Experimental Study on Partial Replacement of Cement by Coconut Pith Ash in Concrete

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Abstract: Sustainable development is the need of the hour, we have to take lead in initiating activities that would minimize the exploitation of our natural resources resulting in their effective utilization. With the increase in demands and need for infrastructural development, there is an urgent need to focus attention on low-cost alternative construction materials.This work presents the results of laboratory tests carried out using Coconut Pith Ash (CPA) as a partial re-placement for cement in concrete. Concrete cubes, cylinders & beams were casted and tested at curing ages of 7, 14 and 28 days using 5,10,15 and 20 as partial percent replacement levels. The slump test result shows that the workability of the concrete decreased as the CPA content increased. Results Showed that the Compressive, Split tensile and Flexural Strength of the CPA. Concrete attains its strength with curing age but the strength decreases with increasing percentage of coconut pith ash. The strength gained at 28 days for 5%, 10%, 15% and 20% are compared. The results reveal that we can replace the coconut pith ash by 10% to obtain the desired strength of M20 concrete

Keywords : CPA – Coconut pith ash

I. OBJECTIVE OF THE PRESENT INVESTIGATION

The Source of availability of ordinary cement is slowly reduced and limited. Our object is to use Coconut pith ash as partial replacement with cement in concrete. The environmental pollution and problems in by using cement can also be minimized when Coconut pith ash is used as a partial replacement material for concrete.

The work presented in this paper reports an investigation on the behavior of concrete produced from cement with CPA having various proportions with Portland Pozzalanoic Cement (PPC).

II. LITERATURE REVIEW

International Society of Thesis Publication published a paper on “Strength Properties of Coconut Fiber Ash Concrete”. In that paper it is clearly described that CFA contains reasonable quantities of elements such as silica, alumina and iron oxides found in Ordinary Portland Cement (OPC). The workability of fresh CFA concrete measured by the slump test reduces as the CFA content increases. Therefore CFA makes concrete to be less workable which in turn helps to control bleeding of concrete to avoid segregation of the ingredients of the concrete mix. The optimum compressive strength of 31.88N/mm2 was obtained at 10% re-placement at 60 days of age. The percentage strength at this optimum point to the control is 99.3%.
Felix F. Udoeyo andSanni A. Abubakar has studied the possibility of Maize – Cob ash filler in concrete. Based on this research, the following conclusions may be drawn the workability of fresh MCA concrete with a direct replacement of cement by the same mass of ash decreased with an increase in . The increased setting times of MCA concrete could be of advantage in mass concrete work where early heat evolution constitutes a problem. The compressive and split tensile strengths and modulus of rupture decreased with an increase in MCA content. All MCA concrete specimens, with the exception of samples with a 30% replacement level, attained at least 70% of their 28-day strength at seven-day curing.

A. M.S. Lekshmi and B.V.Subha Assistant Professor, Department of Civil Engineering, Toc H Institute of Science and Technology,Arakkuunnam,Ernakulam -682 313,Kerala,India has revealed the paper on “Sustainable Building Materials in Kerala – An Overview”. Investigations on the industrial use of banana fibre andpineapple leaf fibre, fibrous wastes from fruit plantations, are outlined. Future studies are required to be conducted on the prospects of using tapioca fibre as a natural fibre composite. Detailed exploration and research in the effective utilization of the above mentioned natural fibres would result in economical improvement and

eco friendly environment generation for the state of Kerala. Studies reveal that we have to put in lot of effort in utilizing our own locally available building materials for shapimg our own economy to the fullest extent.

III. MATERIALS AND METHODS

In this experimental work M20 grade of concrete has designed and Concrete cube, cylinder and prism were molded and it was tested on 7th, 14th and 28th day with proper curing. To find the mix design of concrete, material properties of Cement, Fine aggregate, Coarse aggregate and Coconut Pith ash were determined.

In this work locally available CPA were replaced with 0%, 5%, 10% , 20% with the cement and compressive strength of concrete cube were calculated, with 5%, 10%, 15% replacement, split tensile strength of concrete and with 0%, 5%, 10% replacement ,flexural strength of concrete prism were calculated

Chemical composition of coconut pith ash

Constituents	**Composition In Coconut Pith Ash (%)**	**Composition In Cement (%)**
SiO_2	14.34	21.36
AL_2O_3	35.61	5.24
Fe_2O_3	0.18	3.14
CaO	33.27	60.08
MgO	19.86	4.7
SO_3	0.004	2.25

Table 1

IV. FACTORS INFLUENCING ASH PROPERTIES

It is understood that CPA produced in uncontrolled condition may not be useful for any effective application. The factors influencing the ash properties are the incinerating condition (temperature & duration), rate of heating, geographical location, fineness, color and crop variety and crop year.

Comparing Test Results for Cement and Coconut Pith Ash

S.No	**Description**	**Cement**	**Cpa**
1.	Specific gravity	3.18	1.898
2.	Consistency	33%	56%
3.	Initial setting time	110 minutes	150 minutes

Table 2

Materials Required for Per m3

Description	***For Conventional***	**5% *Replacement***	**10 % *Replacement***	**15% *Replacement***	***20% Replacement***
Volume of water	191.6 lit	191.6 lit	191.6 lit	191.6 lit	191.6 lit

Weight of Cement	383 kg	363.85 kg	344.7 kg	325.55 kg	306.4kg
Weight of Fine Aggregate	523.01 kg	523.01 kg	523.01 kg	523.01 kg	523.01 kg
Weight of Coarse Aggregate	1219.6 kg	1219.6 kg	1219.6 kg	1219.6 kg	1219.6 kg
Weight of Coconut Pith Ash	--------	19.15 kg	38.3 kg	57.45 kg	76.6 kg

Table 3

V. RESULT AND DISCUSSIONS

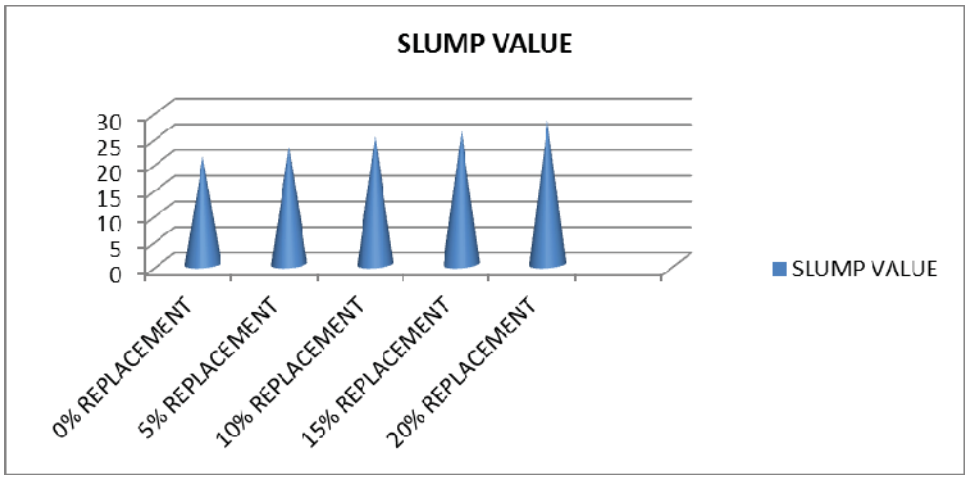

Fig 1

COMPRESSIVE STRENGTH ON VARIOUS PERCENTAGE OF CPA AND DAYS OF CURING

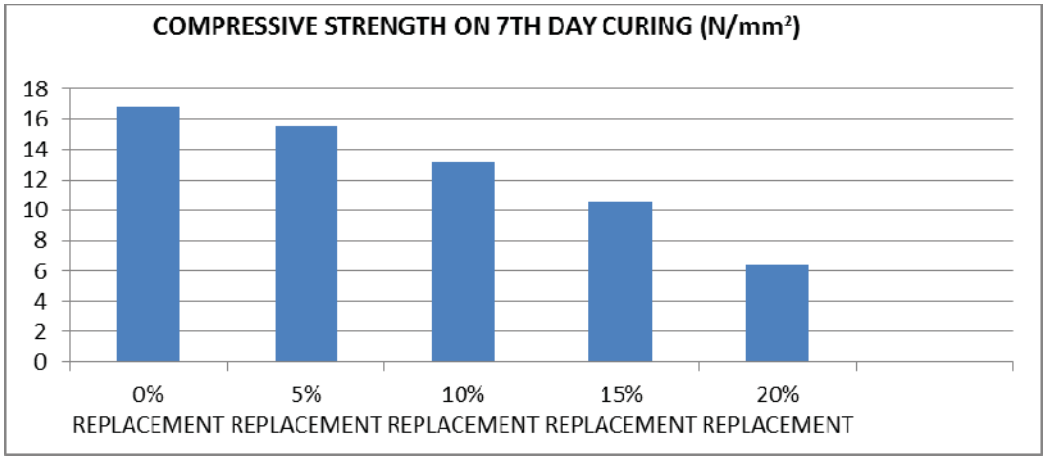

Fig 2

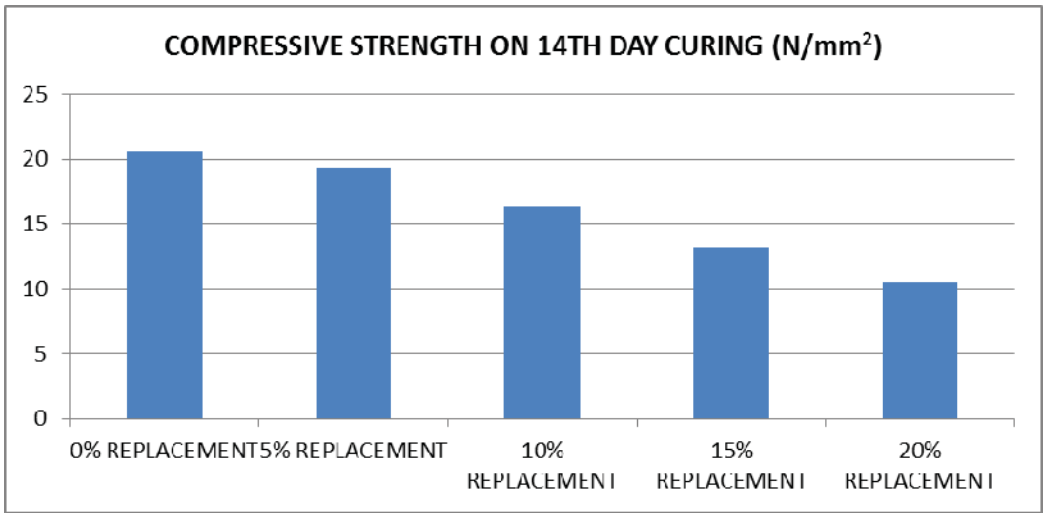

Fig 3

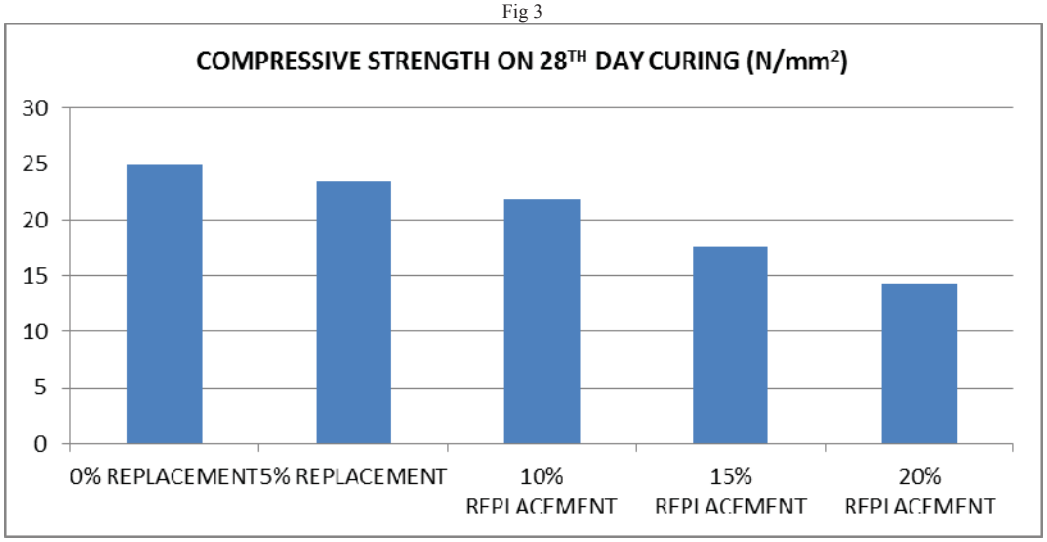

Fig 4

VI. COMPARISON OF THE COMPRESSIVE STRENGTH ON VARIOUS PERCENTAGE OF CPA AND AGE OF CURING

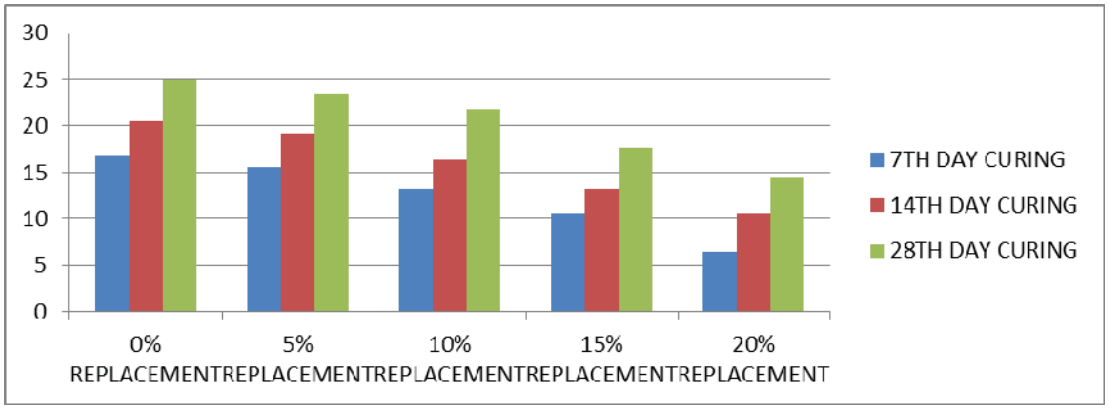

Fig 5

Split tensile strength of concrete

The tensile strength is one of the basic and important properties of the concrete. The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However, the determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack. The cracking is a form of tension failure.

Fig 6

Chart showing the variation of split tensile strength with days of curing

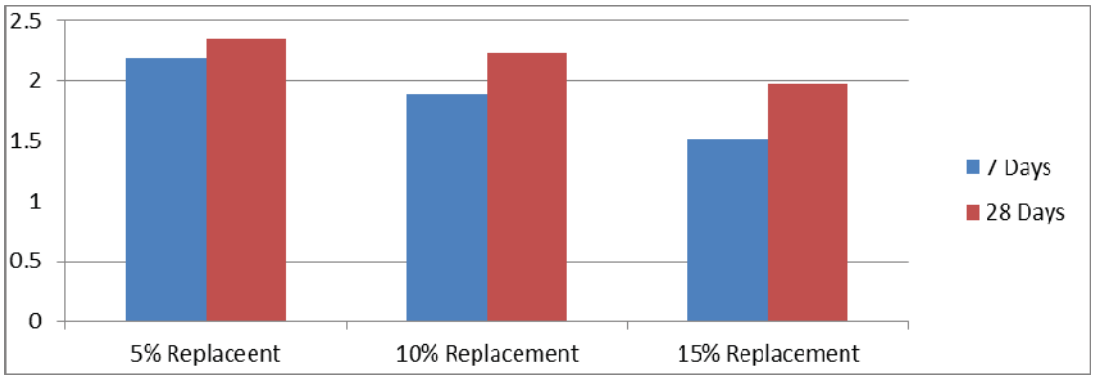

Fig 7

Flexural strength of concrete

Flexural strength, also known as modulus of rupture, bend strength, or fracture strength, a mechanical parameter for brittle material, is defined as a material's ability to resist deformation under load. The transverse bending test is most frequently employed, in which a specimen having either a circular or rectangular cross-section is bent until fracture or yielding using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture.

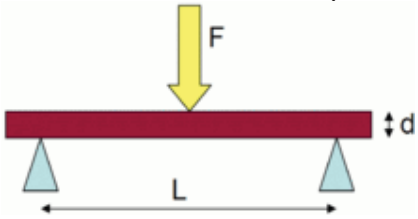

Fig 8 Flexural Strength of Concrete

Chart showing the variation of flexural strength

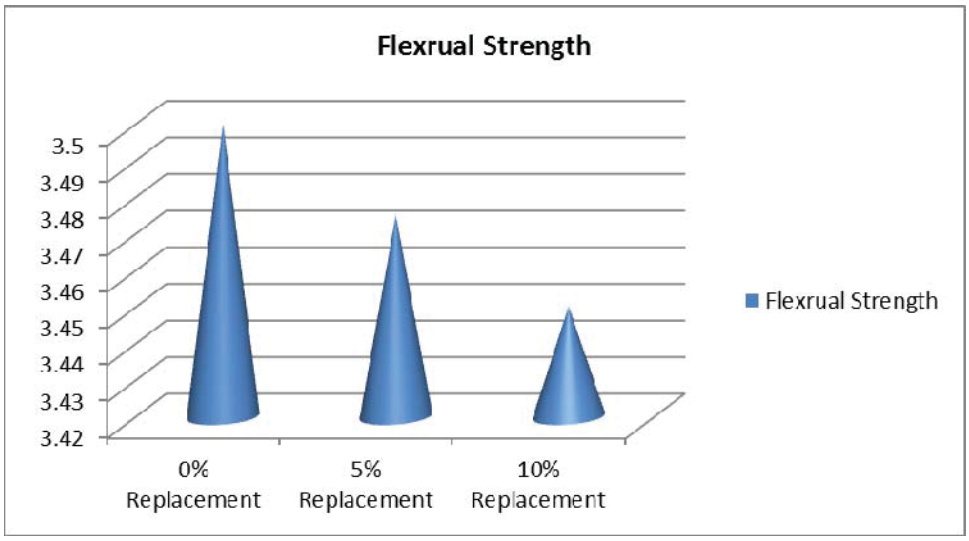

Fig 9

VII. CONCLUSION

- CPA contains reasonable quantities of elements such as silica, alumina and iron oxides found in Ordinary Portland Cement (OPC).
- The workability of fresh CPA concrete measured by the slump test reduces as the CPA content increases. Therefore CPA makes concrete to be less workable which in turn helps to control bleeding of concrete to avoid segregation of the ingredients of the concrete mix. This shows that CPA can be used effectively as supplementary cementitious material in concrete works.
- The maximum compressive strength of 23.54N/mm^2 was obtained at 5% replacement at 28 days of age. Although it is seen that we can replace the cement upto 10% to get the strength of M – 20 concrete.
- The Maximum split tensile strength of 2.35N/mm^2 was obtained at 5% replacement at 28 days of age.
- The Maximum flexural strength of 3.475 N/mm^2 was obtained at 5% replacement at 28 days of age
- Although it is seen that we can replace the cement up to 10% to get the desired strength of concrete.

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