# Experimental Works on Self-Compacting Concrete By Partial Replacement of Rice Husk Ash with Subjected To Acid Attack

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***Abstract*: *The objectives of this work is effect of Rice husk ash (AWM) in self-compaction concrete (SCR) in order to increase in strength and a better bonding between aggregate and cement paste. SCR had an improvement over conventional concrete so that it can be placed easily without vibration or mechanical consolidation. The properties of SCR have been studied in several researches due to its importance and ability to solve the problems of concrete mix. AWM was used to substitute cement in stepped concentration of 0 %, 5%, 10%, 15%, 20% and used to gain characteristic CS of $M_{40}$ grade concrete mix. It is cured normal water and sulphuric acid solution ($H_2SO_4$) in for different ages (7days, 28days and 60days) and the strengths were determined. Sulphuric acid used in the percentages of 0%, 1%, 3%, 5%.***

***Index Terms*: *Self compacting concrete, cement replacement, rice husk ash, acid solution.***

## I. INTRODUCTION

Self-compacting concrete (SCR) is a new approach to high performance concrete (HPC) developed in the year 1986 by Japan. Congested reinforcement and reduction of concrete expedient is also one the reason to develop SCR. SCR flows into the formwork and around obstructions under its own weight to fill it completely and self-compacting, without any segregation and blocking.SCR mixes normally have a much higher content of fine fillers, including cement, and produce excessively high CS concrete, which restricts its field of application to special concrete only. This paper, it explores about the use of AWM to raise the number of fines and consequently reach self-compact ability in capable way and focuses on comparison of fresh and hardened properties of SCR containing different percentages of 0%, 5%, 10%, 15% and 20% AWM as an admixture. Sulphuric acid ($H_2SO_4$) is one of the violent natural threats to concrete structures. Acid show aggression is exaggerated by the process of corrosion and escape of cement paste constituents. Important volume of admixtures in SCR paste can really control its resistance to acid aggression. Curing $H_2SO_4$ acid as 0%, 1%, 3% and 5% in SCR to avoid the acid rain effects, higher durability, no difficulty to place, no vibration, reduced noise levels and good surface finishing of concrete.

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## II. STUDY AREA

In present study a concrete mix design is made for $M_{40}$ and is taken as normal concrete. In the normal concrete cement is replaced with (5%, 10%, 15% and 20%) of AWM. This study was conducted for the duration of 7, 28 and60 days. Specimens of two types, namely specimens casted with normal concrete and on concrete by partial replacement of cement with AWM, were exposed to three percentages of $H_2SO_4$ solutions with concentrations of 0%, 1%, 3% and 5%. It is well known that the concrete under acidic environment is deteriorated due to a chemical attack. For example, acid rains cause concrete unexpectedly short service life due to the damages concrete cover.

## III. METHODOLOGY

### A. Concrete Mix design (as per is 10269: 1982)

In this analysis mix proportioning is done using BIS method for, $M_{40}$ grade of concrete. The consequential mixes are modified after conducting trials at laboratory by duly the Indian standards guidelines and test result values are satisfied.

### B. Mix Proportions by Weight

W/C ratio =0.39, Cement = 1, Fine aggregate =1.12, Coarse aggregate = 2.28.

**Testing of hardened properties:**

After getting final results of mix proportions, cubes are been casted.

**Fig(a) Casted cubes $M_{40}$ grade of SCR**

## IV. SPRCIMENS CURING

The specimens are gone in moulds at intact room temperature about to 24 hours. The specimens are then divide from the moulds and instantaneously transfer to curing ponds contains $H_2SO_4$ (0%, 1%, 3%, 5%) and cured for 7, 28 and 60 days. Find out the PH value of dilute acid day by day. In this concentration of acid decreases, so maintain the equal level PH to previous concentration for entire curing period as per IS: 516-1969.

**Fig (b) Curing Cubes of $M_{40}$ grade of SCR**

**Testing for specimens :** The specimen has been ensuring to undergo proper testing on schedule point in time. The casted specimens are tested as per Indian standard measures, directly away following they are detached from curing pond and wiped off the surface water, as per IS 516-1959.

**A. Compressive Strength (CS) values of concrete:**

The CS of $M_{40}$ grade SCR containing percentage replaced cement by AWM with different percentages tabulated below the strength of specimen determined after 7, 28 and 60 days.

**B. Sulphate Attack ($H_2SO_4$)**

Most of the soils contain various sulphates like calcium, magnesium, potassium and sodium in different forms. Ground water includes less calcium sulphate when compare to rest of sulphates because of its low solubility. In Agricultural soil, Ammonium sulphate is more due to the usage of fertilizers in the form water. Therefore sulphate attack is a common occurrence in natural or industrial situations. For tests in the present experimental work is conducted on specimen size of150 mm X 150 mm X 150 mm cubes for 7, 28 and 60 days curing in different concentration solutions. Then after, assess the weight loss due to the assailment.

## V. EXPERIMENTAL RESULTS

In this present analysis, replacing the cement in different percentages with AWM, compaction factor of the particular percentage is required to know about workability. Therefore, the results show that workability exits below as shown in table no: (a).

**COMPACTION FACTOR TEST**

**Table (a): Workability of AWM (% Replacement of cement)**

| S. no. | Percentage of AWM replaced in cement (by weight) | Values of compaction factor |
|---|---|---|
| 1 | 0 | 0.858 |
| 2 | 5 | 0.839 |
| 3 | 10 | 0.818 |
| 4 | 15 | 0.809 |
| 5 | 20 | 0.778 |

The experimental investigation was carried by making AWM concrete by replacing cement with rice husk ash in the range of 0% by weight, 5% by weight, 10% by weight, 15% by weight, and 20% by weight of cement and checked for 7, 28 and 60 days for CS when it was solution of $H_2SO_4$ solution of 1%, 3%, 5% was to evaluate attack by sulfuric acid.

**Table (b): SCR $M_{40}$ grade of CS results for normal water curing**

| Name of the Specimen | Percentage of AWM | strength of specimen (N/mm2) | | |
|---|---|---|---|---|
| | | 7 Days | 28 Days | 60 Days |
| S-0 | 0 | 27.39 | 39.37 | 49.59 |
| S-05 | 5 | 27.23 | 39.09 | 49.36 |
| S-10 | 10 | 27.12 | 39.01 | 49.26 |
| S-15 | 15 | 26.27 | 38.45 | 48.89 |
| S-20 | 20 | 23.41 | 37.79 | 47.76 |

The above table (b) represents the CS of $M_{40}$ AWM concrete in normal hardening water with suitable replacements of AWM 0% to 20% with an interval of 5%l. During this 7 day period, the CS will gradually increase until 10% of the cement has been replaced by AWM. Thereafter, the CS will decreases to 15% and 20% of AWM replacement with cement. The graphical representation of the table is shown in following fig.(1).

**Table (c): SCR $M_{40}$ grade of CS results for 1% $H_2SO_4$ solution**

| Name of the Specimen | Percentage of AWM | strength of specimen (N/mm2) | | |
|---|---|---|---|---|
| | | 7 Days | 28 Days | 60 Days |
| S-11 | 0 | 27.01 | 38.73 | 48.95 |
| S-12 | 5 | 26.55 | 38.21 | 48.25 |
| S-13 | 10 | 26.31 | 37.91 | 48.11 |
| S-14 | 15 | 24.86 | 36.57 | 47.17 |
| S-15 | 20 | 21.66 | 35.52 | 45.77 |

The above table (c) shows the CS of AWM $M_{40}$ concrete, which was hardened in a 1% $H_2SO_4$ solution with various replacements from AWM 0% to 20% with an interval of 5% . During this 7 day period, the CS will gradually increase until the 10% of cement has been replaced by AWM. Then the CS is reduced to 15% and the AWM to20% by cement. In this table the CS values of concrete are less comparable with normal hardening conditions and with 1% $H_2SO_4$. The graphic representation of the table is shown in the following fig.(2).

**Table (d): SCR $M_{40}$ grade of CS results for 3 % $H_2SO_4$ solution.**

| Name of the Specimen | Percentage of AWM | strength of specimen (N/mm2) | | |
|---|---|---|---|---|
| | | 7 Days | 28 Days | 60 Days |
| S-31 | 0 | 25.21 | 38.4 | 48.83 |
| S-32 | 5 | 24.82 | 37.77 | 48.08 |
| S-33 | 10 | 24.67 | 37.45 | 47.89 |
| S-34 | 15 | 23.63 | 35.82 | 47.26 |
| S-35 | 20 | 20.82 | 34.44 | 45.57 |

The above table (d) shows the CS of $M_{40}$ AWM concrete, which was hardened in a 3% $H_2SO_4$ Solution with different replacements of AWM 0% to 20% in an interval of 5%. In this CS, 7 days gradually increase until the 10% of cement is replaced by AWM. Thereafter, the CS is reduced 15% and its replacement by 20% the AWM. In this table, the CS values of concrete values are less comparable with normal hardening conditions and with 3% $H_2SO_4$. The graphical representation of the table is shown in following fig (3)

**Table (e): SCR $M_{40}$ grade of CS results for 5 % $H_2SO_4$ solution.**

| Name of the Specimen | Percentage of AWM | strength of specimen (N/mm2) | | |
|---|---|---|---|---|
| | | 7 Days | 28 Days | 60 Days |
| S-51 | 0 | 24.94 | 37.56 | 47.82 |
| S-52 | 5 | 24.64 | 36.68 | 46.72 |
| S-53 | 10 | 24.43 | 36.47 | 46.46 |
| S-54 | 15 | 23.43 | 35.26 | 45.34 |
| S-55 | 20 | 20.46 | 33.7 | 43.32 |

The above table (e) shows the CS of AWM $M_{40}$ concrete, which was hardened in a %% $H_2SO_4$ solution with various replacements from AWM 0% to 20% with an interval of 5% . During this 7 day period, the CS will gradually increase until the 10% of cement has been replaced by AWM. Then the CS is reduced to 15% and the AWM to20% by cement. In this table the CS values of concrete are less comparable with normal hardening conditions and with 5% $H_2SO_4$. The graphic representation of the table is shown in the following fig.(4).

## VI. CONCLUSIONS

1. The outcome caused by sulphuric acid ($H_2SO_4$) on the concrete is reduced by the replacement of AWM in the cement. In curing stage the concrete cubes are immersed 0%, 1%, 3%, 5% of sulphuric acid solution at 7, 28 and 60 days.
2. The strength of cubes with 5% and 10% replacement of AWM is higher than cubes with 15% and 20% replacement of AWM. Increasing replacement of AWM in the concrete, workability of concrete decreases.
3. Then 5% and 10% replacement of AWM concrete partially reduce to the acid rains effects and it gives better performance, improved quality of construction and reduction of onsite repair substantial reduction of environmental noise loading and around a site.
4. SCR makes the level of durability and reliability of the structure. The high resistance to external segregation and the mixtures self-compacting ability allow the elimination of micro-defects, air bubbles and Self-compacting concrete gives more structural durability.

**Analysis of CS values by graphs**

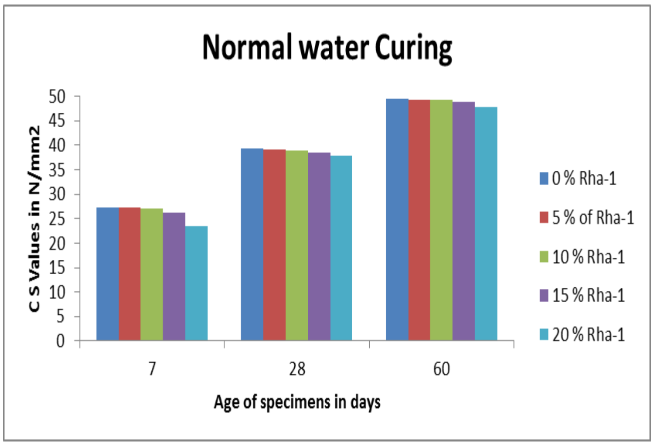


**Fig 1: Represents CS results for normal water curing**

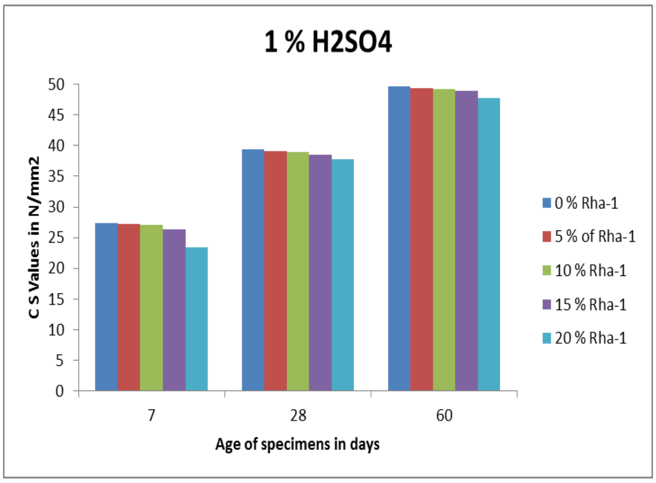


**Fig 2:Represents CS results for 1% $H_2SO_4$ solution**

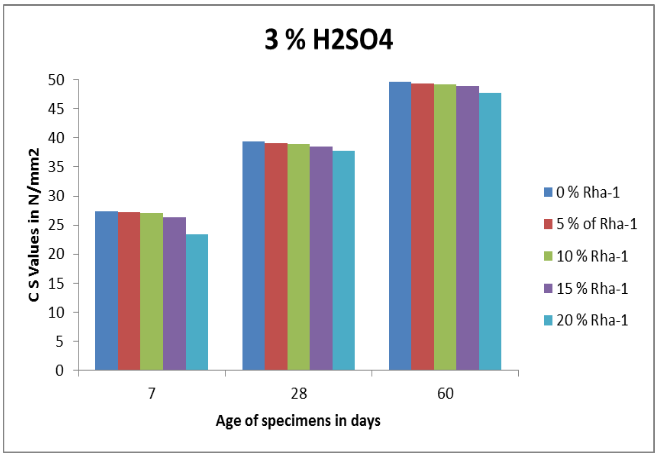

**Fig 3:Represents CS results for for 3% $H_2SO_4$ solution**

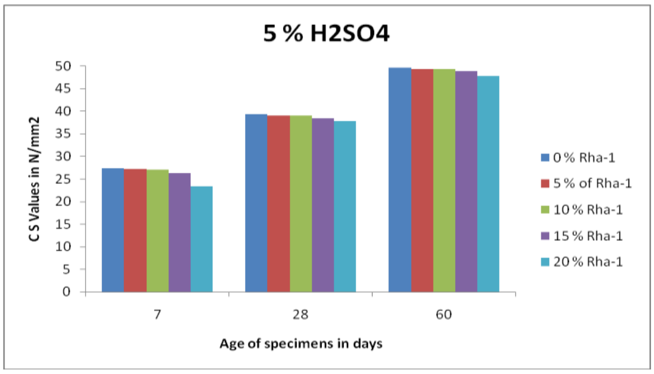


**Fig 4:Represents CS results for for 5% $H_2SO_4$ solution**

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**R.RamyaSwetha**, working as a assistant professor, civil engineering department in DNR college of Engineering and Technology(DNRCET) Bhimavaram, INDIA. Now pursing PhD in JNTUK-Kakinada.Completed Master of Engineering(Structural Engineering) in the year 2013.Completed.Bachelor of Engineering (Civil Engineering ) in the year 2009. Publications: Studies of Nitric Acid Attack on Rice Husk Ash Concrete" International Journal of Civil Engineering & Technology, Scopus Indexed Journal Engineering and Technology, Volume 8, Issue 9, pp. 927–934, ISSN Print: 0976-6308 and ISSN Online: 0976-6316 September 2017.Life member in Indian Society for Technical Education(LM 122263).And also paper presentation is done in one international and two national conferances.Participated in FDP's also.

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**Dr. U. Ranga Raju**, Principal of DNR College is an exceptional and the one the who leads the college to brighter future. He received Ph.D from IIT Madras, One of the most coveted colleges for technical education in India.

He pledged to work his full potential in order to make this institute more productive and goal driven. He often encourages students to opt in for practicality in order to bring creativity in them and also he take up projects. .Member in FIE. He participated in various workshops, seminars, training programs, faculty development programs and seminars. And he delivered guest lecturers for various institutions.