Experimental Investigation on Self Compaction Concrete by Partial Replacement of Cement with Ground Nut Ash & Fly Ash

P. Vinod Kumar[1] V. Bhargavi[2]
PG Student [2]Assistant Professor
[1,2]Department of Computer Engineering
[1,2]Visakha Technical Campus, Visakhapatnam, Andhra Pradesh, India

Abstract— Self-Compaction Concrete is a mixture of cement, fine aggregate and coarse aggregate, which is mainly derived from natural resources along with addition of superplasticizers to increase the flowability of concrete. 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. India is facing a serious challenge in disposing the waste in landfills throughout the country. The landfill disposal is resulting in high disposal costs and potential environmental problems. If current trend continues, waste production will grow by 5% each year, which will ultimately result in saturated capacity of landfills by 2020. This project reports on the results of an investigation of utilization of ground nut ash as additional material in concrete mixes to be used for housing projects, for which it must be assured that the resulting concrete has the proper strength, beyond to the addition of Ground nut ash fly ash was also considered as 10% for all mixes. Concrete mixes containing various contents of the Ground nut ash and fly ash were prepared and basic characteristics such as Flowability tests, compressive strength, and split tensile strength were determined. Four concrete mixes with 0%, 10%, 20%, 30% and 40% of ground nut ash and fly ash as an additional material to the concrete were prepared for M-30 concrete.

Key words: Compressive Strength, Flowability, Fly Ash, Ground Nut Ash, Self-Compaction

I. INTRODUCTION

Self-compacting concrete (SCC) has high flow ability and cohesive properties as required. It spread and consolidate readily into place (i.e. due to low viscosity) through and around the narrow space/ congested/ dense reinforcement under self-weight. It fills formwork without external vibration or some time little vibration, without segregation and bleeding. In case of Normally Vibrated Concrete (NVC) there is a problem with regard to satisfactory compaction in areas of congested reinforcement. The poring capacity and stability of SCC can be defined by four key parameters: flow ability, passing ability, viscosity and segregation resistance. The basic difference among SCC and Normally Vibrated Concrete (NVC) is the inclusion of a filler material. Further, NVC tends to present a problem with regard to sufficient compaction in thin sections of congested reinforcement. The substitution of cement by supplementary cementitious materials such as mineral admixtures partially introduced favorable behavior with respect to above-mentioned defects and incidentally reduces the cost. The materials that are commonly used are fly ash, GGBS, silica fume, rice hunk ash. The use of such materials not only improves the properties of fresh concrete but also enhances the long-term durability characteristics. In this study an effect of fly ash on flowability and strength characteristic of SCC at different water cement and different water binder ratio have been studied.

II. LITERATURE REVIEW

T.C. Nwofor and S. Sule (2015) this study investigates the use of considerable volume of groundnut shell ash as the partial replacement for cement in concrete production. A total of 100 specimens of the GSA/OPC concrete was cured in cubes of 100mm dimension for 7, 14, 21 and 28 days and the compressive strength and density determined. The percentage replacement of Ordinary Portland Cement (OPC) varies to the control (0% replacement) about 40%. The results generally show a decrease in density and compressive strength as the percentage replacement with GSA increases suggesting less hydration with cement. Based on a general analysis of the results as well as the logical comparison to the acceptable standard, a percentage replacement of 10% is suggested for sustainable construction, especially in mass concrete constructions.

Tambichik (2014) this study on Green Concrete (GC) is defined as a concrete that utilize a waste material for at least one of its components. The production of GC has been increasing due to the drawback of conventional concrete that create many environmental problems. In Malaysia, the amount of waste generates from agricultural and construction industries were increasing every year. Hence, one of the solutions to reduce the impact of conventional concrete and limited landfill spaces due to excessive waste is by utilizing it in concrete. This paper reviews the possible use of construction waste (Recycle Concrete Aggregate) and agricultural waste (Palm Oil Fuel Ash, Rice Husk Ash and Palm Oil Fibre) as partial replacement for the basic material in a concrete to produce an innovative Green Concrete. The optimum replacement level for each type of waste was also been review. Green Concrete also has the potential to reduce environmental pollution and solve the depletion of natural sources. The result from this review shows that the addition of agricultural waste or construction waste in concrete indicate positive and satisfactory strength when compared to normal concrete. Finally, a mass production of Green Concrete can fulfil the Construction Industry Transformation Plan (CITP) 2016-2020 made by CIDB that emphasizes on a construction system which is environmentally sustainable

Raja Kumar, Meenambal (2014) studied that the CBR values increased up to addition of 12%Coal ash +12%Groundnutshell ash,16%Coal ash + 16%Bagasse ash and 16%Bagasse ash + 16% Groundnut shell ash and decreased with further increase in Coal ash, Bagasse ash and Groundnut shell ash content. The percentage increase in the unconfined compressive strength value is 104.76%, 97.62% and 107.94% for respective combinations under light compaction.

Groundnut shell can be found in large quantities as agricultural farm waste in Nigeria, producing up to 2.699 million metric tons per year (Sada et al., 2013). Groundnut shell was first planted in South Africa mainly Brazil and later spread to other part of America, Asia, and northwestern Argentina (Tata et al., 2015). The outer part of groundnut is called groundnut shell. Over a period of years, it is treated as a solid waste. Utilization of groundnut shell in the construction industry is expected to solve the pollution problem and increase the economic base of farmers, which encourage them to increase the production (Sada et al., 2013). Groundnut shell is already used for developing roof texture. It should be crushed properly as per the code requirement prior to use in concrete.

III. Experimental Procedure

Ten controls mixes with partial replacement of ground nut & fly ash with cement were prepared. In all fourty five cube samples of self-compacting concrete with five different weight percentages of fly ash (0%, 10%, 20%, 30% and 40%) were cast to study the effect on compressive strength at 14, 28 days. The various flowability tests on SCC are stipulated as per standards mentioned in EFNARC.

To achieve the desirable properties likes flowability chemical admixture (HRWR AND VMA) was also used. The Indian standard mixed proportioning guide line as mentioned in IS 10262:2009 has been used for mix proportioning.

The various flowability tests on SCC are stipulated as per standards mentioned in EFNARC. The experimental investigation and the test procedure adopted to study the performance of fly ash induced self-compacting concrete with crumb rubber as a partial replacement material is now described in detail.

Mix no.	Cement (kg)	Ground nut ash	Fly Ash (Kg) 10%	% GNA	W/c ratio	Water binder ratio	F.A (Kg)	C.A (Kg)	Water (liters)	Extra water
1	454	-	-	-	0.35	-	810	1242	140	18.93
2	409	45.4	45.4	10	0.42	0.38	810	1242	171	18.52
3	363	90.8	45.4	20	0.46	0.38	810	1242	166	18.14
4	318	136.2	45.4	30	0.52	0.38	810	1242	165	18.46
5	273	181.6	45.4	40	0.57	0.38	810	1242	155	18.31

Table 1: Mix Proportion

IV. Results

A. Fresh Properties

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

Mix No.	% of GNA+FA by Weight of Binder	SLUMP FLOW TEST (time in sec)		
		300 mm	500 mm	700 mm
1	10	0.5	1.8	10.94
2	20	1	1.5	12
3	30	0.5	1	5
4	40	-	1	2

Table 2: Slump Flow Test Results

Mix no.	% GNA+ Fly ash by Wt. of binder	L BOX TEST	J BOX TEST
		H2/H1	Time in sec.
1	0	0.872	8
2	10	0.78	11
3	20	0.96	8
4	30	0.95	8
5	40	0.87	16

Table.3.L-box and J-Box Test Results

Mix no.	%GNA + Fly ash by wt. of Cement	Compressive Strength (MPa)	
		14 Days	28 Days.
1	0	33.90	39.82
2	10	35.10	42.15
3	20	33.50	41.42
4	30	34.77	40.82
5	40	36.72	42.96

Table 4: Compressive Strength Results at 14 & 28 days

Mix no.	% Ground nut ash by wt. of binder	Split Tensile Strength of Cube (MPa) 28 Days	
		W/B = 0.38	W/B = 0.36
1	10	4	4
2	20	4.8	4.6
3	30	4.2	4
4	40	4.4	4.3

Table 5: Split Tensile Results at 28 days for Cylinders

V. Conclusion & Future Scope

A. Conclusion

On the basis of available information, general conclusions derived from experimentation for studying the effects of fly ash on self-compacting concrete from the present study are stated. The new IS: 10262:2009 code preamble was used for mix proportioning of fly ash 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 cement with varying percentage of Ground nut ash and fly ash enhances the cohesiveness of SCCs mixes because of the oxide contents present in ground nut ash. Further it can be concluded that for a given flowability, however smaller quantity of water is required in case of fly ashes 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 Ground nut ash replacement with cement was 20 percent the compressive strength increased by about 7% as compared to 30% replacement of fly ash by weight of cement.
6) The compressive and split tensile strength increase is nominal at 40% replacement of ground nut ash and fly ash as compared to 20% replacement of ground nut ash

and fly ash by weight of cement i.e. the strength decreases by about 3% as compared to 30% replacement of ground nut ash fly ash with cement.

B. Future Scope

A rational mix proportioning of SCC procedure may be laid in accordance with IS: 10262 2009 guidelines for concrete mix proportioning.

The cementing co-efficient factor for the Ground nut ash and fly ash may be used for adjustment in water/cement ratio. In the present work the cementing coefficient factor for ground nut ash and fly ash was taken up to 0.5. A further study should be carried out at different cementing co-efficient of ground nut ash and fly ash.

REFERENCES

[1] Experimental Investigation on Self Compacting Concrete Using Ground nut ash, Sada, K.S. Johnsirani*, Dr. A. Jagannathan**, R. Dinesh Kumar***, International Journal of Scientific and Research Publications, Volume 3, Issue 6, June 2013 1 ISSN 2250-3153
[2] Experimental Investigation on Self Compacting Concrete by Partial Replacement of peanut ash and Quarry Dust, Tata Rao, M. Pavan Kumar, International Journal of Innovative Research in Science, Engineering and Technology, Vol. 5, Issue 5, May 2015
[3] Experimental Investigations on Partial Replacement of Cement with Fly Ash In Design Mix Concrete T.C. Nowofor, Prof. Jayesh Kumar Pitroda, Dr. L.B. Zala, Dr.F.S. Umrigar, International Journal of Advanced Engineering Technology E-ISSN 0976-3945,2015
[4] IS: 3812-2003, "Specifications for Pulverized fuel ash", Bureau of Indian Standards, New Delhi, India.
[5] IS: 8112-1989, "Specifications for 43 grade Portland cement", Bureau of Indian Standards, New Delhi, India.
[6] IS: 383-1970, "Specifications for Coarse and Fine aggregates from Natural sources for Concrete", Bureau of Indian Standards, New Delhi, India.
[7] American Concrete Institute. " Self-Consolidating Concrete", ACI 237R-07.
[8] American Society for Testing and Materials." Standard specification for coal fly ash and raw or calcined natural pozzolan for use in Concrete", ASTM C 618 (2003).
[9] Bureau of Indian Standards." Plain and reinforced concrete code for practice", IS-456 (2000), New Delhi.
[10] EFNARC (European Federation of national trade associations representing producers and applicators of specialist building products), "Specification and Guidelines for self- compacting concrete", February 2002, Hampshire, U.K.
[11] EFNARC." Specification and guidelines for self-compacting concrete". European Federation of Producers and Applicators of Specialist Products for Structures, 2002
[12] Goodier," Development of self-compacting concrete", Proceedings of the Institution of Civil Engineers, Nov 2003, Issue SB4, PP 405- 414.
[13] Multicausal et-al," Effect of Mineral Admixtures on Properties of Scc", Cement & Concrete Composites 33, 12 April 2011, PP 771- 776 Int.
[14] Experimental Investigation on Self Compacting Concrete by Partial Replacement of Fine Aggregate with Quarry Dust and Cement with Fly Ash
[15] Experimental Investigation On Self Compacting Concrete Using Cement Kiln Dust, Prof. Shriram H. Mahure *, Mayur B. Vanjare **
[16] Experimental Investigation on Self-Compacting Concrete using Fly Ash, Jaganathaperumal. T
[17] IS: 456:2000: PLAIN & REINFORCED CONCRETE
[18] IS 10262:2009: CODE FOR MIX DESIGN

