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Experimental Study of Self Compacting Concrete made With GGBS and RHA under Axial Compression and Flexure

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***Abstract*— Self compacting concrete can be considered as the greatest technical advancement and most revolutionary development in concrete technology over the years at least 1980 till today. ''Self compacting concrete (SCC) is concrete which flows under its own weight without any segregation and maintaining its homogeneity, also flow through all shapes and obstruction and needing no vibrations for compaction (self compacting)''. Thus the main requirements of SCC are flow ability, filling ability; self compacting without segregation .it can be achieved by proper mix design, which can be more appropriate stated as proportioning of various compacting of the concrete. Due to industrialization there is huge amount of rice husk ash and ground granulated blast furnace slag created. Both are cheaper and easily available can be use as admixture in self compacting concrete.**

***Keywords*: Rice Husk Ash, GGBS (Ground Granulated Blast Furnace Slag)**

I. Introduction

More than hundred papers are reviewed and presented in the main thesis, out of which few important reports have been presented. Self compacting concrete was developed at first in Japan by Prof.Okamura [6] of Kochi university of Technology in 1986. Studies to develop SCC and its workability have been carried out by Ozawa & Maekawa at the University of Tokyo. Research scholars all over the globe have reported the need of admixtures in SCC. H.Okamura & M. Ouchi (1997) [7] have investigated the effect of superplasticiser on the balance between flowability and viscosity of mortar in SCC. K.Ganesh Babu and V. Sree Rama Kumar (2000) [3] quantified the 28-day cementitious efficiency of ground granulated blast furnace slag (GGBS) in concrete at the various replacement levels. Nan Su et al (2001) [5], Okamura H (2003) [6] and EFNARC guidelines (2002 & 2005)[11] have proposed the mix design methods for SCC using different mineral admixtures. Many investigators have reported the use of fly ash, GGBS etc. as filler materials in SCC. Suresh Babu. T (2009)[10] has studied elaborately about stress-strain behavior of SCC and GFRCC with different admixtures. Mehta P.K (1977)[4], Seshagiri Rao M.V (1999)[12], Rama Rao G.V (2004)[9] have reported the effective use of RHA as an admixture to improve the strength characteristics. Papworth (1994) [8], D.R. Seshu (2003)[2] have presented models for the stress-strain behaviour of conventional, fibre reinforced and steel fibre reinforced self compacting concrete mixes respectively. Annie Peter (2007)[1] have reported the flexural behaviour of steel fiber reinforced SCC.

II. EXPERIMENTAL PROGRAMME

In order to achieve the fresh and hardened properties of self compacting, numbers of cubes, cylinders and beam were casted with three different mixes of M30, M40, and M60. The cement, sand and coarse aggregates were weighed according to the mix proportion as per EFNARC Guideline. To this dry mix the required quantity of GGBS (**Alccofine1206)** and RHA was added and homogenously mixed. The viscosity modifying agent (VMA) was added at the rate of cementations material.

Cement:

Ordinary Portland cement of 43 grades from single lot was used in this investigation. It was fresh and without lumps. All tests on cement were conducted, as per procedure laid down in code IS: 8112-1989

Fine Aggregates

The sand used for the experimental programmed was locally procured and confirmed to Indian standard IS: 383-1970. Properties of the fine aggregate used in the experimental work. The aggregates were sieved through a set of sieves to obtain sieve analysis. The fine aggregates belonged to grading zone II.

Coarse aggregates

Two types of aggregate with different sizes have been used in this study. **CA - I** aggregate passing 20 mm sieve and retained on 12 sieves, CA **- II** Aggregate passing 10 mm sieve and retained on 6mm The percentage contributions of aggregates have been taken as 50% CA - I and 50% CA - II for proportioning of the concrete mix. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. The aggregates were tested as per IS: 383-1970

Ground Granulated blast Furnace slag

Ground granulated blast furnace slag (GGBS) is a byproduct from the blast furnace used to make iron. These operate at a temperature of about 1500 degrees centigrade and are fed with a carefully controlled mixture of iron-ore, coke and limestone. **ALCCOFINE 1206** is a specially processed product based on slag of high glass content with high reactivity obtained through the process of controlled granulation are used in this investigation. The raw materials are composed primary of low calcium silicates.

Rice Husk Ash

RHA resulting from the burning of rice husks at control temperatures have physical and chemical properties that meet ASTM (American Society for Testing and Materials) Standard C 618-94a. At burning temperatures of 550 ^{0}C – 800 ^{0}C, amorphous silica is formed, but at higher temperatures crystalline silica is produced. The silica content is between 90 and 96%. Due to industrialization there is huge amount of rice husk is Available and is used in this investigation.

III. TEST PROCEDURE

In this thesis work, numbers of cubes, cylinders and beam were casted with three different mixes. For compressive strength assessment, cubes of size 150mmX150mmX150mmn were prepared. For tensile strength assessment, cylinders of diameter 150mm and length 300mm were prepared. Indirect tension test (Brazilian test or split tensile test), was carried on these cylindrical specimens. For flexural strength assessment, the beams of size 100mmX100mmX500mm were prepared and two points loading on an effective span of 400mm was adopted After 28 days of curing the specimens were tested for their respectively strengths.

Table 1 SCC mixes with GGBS and RHA

S.No	Mix	Cement kg.	C.A kg	F.A kg	RHA kg*	GGBS kg	Water kg	S.P %	VMA %
1	M30	280	780	844	3.60*	116.40	180	0.68	0.07
2	M40	350	800	800	4.50*	145.50	190	0.84	0.08
3	M60	450	660	810	30**	150	190	0.98	0.01

Table 2 Fresh Properties of SCC with GGBS and RHA

MIX	Fresh properties				
	Slump Test		V Funnel Test		L Box Test
	Slump mm	T_{50} time Sec	Time for Discharge	T_5 min. Sec	H_2/H_1
M30	750	4.20	7.20	8.6	0.98
M40	760	4.00	5.90	8.35	0..98
M60	720	3.24	6.54	8.37	0.96

Table 3 Hardened Properties of SCC with GGBS and RHA

MIX	Hardened properties				
	Strength at 28 days N/mm^2				
	Compressive strength			Tensile strength	Flexural strength
	3d	7d	28d		
M30	14.30	22.20	41.20	3.829	4.20
M40	20.80	32.50	58.25	4.720	5.40
M60	18.89	39.97	65.52	5.680	5.98

IV. DISCUSSION AND RESULTS

1. The addition of RHA to GGBS mixes has shown improved performance in terms of strength and durability in all grades of SCC.This is due to the presence of highly reactive silica in GGBS and RHA.
2. Studies indicated that there is a good compatibility between mineral combinations GGBS and RHA along with the chemical admixtures such as SP and VMA when used in SCC.
3. The Bolomey‟s empirical expression can be used to predict the strength efficiency of the GGBS and RHA in SCC at different percentage of replacement levels.

2) The strength efficiency factor „k‟ of GGBS in SCC mixes at 28 days was found to be between 0.7 to 1.8. The strength efficiency factor k for normal concrete mixes were reported to be between 0.7 to 1.3 shows the strength efficiency factors are slightly higher for SCC mixes with GGBS.

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