samples were carefully collected to avoid mixing the corn cob with sand. The collected samples were then burnt into ash by open burning in metal container with temperatures reaching 560^0c .The burnt corn cob was then grounded separately use the material after cooling.The resulting ashes easily passed through the sieve with openings of IS 150 micron sieve. In furnace burning the corn cob broken into smaller particles and burnt into ashes in a locally fabricated furnace at temperatures generally below 700^0c.The idea of burning them in a furnace was dropped because it will be time

consuming and un economical for most people especially those at the rural areas.

II. LITERATURE REVIEW

Many researchers have already found that it is possible to use corn cob ash as a cement. Such as K.A Mujedu (2014) investigated the use of corn cob ash and saw dust ash as cement replacement in concrete works.This study is to help reduce the cost of concrete production arising from the rising cost of cement, and reduce the volume of solid waste generated from corn cob. Varied percentage of corn cob ash at 0%, 10%, 20%, 30%, 40% and 50% replaced cement in a mix of 1:2:4 concrete mixes. The compressive strength of concrete cubes increased as the days of curing increased and decreased with increasing ashes replacement. Kayode Oluborode (2015), This research investigates the corn cob ash (CCA) as effective constituent in self-compacting concrete. Varied percentage of corn cob ash at 0%, 10%, 20% and 30% replaced cement in a mix of 1:2:4 concrete with variable plasticizer admixture of SP430 at 0%, 1%, 2% and 3% replacement. The compressive strength of concrete increased in percentage replacement of 2%SP430 and 30% CCA meet the requirement of self compacting concrete. Raheem et.al (2010) investigated effects of admixtures on the properties of corn cob ash cement concrete. Adesanya and Raheem (2009) studied the workability and compressive strength characteristics of corn cob ash blended cement concrete.

S.No	Property	Value
1	Normal consistency	26%
2	Initial setting time	40 minutes
3	Final setting time	8 hours
4	Specific gravity	3.154
5	Fineness of cement(90 micron sieve)	3%

III. MATERIALS USED

The materials used for this project are Ordinary Portland Cement (OPC 53grade), Corn Cob Ash, Fine aggregate, Coarse aggregate (22mm gravel), Conplast SP430 (Plasticizer).

a. CEMENT : Cement can be defined as the bonding material. Ordinary Portland cement is one of the most widely used type of Portland cement. OPC 53 grade cement is used for this project. The values of properties of cement are shown in Table 1.

b. **FINE AGGREGATE:** River sand used as a fine aggregate. Material which are small to be passed on 4.75mm sieve size is called fine aggregates. The values of properties of fine aggregate are shown in Table 2.

Table 2: Physical properties of fine aggregate:

S.No	Property	Value
1	Specific gravity	2.60
2	Water absorption	1%
3	Bulking of sand	11.9%
4	Fineness modulus	2.558

c. **COARSE AGGREGATE:** Locally available coarse aggregate is used. Material which are large to be retained on 4.75mm sieve size is called coarse aggregates. Its maximum size up to 40mm is used for coarse aggregate in most structural applications, for this project 20mm size of coarse aggregate is used. The values of properties of coarse aggregate are shown in Table 3.

Table 3: Physical properties of coarse aggregate:

S.No	Property	Value
1	Specific gravity	2.60
2	Water absorption	0.50%
3	Fineness modulus	2.298

d. CORN COB ASH (CCA)

In this work Corn Cob Ash prepared by open burning method. Corn cobs collected from agricultural land were air dried for a week and then burnt into ash in a metal container. Sieve the burnt sample in 150 micron IS sieve after the sample was cooling. The values of properties of corn cob ash are shown in Table 4.

Table 4: Physical properties of corn cob ash:

Sl. No	Property	Value
1	Specific gravity	2.28
2	water absorption	0.75%
3	Fineness modulus	4.5%

e. SUPERPLASTICIZER: Conplast SP430 is used as plasticizer admixture. Conplast SP430 is highly efficient superplasticizer giving large increase in workability without change in compressive strength. It is supplied as a brown liquid stage. Conplast SP430 compiles with IS: 9103-1999 and BS: 5075 Part 3. It had a specific gravity of 1.20 to 1.21 at 30^0 C.

f. **WATER:** It is used for casting and curing of specimen.

IV. EXPERIMENTAL STUDY: Mix design M20 is used based on the properties of materials and according to with IS: 10262: 2009. The mix proportion is presented on Table 5.

Table 5: Mix-proportion

Water cement ratio	Cement	Fine aggregate	Coarse aggregate
0.42	1	1.16	2.58

a. COMPRESSIVE STRENGTH TEST

The concrete was mixed according to the mix design and cube is casted into the cube moulds of 150mmx150mmx150mm. Concrete in which cement is replaced with corn cob ash by 10%, 20% and 30% with and without superplasticizer at 2% is also mixed and casted. The compressive strength test was carried out on the specimen after 7, 28 and 60 days curing. The compressive strength values for CCA cement concrete without and with 2% SP are shown in Table 6& 7.

Table 6: Compressive strength values for CCA cement concrete

% of Corn cob ash used	7 days compressive strength in MPa	28 days compressive strength in MPa	60 days compressive strength in MPa
0%	19.55	24.44	26.67
10%	17.7	23.55	27.55
20%	15.5	16.8	20
30%	13.3	14.2	18.22

Table 7: Compressive strength values for CCA cement concrete with 2% SP

% of CCA used with 2% SP	7 days compressive strength in MPa	28 days compressive strength in MPa	60 days compressive strength in MPa
0%	19.11	25.33	27.11
10%	17.33	27.11	28
20%	14.67	17.78	26.67
30%	12.89	15.55	17.77

b. SPLIT TENSILE STRENGTH TEST

The concrete was mixed according to the mix design and cylinder is casted into the moulds of 200mmx100mm size. Concrete in which cement is replaced with corn cob ash by 10%, 20% and 30% with and without superplasticizer at 2% is also mixed and casted. The split tensile strength test was carried out on the specimen after 7, 28 and 60 days curing. . The tensile strength values for CCA cement concrete without and with 2% SP are shown in Table 8& 9.

Table 8: Tensile strength values for CCA cement concrete

% of CCA used	7 days Tensile Strength in MPa	28 days Tensile Strength in MPa	60 days Tensile Strength in MPa
0%	1.75	2.5	2.86
10%	0.95	2.38	3.02
20%	0.64	1.9	2.23
30%	0.5	1.59	1.91

Table 9: Tensile strength values for CCA cement concrete with 2% SP

% of CCA used with 2%SP	7 days Tensile Strength in MPa	28 days Tensile Strength in MPa	60 days Tensile Strength in MPa
0%	1.75	2.5	2.86
10%	0.95	2.38	3.02
20%	0.64	1.9	2.23
30%	0.5	1.59	1.91

c. FLEXURAL STRENGTH TEST

The concrete was mixed according to the mix design and prisms are casted into the moulds of 500mmx100mmx100mm size. Concrete in which cement is replaced with corn cob ash by 10%, 20% and 30% with and without superplasticizer at 2% is also mixed and casted. The flexural strength test was carried out on the specimen after 7, 28 and 60 days curing. The flexural strength values for CCA cement concrete without and with 2% SP are shown in Table 10& 11.

Table 10: Flexural strength values for CCA cement concrete

% of Corn cob ash used	7 days Flexural Strength in MPa	28 days Flexural Strength in MPa	60 days Flexural Strength in MPa
0%	3.18	4.17	4.90
10%	2.94	3.92	5.39
20%	2.69	3.67	4.90
30%	2.45	3.43	4.41

Table 11: Flexural strength values for CCA cement concrete with 2% SP

% of Corn cob ash used with 2% SP	7 days Flexural Strength in MPa	28 days Flexural Strength in MPa	60 days Flexural Strength in MPa
0%	3.18	4.41	5.39
10%	2.52	4.46	5.88
20%	2.45	4.41	5.64
30%	2.21	3.67	4.65

4. RESULT AND DISCUSSION

The above results are taken from the experimental investigation. All the values are the average of the three specimen tested. The graphical representation of the compressive strength, split tensile strength and flexural strength are shown in below.

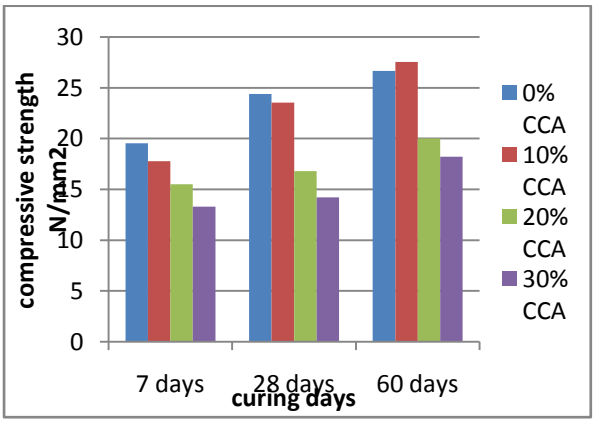

Fig.1 Compressive strength for CCA cement concrete

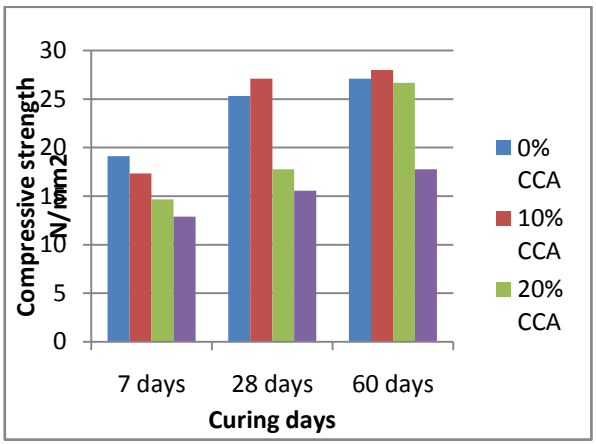

Fig .2 Compressive strength for CCA cement concrete with 2% SP

From fig 1&2, the compressive strength of the 10% CCA replacement concrete at 60 days is greater than the strength of the conventional concrete and it is also noted that, with the effect of 2% SP, the 28 days compressive strength of concrete 10% CCA replacement concrete is greater than the strength of the conventional concrete with SP. The compressive strength was increasing with respect to increase of curing days and decreasing with increase of CCA percentage.

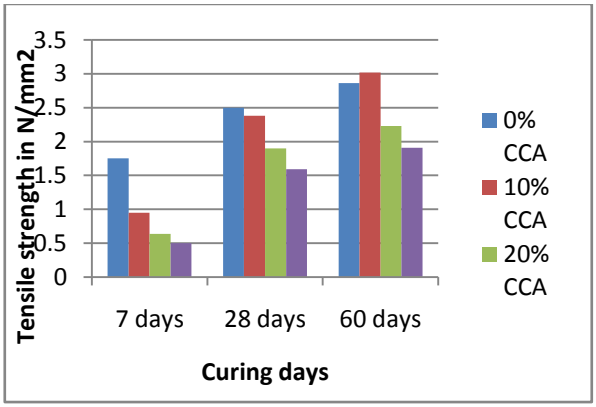

Fig. 3 Tensile strength for CCA cement concrete

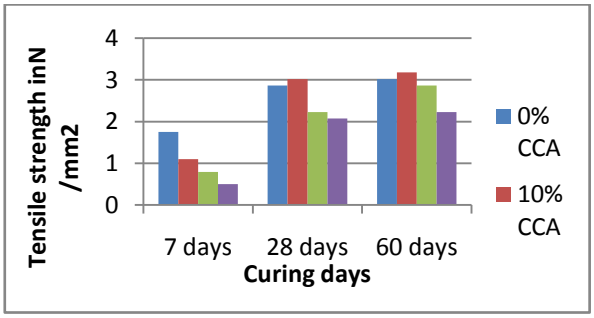

Fig.4 Tensile strength for CCA cement concrete with 2% SP

From fig 3&4, the tensile strength of the 10% CCA replacement concrete at 60 days is greater than the strength of the conventional concrete and it is also noted that, with the effect of 2% SP, the 28 days tensile strength of concrete 10% CCA replacement concrete is greater than the strength of the conventional concrete with SP. The tensile strength was increasing with respect to increase of curing days and decreasing with increase of CCA percentage.

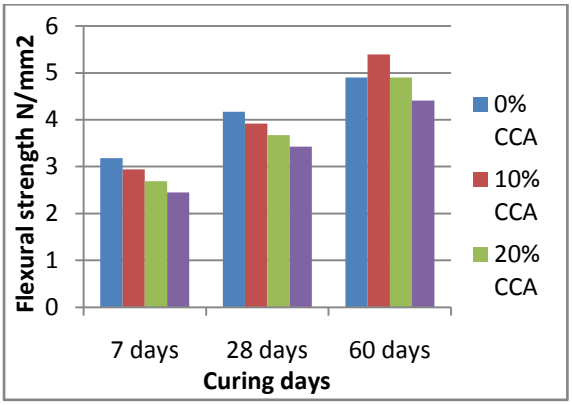

Fig.5 Flexural strength for CCA cement concrete

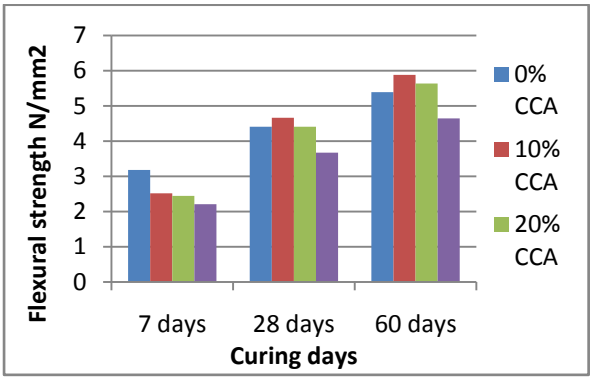

Fig.6 Flexural strength for CCA cement concrete with 2% SP

From fig 8&9, the flexural strength of the 10% CCA replacement concrete at 60 days is greater than the strength of the conventional concrete and it is also noted that, with the effect of 2% SP, the 28 days flexural strength of concrete 10% CCA replacement concrete is greater than the strength of the conventional concrete with SP. The flexural strength was increasing with respect to increase of curing days and decreasing with increase of CCA percentage.

4. CONCLUSION

From this result, the compressive strength of the 10% CCA replacement concrete at 60 days is 3.3% greater than the strength of the conventional concrete and it is also observed that, with the addition of 2% SP, the 28 days compressive strength of 10% CCA replacement concrete is 7% greater than the strength of the conventional concrete. The 10% CCA replacement concrete is more suitable for M20 concrete mix. While comparing all percentages of CCA replacement, the strength was increasing with respect to increase of curing days and decreasing with increase of CCA percentage. Workability of CCA concrete mix is decreased with the increase of CCA percentage, so it requires more water to make the mix more workable. Conplast SP430 was used to produce substantial water reduction which resulted in a considerable increase in the compressive strength.

V. REFERANCES

[1]. Mujedu K. A., Adebara S. A. and Lamidi L. O. (2014). "The Use of Corn Cob Ash and Saw Dust Ash as cement Replacement in concrete Works", The International Journal Of Engineering And Science, Vol.3, issue 4, pp.22-28.

[2]. Adesanya, D. A. and Raheem A. A. (2009a). ''A Study of the Workability and Compressive Strength Characteristics of Corn cob Ash Blended Cement Concrete'', Construction and Building Materials, Vol. 23, pp. 311 – 317.

[3]. Adesanya, D. A. and Raheem A. A. (2009b). ''Development of Corn cob Ash Blended Cement'', Construction and Building Materials, Vol. 23, pp. 347 – 352.

[4]. Adesanya, D. A. and Raheem A. A. (2010). ''A Study of the Permeability and acid attack of Corn cob Ash blended Cements'', Construction and Building Materials, Vol. 24, pp.403 – 409.

[5]. Olafusi, O. S. and Olutoge, F. A. (2012): ''Strength Properties of Corn Cob Ash Concrete'', A Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 3 (2), pp. 297 – 301.

[6]. Raheem, A. A. et al, (2011): "A study of thermal conductivity of corn cob ash blended cement mortar", The Pacific Journal of Science and Technology, Vol.12 No. 2, pp. 106 – 111.

[7]. Oladipupo, O. and O. Fetus, (2012): "Strength properties of corn cob ash concrete", J. Emerg. Trends Eng. Applied Sci., 3: 297-301.

[8]. Kayode Oluborode and Ilesanmi Olofintuyi (2015). "Self-Compacting Concrete: Strength Evaluation of Corn Cob Ash in a Blended Portland Cement", American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS) (2015) Volume 13, No 1, pp 123-131

[9]. Shetty M.S., Concrete Technology Theory and Practice, revised multi-colour edition. 2005, India:S.Chand & Company Ltd India.

[10]. American Standard for Testing Materials, Specification for fly ash and raw or calcium natural pozzolana for use as a mineral admixture in Portland cement concrete. ASTMC 2005, 618-78.

[11]. Indian standard code of practice for recommended guidelines for concrete mix design, IS: 10262- 1982.

[12]. IS 12269-2013, Ordinary Portland cement 53 grade specification.

[13]. IS: 2386-1963 Methods of aggregates for concrete.

[14]. IS: 456-2000, Plain and reinforced concrete code of practice.