Experimental Behaviour of Water Hyacinth Ash as Partial Replacement of Cement on Short Column

N.Balasundaram , V.Murugesh

Abstract - The present study on investigations of short column concrete under axial loading condition with the substitute for cement by water hyacinth ash (WHA). The strength of the column can be investigated with different proportions of cement replacement by 0% and 10%, of the cement weight for M30.WHA replacement increases to concrete it delays the setting time of concrete and also affect the potency of concrete. A total of five columns consisting of two conventional RCC columns, three RCC column with 10% replacement , was tested. The experimental result reveals that the optimal percentage of addition of WHA to the concrete was found to be 10% with respect to the weight of cement. Results show that WHA is used as a substitute cement substance in concrete.

Index terms: Short column, WHA, setting time, and compressive strength

I. INTRODUCTION

Over the last decades the various raw materials, or fibers were developed in the biased substitute for cement and used in the construction industries. The locally available materials from industrial, agricultural or domestic waste such as fly ash, silica fume, blast furnace slag, coconut shell, egg shell, etc. The exploration of innovative raw materials for the alternative to cement without affecting the properties of concrete. Plant extracted based materials has been used as a biased substitute for cement. Water hyacinth is found as unutilized supplementary cementitious material and entirely free from biomass .It grows widely and rapidly within two weeks. The Water hyacinth plant is normally found in a stagnated pool or lake. The plant length is 1.604 mm and diameter is 5.5 micron. water hyacinth ash in concrete is the new revolutionary concept of sustainable concrete. In this paper study have been carried to analyze the bio-waste as supplementary cementitious material[1].

The strength and deflection were decreasing linearly from increasing WHA content of concrete. Several studies carried out on testing reinforced concrete short columns with different mix proportions of WHA on concrete.

Fig.1 -Water Hyacinth At Coimbatore Lake

II. MATERIALS AND METHODS

Ordinary Portland cement 53 grade was adopted in this work. The nominal size of coarse aggregate is 20mm. The coarse aggregate was also tested for specific gravity, crushing strength, water absorption, etc. Normal river sand is used and tested for specific gravity, fineness as per IS383.

SPECIMEN	0%	10%
RCC COLUMN 100 x100 x600 mm	2no's	3no's
TOTAL	5 No's	

Water hyacinth plants were collected from the tagnant lake located at Coimbatore, Tamilnadu . The collected plants are well cleaned without debris and impurities[2]. Then the plants are dried for two weeks in the open atmosphere. After dry process, the samples are cut

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into small pieces using a table knife. The cut samples are grinded and

pulverized, using a milling machine. Then the samples are sieved out by means of 150μ. The collected samples were kept in oven under 800° c for 6 hours in order to change organic into inorganic substances.

Fig.2 Water Hyacinth Ash

Water hyacinth ash was also tested for various properties like specific gravity, fineness and water absorption, etc. The consistency of cement is carried out with and biased substitution of cement by WHA[3].

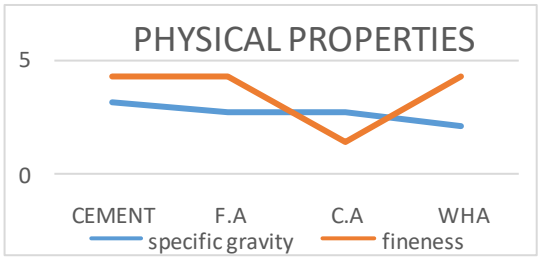

Fig.3 – Physical Properties of WHA

Setting time of cement can be tested for and substitute of cement by 0%, 10% and 20% of the WHA. From the investigation, it is noted that the WHA increases from cement content, which delays the final setting time of cement.

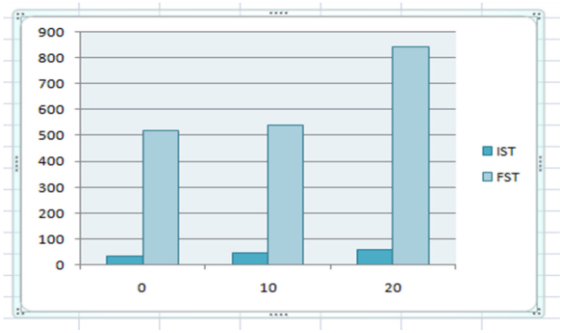

Fig.4 Setting time of cement

III. EXPERIMENTAL INVESTIGATION

a. *Concrete Mix Design*

Concrete mixes design was done as per IS 456:2000 and IS10262:2009 .The mix proportion of M30 was given below

TABLE.1 - MIX PROPORTION OF M30

SL.NO	MATERIAL	QUANTITY (kg/m^3)
1	Cement	413
2	Fine Aggregate	692
3	Coarse Aggregate	1178
4	Water	186
5	Water-Cement Ratio	0.45
	MIX PROPORTION	1:1.68:2.85:0.45

b. *Design of Column*

The columns are designed as per IS 456:2000 .As per the design 4 numbers of 12 mm diameter bars and 8mm diameter bars are used as transverse reinforcement.

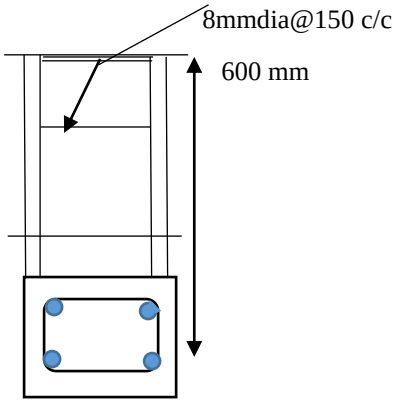

Fig. 5 –Column Reinforcement Details

c. *Test Specimen Details*

An experimental investigation has been carried out to study the behaviour of short column having 100 x 100 x 600 mm sizes of M30 mixes and replacement of cement by WHA (0% and 10%).

From this investigation, the columns are tested and obtain the optimum dosage of WHA in concrete. Several trials were done by compression test, and split tensile strength[4].

d. *Test Setup*

A Short column was tested on a universal testing machine. The five columns are cast as per mix design with different proportions. It is placed in a curing tank for 28 days.The specimens are dried and whitewash for the visibility of cracks. Then the specimen is placed on the UTM as shown in fig.7. The load was applied until the failure occurs. By gradually increasing to load ,the deflection of the column is noted at regular intervals[5].

First crack is noted on the specimen for the corresponding load. Finally the ultimate load and corresponding deflection was noted. Few trials are done for different proportions of the column.

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Fig. 6 - Universal Testing Machine

Fig. -7 - Universal Testing Machine With Specimen

Fig. 8 - Universal Testing Machine Test

Finally, the initial crack and ultimate load of the short columns are plotted. The ultimate loads are plotted on a graph and compared with the conventional concrete[6].

e. Load-Deflection Behaviour

The specimens are tested until the failure took place. The specimens are axially loaded into UTM. The dial gauge seats at the side of the column for deflection purpose. The parameters such as initial cracking load, ultimate load and deflection of specimens are noted. First crack on the surface of the specimen are noted and marked. The deflection is noted for every 5 kN for the applied load. The load and deflection of all specimens are noted. The compression strength of replacing column (10%) shows better result than conventional concrete. It was observed that the addition of 10% of WHA improves the performance of the column, when compared to conventional column[7].

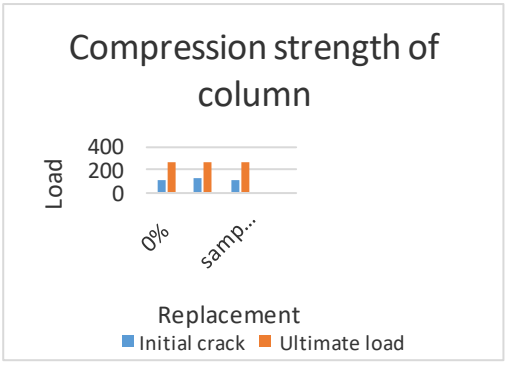


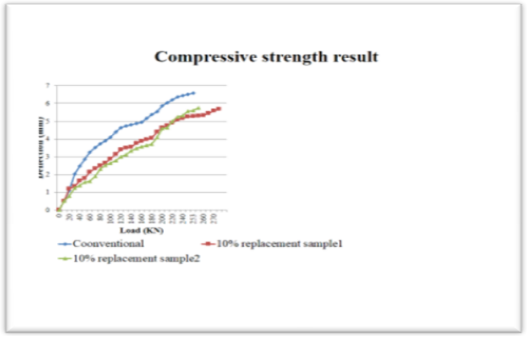
Fig. 9 – Compressive Strength of Column

IV. CONCLUSION

The results shows the effectiveness of using WHA for the partial replacement of cement in concrete. Based on the investigation, the following conclusion is drawn

- The setting time of concrete delayed due to addition of WHA in concrete.
- The compression strength of short column increases by 10% replacement of WHA than conventional concrete. Further addition of WHA will reduce the potency of concrete
- For the investigation ,WHA is used as a biased substitute of cement has dual benefit of cost disposal and decrease in the manufacturing cost[8].
  Fig.10- Compressive Strength Result
- Addition of WHA in RCC short column results in an increase in ultimate buckling load for 10% of WHA replacement of cement

For higher replacement of WHA in cement, the compressive strength and split tensile strength gets decrease[9].



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