Study on Self Compaction Concrete by Partial Replacement of Fine Aggregate with Corn Cob

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Abstract— Concrete is a mixture of cement, fine aggregate and coarse aggregate, which is mainly derived from natural resources. Increasing population, expanding urbanization, climbing way of life due to technological innovations has demanded a huge amount of natural resources in the construction industry, which has resulted in scarcity of resources. This scarcity motivates the researchers to use, solid wastes generated by industrial, mining, domestic and agricultural activities. High demand of natural resources due to rapid urbanization and the disposal problem of agricultural wastes in developed countries have created opportunities for use of agro-waste in the construction industry. This project reviews one of the agro-waste materials, which are used as a partial replacement of fine aggregate in concrete. Different properties of fresh and hardened concrete and their durability when admixed with agro-wastes are reviewed. Agro-waste used in self-compacting concrete and conventional concrete are also reviewed and their properties are compared. Strength tests were studied among compressive strength, tensile strength of agro-waste concrete.

Key words: Agro-Waste Concrete; Agricultural Waste; Fine Aggregate

I. INTRODUCTION

Cement concrete is the most widely used building material due to its satiating performance in strength requirements and its ability to be moulded into a variety of shapes and sizes. Construction works globally is increasing at frightening rate with substantial consumption of cement in large proportion, hence the need for full or partial replacement of cement.

Self-compacting concrete (SCC) was first developed to increase concrete usage by engineers in Japan in the early 1980s with the introduction of conventional super-plasticizers to create highly fluid concrete, while also using viscosity-modifying admixtures (VMA), which increased plastic viscosity thus preventing segregation up to a level of fluidity that would normally cause segregation.

SCC is defined as a highly flowable, yet stable concrete that can spread readily into place and fill the formwork without any consolidation and without undergoing any significant segregation.

Corn-cob ash has been proven to be a good substitute of fine aggregate by different researchers up to a percentage of 10%, while investigated effects of admixtures on the properties of corn cob ash cement concrete and they concluded that admixtures generally improve the workability of corn cob ash cement concrete and the greatest effect was caused by plasticizer which improves the flow properties of the mix by dispersing the cement particles and breaking up cement agglomerate and the incorporation of admixtures in corn cob ash cement concrete generally increases its compressive strength at all ages irrespective of the type used.

II. LITERATURE REVIEW

Corn is the most widely planted crop in the world. A hard cylindrical central core of maize is called as Corn cob (on which are borne the kernels or grains of an ear of corn). From the data revealed by Food and Agriculture Organization (FAO), nearly 589 million tons of maize is being produced worldwide in the year 2000 (FAO Records; 2002). Corncob is a readily available energy producer as biomass, but it can be harmful, when proper disposal method is not adopted and pollutes the environment. Typically, corncob is commonly used as animal feed and in some cases as alternate fuel for energy generation.

There had been several research work has been carried out on the use of corn cob ash (CCA) as a pozzolanic material as a partial replacement of constuient materials used in manufacturing of blended cement concrete.

Ogunfolami reported that mixing of the CCA as a partial replacement with Ordinary Portland Cement can be carried out at the point of need i. e. on site.

Adesanya and Raheem studied the use of CCA blended cement produced in the controlled circumstances. The studies revealed that the compressive strength properties of the CCA-blended cement concrete is less than that of sample made with plain concrete at early curing ages but significant improvement is noticed at later ages (after 90 days).Thus, there is necessary to look for ways to improve the strength characters during early ages. Raheem et al. concluded that the addition of admixtures in corn cob ash cement concrete increases compressive strength character at short term and long term curing periods irrespective of the type of binding materials used. There is a chances of increase in strength can be achieved at early ages by using accelerators. With Plasticizer, high strength can be achieved at both short term and long term curing periods while with Water reducing agents and retarder, greater strength can be achieved at long term only.

Adesanya and Raheem investigated that increase in percentage of CCA in cement makes decrease in lime saturation factor (LSF). At a 25% replacement level of Corncob Ash (CCA) into OPC results in decrease of LSF from 92 to 72 with . from the results of Antonio et. al. up to 10% CCA replacement in cement production is more appropriate without compromising the structural virtue of OPC. In addition, it was found that the fresh and hardened properties of the resulting concrete can also improved with addition of CCA to the mixtures. Furthermore, it was shown that the substitution of 10% CCA in cement can lead to measurable reduction in thermal conductivity of the mix.

Ettu et al. experimented that the short term compressive strength results of OPC-CCA duple mingle

cement concrete were found to be much lesser than the values obtained for the control samples; at the age of 50 days strengths were equivalent to the control values; while for 90 days curing period strengths values were higher than the control specimen values exclusively at 5-15% replacement level of OPC with CCA, ranges from 24.00N/mm2 for 15% replacement of OPC with CCA to 27.00N/mm2 for 5% replacement of OPC with CCA when compared with the control sample value of 23.60N/mm2. From the above result a conclusion can be drawn that binary blended cement composites produce from OPC-CCA can be hold good for civil engineering constructions.

III. Experimental Procedure

Fifteen controls mixes with partial replacement of corn cob with fine aggregate were prepared. In all one hundred and thirty five cube samples of self-compacting concrete with three different weight percentages of corn cob (0%, 10%, 20%) were cast to study the effect on compressive strength at 14,28,56 days. The various followability tests on SCC are stipulated as per standards mentioned in EFNARC.

IV. Results

A. Fresh properties:

The following are the results obtained in various laboratory tests carried out in this study:

Mix no.	Cement (kg)	W/c ratio	C.A (Kg)	F.A (Kg)	corn cob(Kg)	% corn cob	Water (liters)	Extra water
1	340	0.4	1111	768	-	-	178	18.93
2	340	0.4	1111	768	46.33	10	190.3	18.52
3	340	0.4	1111	768	93.66	20	201	18.14

Table 1: Slump flow test results

Mix No.	% corn cob by Wt. of Cement	Slump Flow Test (in sec.)			Spread Diameter in mm
		300 mm	500 mm	700 mm	
1	10	1	2.8	7.2	
2	20	1	3	7.5	
3	10	0.85	1	5	
4	20	1	3	7	
5	10	1	3	4	
6	20	0.8	2	5	

Table 2: L-box and J-Box test results

Mix no.	% corn cob by wt. of Cement	L BOX TEST	J BOX TEST
		H_2/H_1	Time in sec.
1	10	0.87	7.6
2	20	1	9
3	10	0.91	9.4
4	20	0.90	10
5	10	0.92	9.1
6	20	1	11

Table 3: Compressive Strength Results at 28 days

Mix no.	% corn cob by wt. of binder	Compressive Strength of Cube (MPa)	
		14 Days	28 Days
1	10	24.40	32.34
2	20	24.00	33.45
3	10	22.00	34.53
4	20	25.60	35.65
5	10	22.72	32.27
6	20	22.64	35.92

V. Conclusion & Future Scope

A. Conclusion

On the basis of available information, general conclusions derived from experimentation for studying the effects of corn cob on self compacting concrete from the present study are stated. The new IS: 10262:2009 code preamble was used for mix proportioning of corn comb induced SCC. The following conclusions are arrived at on the basis of present investigation.

1) Slight bleeding was observed in all the trial mixes which get reduced after using VMA.
2) Better cohesive mix was observed when water to binder ratio was 0.36 and dose of HRWR and inbuilt VMA was 2.2% by weight of cement
3) The effect of partially replacing fine aggregate with varying percentage of corn cob enhances the cohesiveness of SCCs mixes. Further it can be concluded that for a given flowability, however smaller quantity of water is required in case of agro wastes with high fineness and low carbon content.
4) Compressive strength showed improved results when water to binder ratio was .36 and dose of HRWR and in built VMA was 2.2% by weight of cement.
5) When corn replacement with Fine aggregate was 20 percent the compressive strength increase by about 7% as compared to 10% replacement of corn cob by weight of fine aggregate.

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