*International Journal of Research in Advent Technology (IJRAT) Special Issue "*ICADMMES 2018*"*
E-ISSN: 2321-9637
Available online at www.ijrat.org

Self Compacting Concrete With Partial Replacement of Cement By Rice Husk Ash

B.Manikanta [1], R.Sumathi [2] , Shyamala Bhoomesh [3], Gandrakota Akhila [4]
[1] *B.Tech Scholar, Department of CE, Malla Reddy Engineering College (A), Hyderabad*
[2] *Assistant Professor, Department of CE, Malla Reddy Engineering College (A), Hyderabad*
[3] *Assistant Professor, Department of CE, Malla Reddy Engineering College (A), Hyderabad*
[4] *B.Tech Scholar, Department of CE, Malla Reddy Engineering College (A), Hyderabad*

Abstract
Now days, the ecological trend aims at limiting the use of natural raw materials in the field of building materials and hence there is an increased interest in the use of alternative materials (waste) from various industrial activities, which presents significant advantages in economic, energetic and environmental terms. One of such materials is Rice Husk Ash (RHA). Rice husk ash (RHA) is a highly reactive pozzolanic material produced by the controlled burning of rice husk, and it is widely used as a mineral admixture to produce Self Compacting Concrete (SCC). SCC is a new kind of High Performance Concrete (HPC) which has an excellent deformability and segregation resistance. By name it can be defined as a concrete, which can flow through and fill the gaps of reinforcement and corners of the moulds without any need for external vibration. The main objective of this study is to investigate the utilization potential of Rice Husk Ash(RHA) in self-compacting concrete (SCC). The effect of Ordinary Portland Cement (OPC) partial substitution with RHA on the mechanical properties such as workability, compressive strength, and flexural strength of the SCC were investigated. The tests were conducted to find the optimal mix design for best compressive strength.The tests are conducted to determine the strength characteristics of the SCC, when cement partially substituted in different proportions of RHA. The preliminary results of research based on partial replacement of cement with RHA in SCC and its effectiveness in analysed and computed. There are few researches about the rice husk-bark ash characteristics and its mechanical properties relating to the concrete work. Therefore, the purpose of this research is to utilize the rice husk-bark ash as pozzolanic material for partly replacing Portland cement in order to produce SCC as well as reduce negative environmental effects and landfill volume, which is required for eliminating the waste of ash.
Keywords: Rice husk ash, Self Compacting concrete, ordinary Portland Cement, Compressive strength, flexural strength

Introduction

Now-a-days cementitious binders play significant role in the construction of buildings and structures. The use of Portland Pozzolanic Cement (PPC), as alternative for the commonly used Portland cement, has been re-introduced in the last few decades after a prolonged use of Ordinary Portland Cement (OPC). This shift is due to a number of reasons such as cost reduction, performance, durability, and environmental related issues. The pozzolanic materials such as fly ash, rice husk ash, palm oil fuel ash, bagasse ash, and rice husk-bark ash are used in the production of concrete instead of using the cement only.

There are few researches about the rice husk-ash characteristics and its mechanical properties relating to the normal concrete work. Therefore, the purpose of this research is to utilize the rice husk-bark ash as pozzolanic material for partly replacing Portland cement in order to produce self-compacting concrete (SCC) as well as reduce negative environmental effects and landfill volume, which is required for eliminating the waste of ash.
Self-compacting concrete (SCC) is featured in its fresh state by high workability and rheological stability. SCC has excellent applicability for elements with complicated shapes and congested reinforcement. In concrete materials, most of the previous works studied the effects of pozzolanic materials on physical and mechanical properties of normal concrete.

The preliminary and inevitable interest in the use of partial replacements or by – products as complementary pozzolanic materials was mostly induced by enforcement of air pollution control resulted from cement production industry. Rise husk is by- product taken from rice mill process. All the researchers have developed SCC taking the CA/FA ratio and also considered the limited content of coarse aggregate and more content of fines. But, there are very limited investigations reported considering the partial replacement of RHA as a mineral admixture content in the development of SCC.

Methodology

Wide spread applications of SCC have been restricted due to lack of standard mix design procedure and testing methods. It is pertinent to mention that only features of SCC have been included in Indian Standard Code of practice for plain and reinforced concrete (fourth revision), [2000]. Slump flow test, L-box test, V-funnel test, U-box test are recommended by EFNARC [European Federation of Producers and Applicators of Specialist Products for Structures, May 2005] for determining the properties of SCC in fresh state.

The experimental program consisted of casting and testing specimens for arriving at the maximum size of aggregate. M40 grade of concrete is considered in this study. In the first stage the effective percentage of partial replacement of RHA for M40 grade of concrete was arrived. Nan Su method of mix design [2001] was adopted to arrive at the suitable mix proportions. The mix proportion for M40 grade was arrived, taking the different proportions of RHA into consideration. The effective percentage of partial replacement of RHA was arrived for M40 grade of concrete, based on the mechanical properties and fresh properties of SCC. A total of 27 cubes of standard size 150 mm x 150 mm x 150 mm and 27 cylinders of 150 mm diameter and 300 mm height, 27 prisms of standard size 100 x 100 mm x 500 mm and 27 cylinders of 150 mm diameter and 300 mm height were cast for determining the compressive strength, flexural strength respectively. The parameters of the study thus included percentages partial replacement of RHA with cement and age of curing for satisfying the fresh properties of SCC as per EFNARC specifications [2005] based on a number of trials. The present investigation is mainly directed towards developing a mix with good SCC, with different percentages of partial replacement of cement with RHA and for M40 grade of concrete.

The details of fresh properties and hardened properties of SCC with different percentages of partial replacement of cement with RHA and different mix designs are discussed

Materials

A. Cement: Ordinary Portland cement of 53 grade [IS: 12269-1987, Specifications for 53Grade Ordinary Portland cement] has been used in the study. It was procured from a single source and stored as per IS: 4032 – 1977. Care has been taken to ensure that the cement of same company and same grade is used throughout the investigation. The cement thus procured was tested for physical properties in accordance with the IS: 12269 – 1987.

B.Fine Aggregate: The fine aggregate used was locally available river sand without any organic impurities and conforming to IS: 383 – 1970 [Methods of physical tests for hydraulic cement]. The fine aggregate was tested for its physical requirements such as gradation, fineness modulus, specific gravity and bulk density in accordance with IS: 2386 – 1963

C.Coarse Aggregate: The coarse aggregate chosen for SCC was typically round in shape, well graded and smaller in maximum size than that used for conventional concrete. The size of coarse aggregate used in self compacting concrete was between 10mm to 16mm. The rounded and smaller aggregate particles provide better flowability and deformability of concrete and also prevent segregation. Graded aggregate is also important particularly to cast concrete in highly congested reinforcement or formwork having small dimensions. Crushed granite metal of sizes 16 mm to 10 mm graded obtained from the locally available quarries was used in the present investigation. These were tested as per IS 383-1970.

D. Rice Husk Ash: RHA generally referred to an agricultural by-product of burning husk under controlled temperature of below 800 ℃. The process produces about 25% ash containing 85% to 90% amorphous silica plus about 5% alumina, which makes it highly pozzolanic. "Study conducted by Mehta indicated that concrete with RHA required more water for a given consistency due to its absorptive character of the cellular RHA particles. In an investigation rice husk ash obtained from Indian paddy when reburn at 650 ℃ for a period of one hour transformed itself into an e cient pozzolanic material rich in amorphous silica content (87%) with a relatively low loss on ignition value (2.1%).

E.Super Plasticizer: High range water reducing admixture called as super plasticizers are used for improving the flow or workability for lower water-cement ratios without sacrifice in the compressive strength. These admixtures when they disperse in cement agglomerates significantly decrease the viscosity of the paste by forming a thin film around the cement particles. In the present work, water-reducing admixture Glenium conforming to IS 9103: 1999.

Mix Proportion: The mix proportion was done based on the Modified Nan-Su method. The mix design was carried out for M30 normal grade of self compacting concrete with RHA as partial replacement of cement with a fraction of 0%, 10%, 20% &30%

Table 1: Quantities of Materials for 1m^{3}of SCC mixes

Mix	Cement (kg/m^3)	RHA (Filler) (kg/m^3)	RHA as Cement Replacement (kg/m^3)	Total Powder Content (kg/m^3)	Fine Aggregate (kg/m^3)	Coarse Aggregate (kg/m^3)	W/P (0.40) (kg/m^3)	SP (1.9 %) (kg/m^3)
Mix-1	486	0	0.00	486	710	612	195	9.234
Mix-2	343.8	93.6	48.6	486	710	612	195	9.234
Mix-3	305.6	78.34	102.06	486	710	612	195	9.234
Mix-4	267.2	82.72	136.08	486	710	612	232	5.136

Mix-1: 0 Replacement of cement with RHA

Mix-2: 10% Replacement of cement with RHA

Mix-3: 21% Replacement of Cement with RHA.

Mix-4: 28% Replacement of Cement with RHA

Results and Discussion

Table: 2 Fresh Properties of M40 grade SCC

S. No	MIX	Slump Flow value (mm)	T50 (Sec)	V-Funnel (Sec)	V-Funnel at T5 Min (Sec)	L-Box H2/H1 (blocking ratio)
1.	MIX -1	720	10	9	12	0.9
2.	MIX -2	725	5	6	8	1.00
3.	MIX -3	735	5	7	9	1.00
4.	MIX -4	780	5	11	12	1.0

Table: 3 Compressive Strength of M40 grade SCC

TRIAL MIXES WITH % OF RHA	7 Days Mpa	14 Days Mpa	28 Days Mpa
MIX -1 with 0% RHA	22.4	35.5	42.00
MIX – 2 with 10% RHA	36.20	39.6	44.4
MIX – 3 with 21% RHA	38.33	43.24	48.4
MIX – 4 with 28% RHA	39.21	44.45	49.4

Discussion On Mix Proportions Adopted For SCC:

As described earlier, Nan Su method of mix design [2001] was adopted to design the SCC mix for M40 grade of concrete. As understood, Nan Su method is based on the basic principle that the paste of binders are filled in the voids of aggregates ensuring that the concrete obtained has flowability, self-compacting ability and other desired SCC properties. The packing factors assumed on the basis of better compactability and strength, from a number of trials is 1.12 for M40 grade of concrete. From Nan Su method of mix design for SCC, the density, compactability and strength are dependent on how effectively the aggregates are packed. Hence, the size of aggregate, shape and texture of aggregate65 also plays a deciding factor in the values of fresh and hardened properties.The mix proportion of M40 grade of concrete designed on the basis of Nan Su method for different proportions of RHA replacement of Cement Viz. 0%,

10%, 21% and 28. For the mix proportions obtained, **Table 1** shows the details of various parameters including Partial replacement of cement with RHA–cement ratio (w/c), Coarse Aggregate **-** Fine Aggregate ratio (CA/FA) and fine aggregate – total aggregate (S/a) for various proportions of replacement of cement with RHA.

Effect of Partial Replacement of Rha on The Mechanical Properties of Scc

COMPRESSIVE STRENGTH: Grade of concrete, maximum percentages of replacement of cement with RHA and age of curing are the variables of investigation. The details of the compressive strengths of M40 grades are shown in Figure 1. From the results it was noted that, as the grade of concrete increased the effective percentage of replacement of the cement with RHA is proved to be 28% for M40 grades. The four proportions of RHA with cement for the above four mixes have been arrived and the same was adopted in the further study.

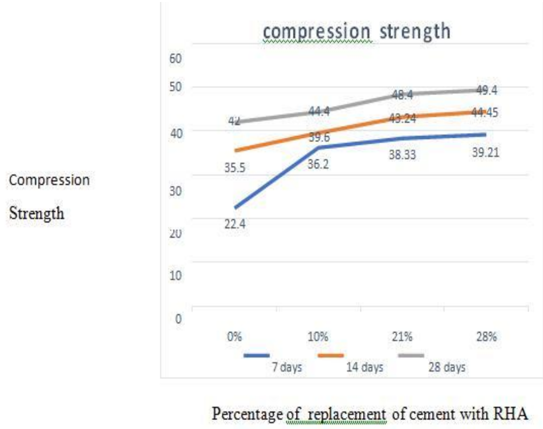

Figure I comparisons of Compression Strength

Conclusions: Based on the systematic and detailed experimental study conducted on SCC mixes with an aim to develop performance mixes, the following are the conclusions arrived. • RHA can be used in large quantities in SCC and cement content can be reduced to as low as 305.6 kg/m3 for M40 grade of SCC. • Required compressive strength, flexural strength and split tensile strength, flowability and adequate self compactibility were obtained. • The slump flow value was obtained within the acceptable value up to replacement of 28% cement by RHA. • The V-funnel & L-box Test showed acceptable value up to replacement of 28% cement by RHA. Hence, as per the requirements of fresh state properties of SCC the addition of 28% RHA can be allowed. • The SCC mixes with replacement of 28% cement by RHA gave optimum results. Compression and Flexural strength was much better than target strength for M grade of Concrete. • RHA being pozzolanic materials shown much better performance after 90 days curing as compared with the same at 28days.

References*:*

[1] **Bouzoubaa N, Lachemi M.** "Self-compacting concrete incorporating high volumes of class F fly ash: Preliminary results", Cement and Concrete Research, 2001, Vol. 31, No.3, pp 413-420

[2] **EFNARC.** "Specification and guidelines for self-compacting concrete", European Federation of Producers and Applicators of SpecialistProducts for Structures, 2002

[3] **EFNARC.** "Specification and guidelines for self-compacting concrete", European Federation of Producers and Applicators of Specialist Products for Structures, May2005

[4] **Nan Su, Kung-Chung Hsub and His-Wen Chai**. "A simple mix design method for self-compacting concrete". Cement and Concrete Research, 2001, Vol. 31, pp1799–1807

[5] **Shazim Ali Memon, Muhammad Ali Shaikh, Hassan Akbar**. (2011), "Utilization of Rice Husk Ash as viscosity modifying agent in Self Compacting Concrete" Construction and Building Materials 25 (2011) pp.1044–1048 K

[6] **Ganesan, K. Rajagopal, K. Thangavel.** (2008), "Rice Husk Ash blended cement: Assessment of optimal level of replacement for strength and permeability properties of concrete" Construction and Building Materials 22 (2008) pp. 1675–1683

[7] **S. Kanakambara Rao.,** "A Review on Experimental Behavior of Self Compaction Concrete Incorporated with Rice Husk Ash" International Journal of Science and Advanced Technology (ISSN 2221-8386).

[8] **Annahita Ansari** performed "Review of Rice husk ash effect in sustainability of materials and environment