Effects Of Sulphuric Acid On M30 Grade Of Self Compacting Concrete (Scc)

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ABSTRACT :- Self-compacting concrete, also referred to as self-consolidating concrete, is in a position to go with the flow and consolidate under its personal weight and is de-aerated almost definitely whilst flowing in the formwork. It is cohesive enough to fill the spaces of almost any size and structure barring segregation or bleeding. This makes SCC in particular really helpful at any place putting is difficult, such as in heavily-reinforced concrete contributors or in complex work forms. The goals of this lookup is blended effects of Rice husk ash (RHA) and Sugarcane bagasse ash (SCBA) included in self compaction concrete in order to make bigger in strength and a higher bonding between combination and cement paste. SCC has an advantage over conventional concrete in that it can be easily placed without vibration or mechanical consolidation. The properties of SCC have been studied in many researches due to its importance and ability to solve the problems of concrete mix.

Rice husk ash(RHA) and Sugarcane bagasse ash (SCBA) was used to replace cement in stepped concentration of 0 %, 5%, 10%, 15%, 20% and used to gain characteristic compressive strength of M30 grade concrete mix and cured normal water and sulphuric acid solution (H_2SO_4) in for different ages (7 days and 28 days) were determined. Sulphuric acid used for the curing of normal water in the concentration of 1%, 3%, 5%. This lookup is aimed to look at the degradation of self-compacting concrete (SCC) due to sulphuric acid assault particularly based totally on measurement of compressive energy loss. The outcomes of excessive extent RHA and SCBA at 0% to 20% cement substitute degrees on the extent of degradation to sulphuric acid will be assessed in this study. Trial mixes with the various water cement ratio, substitute percentage, extent of notable plasticizer and viscosity bettering agent, have been equipped and tested. The test results for acceptance characteristics of self-compacting concrete such as slump flow and T50cm, V-funnel, T5 minutes and L-Box are presented.

Keywords: Sugarcane bagasse ash, Rice husk ash, Sulphuric acid, Super plasticizer, Self compacting concrete, Compressive strength test, Split tensile strength test.

I INTRODUCTION

Concrete is the most basic element for any kind of construction work. No matter what type of building structure it is, the concrete used should be study and well compacted. The main reasons for compacting any type of concrete are:

- To ensure maximum density by removal of any entrapped air.
- To ensure that the concrete used is in full contact with both the steel reinforcement and the form work.

Ensuring the above points not only provide additional strength to the structure but also good finish and appearance to the final product. The compacting of any conventional concrete is done through external force using mechanical device.

For SCC, it is generally necessary to use super plasticizers in order to obtain high mobility. Adding a large volume of powdered material or viscosity modifying admixture can eliminate segregation. The powdered materials that can be added are rice husk ash (RHA), sugarcane bagasse ash (SCBA).

Principle of self-compacting concrete

- Fluidity that allows self – compaction without external energy
- Remain homogeneous in a form during and after the placing process and
- Flow easily through reinforcement.

Fresh properties of self-compacting concrete

The main three properties of SCC in plastic state are

- Filling ability(excellent deformability)
- Passing ability(ability to pass reinforcement without blocking)
- High resistance to segregation

II LITERATURE REVIEW

Athulya Sugathan (2017) has examined this article discusses the possibilities of using dolomite for the purpose of remixing partridges for cementation. The demonstrated replacement percentages of materials are 0%, 5%, 7.5%, 10% and 15% of cement weight. Compressive and tensile strengths of concrete with Dolomite powder are compared with those of reference specimens. The results show that replacing the cement with Dolomite powder increases the tensile strength and tensile strength of the concrete.

Siri Rat Janjaturaphan and Supaporn Wansom (2010): They studied on, "The Pozzolanic Activities of Industrial Sugar Cane Bagasse Ash". They find out the chemical composition of the Sugarcane Bagasse Ash and compared them with the other pozzolanic material that is, rice husk ash and concluded that the SCBA is suitable for the partial replacement of cement.

Nileena et al (2014): Replaced the Ground Granulated Blast Furnace Slag and Granulated Blast Furnace Slag as filler material by the water cement ratio of 0.45. Six different mix proportions were prepared with a partial replacement of cement by GGBS at 30%, 40% and 50% and GBS at 30%, 40% and 50% as partial replacement of fine aggregate. Super plasticizer is used to achieve the self compatibility. The standard tests for fresh and hardened concrete was carried out and it was observed that only a small increase in compressive strength was achieved for 20% partial replacement of GGBS and GBS. But, ultrasonic pulse velocity shows an excellent result that there is no crack or undulations inside the specimen.

Nageswararao et al (2015): Replaced the fine aggregate by crushed stone dust (CSD) and marble sludge powder (MSP) in various proportions in combination. Six mix deigns were prepared by partial replacement of CSD and MSP at 0%, 20%, 40%, 60%, 80% and 100%. Super plasticizer is added in various ratios 0.35, 0.3 and 0.25 to obtain the flow properties. The fresh and hardened concrete (Compressive strength, Split tensile strength and Flexural strength) properties show good results at a partial replacement of MSP (60%) and CSD (40%) with lower water content. However, the durability results are not comparable with normal self-compacting concrete. Self-compacting concrete can be achieved by low water cement ratio with addition of super plasticizer.

Objectives of study

The main objective is to obtain specific experimental data, to understand fresh and hardened properties of the self-compacting concrete and design M_{30} grade self-compacting concrete. The following are the important objectives of the self-compacting concrete. They are

- To design and produce mix proportions for self-compacting concrete (SCC).
- To evaluate the physical and chemical properties of SCC.
- To obtain and compare the physical and chemical properties of self-compacting concrete.
- To evaluate the physical properties and chemical properties of rice husk ash and sugarcane bagasse ash.
- To observe the literature review of self-compacting concrete using rice husk ash and sugarcane bagasse.
- To determine the various tests such as slump flow and T_{50cm}, L-box, U- box, T_5 minutes and V-funnel etc.
- In this project, admixtures such as rice husk ash and sugarcane bagasse ash are used the replacement of cement because of gain the strength of concrete.
- The rice husk ash and sugarcane bagasse ash used to replacement of cement in stepped concentration of 0%, 5%, 10%, 15%, and 20% to gain characteristic compressive strength of M30 grade concrete mix and cured normal water in sulphuric acid solution (H2SO4).
- Sulphuric acid used for curing of normal water in the percentages of 1%, 3%, 5%.
- To determine the various strengths like compressive strength, split tensile strength at the age of 7days and 28 days of curing

III MATERIAL PROPERTIES

Standard proportions of self compacting concrete

Sl no	Name of the chemical	Percentage of proportion (%)
1	CaO	60-67
2	SiO2	17-25
3	Al2O3	3.0-8.0
4	Fe2O3	0.5-6.0
5	MgO and SO3	0.1-4.0 and 1.3-3.0
6	Alkalies	0.4-1.3
7	Loss of ignition	4.5

Physical properties of SCBA

Sl no	Property	Value
1	Financial module	2.12
2	Specific gravity	2.48

Chemical properties of SCBA

S. No.	Name of chemical	SCBA mass (%)
1	Silica (Sio_2)	68
2	Alumina (Al_2O_3)	3.05
3	Ferric oxide (Fe_2O_3)	3.72
4	Calcium oxide (CaO)	5.1
5	Magnesium oxide (MgO)	1.15
6	Sulphur tri oxide (SO_3)	0.67

IV METHODOLOGY

- In this project, for developing rich concrete mix, it is important to select proper ingredients, evaluate their properties and understand the interaction among different materials for optimum usage.
- The materials used for this investigation is the same as that used for the normal concrete mix such as cement, fine aggregate (FA), coarse aggregate (CA) and water. Along with these materials, sugarcane baggase ash (SCBA) and rice husk ash (RHA) are used as a cement replacement material and super plasticizer as a chemical admixture.
- In this experimental work, the typical size of cube150mm×150mm×150mm is used. The mix design (procedure) of concrete is done according to Indian Standard guidelines for M30 grade. Based upon the quantities of component of the mixes, the numbers of SCBA and RHA for 0%, 5%, 10%, 15%, and 20% replacement by weight of sand and weight of cement is estimated.
- The ingredients of concrete are thoroughly mixed in mixer machine till uniform consistency is achieved. Before casting, machine oil is smeared on the inner surfaces of the cast iron mould.

- Concrete is poured into the mould and compacted carefully using table vibrator. The top surface was over by means of a trowel. The specimens are removed from the mould after 24hours and then cured under water for a period of 7, 28 days.
- The samples are taken out from the curing tank just prior to the test. The compressive test, split tensile strength and flexural strength conducted using the capacity above testing machine. These tests are lead as per the relevant Indian Standard specifications.

Mix proportions of conventional concrete for 1m3 of concrete

MATERIALS	
Cement	369.375kg/m^3
Fine aggregate	850.3kg/m^3
Coarse aggregate	1094.38kg/m^3
Admixture	7 kg/m^3
Water	147.75 liters
w/c ratio	0.4
Mix proportion	1:2.3:2.96

Hence materials required for 10 cubes volume are as follows

Cement content	0.03375x369.375 = 12.46kgs
coarse aggregate content	0.03375x1094.38 =36.935kgs
Fine aggregate content	0.03375x850.3 =2869kgs
% of admixture	0.03375x7 = 0.24kgs
Water content	0.03375x147.75 =4.98lits

Hence materials required for 10 cylinders volume are as follows

Cement content	0.05298 x369.375 =19.569kgs
coarse aggregate content	0.05298 x1094.38 =57.98kgs
Fine aggregate content	0.05298 x850.3 =45.04kgs
% of admixture	0.05298 x7=0.37kgs
Water content	0.05298 x147.75 =7.82lits

V RESULTS

Compressive strength results for cubes cured in water after 7 days

Sample Designation	Combined % of RHA & SCBA	Compressive Strength (N/mm^2)
0 -1	0%	21.27
5-1	5%	16.59
10-1	10%	19.78
15-1	15%	18.84
20-1	20%	20.27

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Compressive strength results for cubes cured in water after 28days

Sample Designation	Combined % of RHA & SCBA	Compressive Strength (N/mm^2)
0 -1	0%	35.21
5-1	5%	34.20
10-1	10%	31.77
15-1	15%	27.31
20-1	20%	22.9

Split tensile strength results for cylinders cured in water after 7 days

Sample Designation	Combined % of RHA & SCBA	Split Tensile Strength (N/mm^2)
0-1	0%	2.88
5-1	5%	2.065
10-1	10%	2.001
15-1	15%	1.86
20-1	20%	1.002

Split tensile strength results for cylinders cured in water after 28 days

Sample Designation	Combined % of RHA & SCBA	Split Tensile Strength (N/mm^2)
0-2	0%	3.18
5-2	5%	2.650
10-2	10%	2.350
15-2	15%	2.237
20-2	20%	1.82

Compressive strength results for cubes exposed to 1% by volume of H_2SO_4 solution after 28 days

Sample Designation	Combined % of RHA & SCBA	Compressive Strength (N/mm^2)
0 -2	0%	33.26
5-2	5%	27.77
10-2	10%	25.71
15-2	15%	23.55
20-2	20%	15.17

Compressive strength results for cubes exposed to 3% by volume of H_2SO_4 solution after 28 days

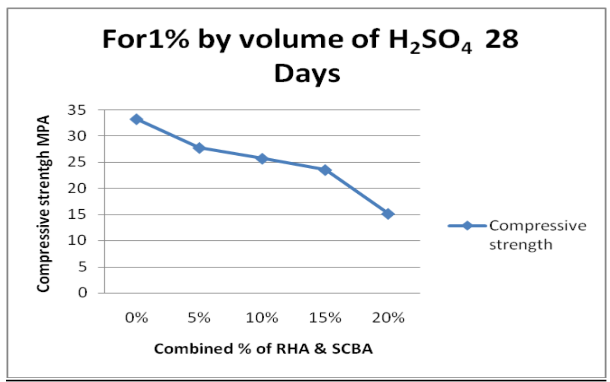
Sample Designation	Combined % of RHA & SCBA	Compressive Strength (N/mm^2)
0 -2	0%	28.13
5-2	5%	26
10-2	10%	20.85
15-2	15%	15.37
20-2	20%	14.45

Compressive strength results for cubes exposed to 5% by volume of H2SO4 solution after 28 days

Sample Designation	Combined % of RHA & SCBA	Compressive Strength (N/mm^2)
0 -2	0%	24.45
5-2	5%	21.78
10-2	10%	17.32
15-2	15%	14.22
20-2	20%	13.18

The test results of compressive strength for cubes exposed to 5% by volume H2SO4 solution after cured in water for 28 days with various combined percentages of rice husk ash and sugarcane bagasse ash such as 0%, 5%, 10%, 15% and 20% and produced target mean of the compressive strength for 28 days at 0% is 24.45N/mm2 and 20% is 13.18N/mm2. The loads of cubes were tested in different trials such T1, T2, T3 calculated average load find out average compressive strength (N/mm2).

Graphical Representation of Compressive Strength exposed 1% by volume H2SO4 solution



Graphical Representation of Compressive Strength exposed 3% by volume H2SO4 solution

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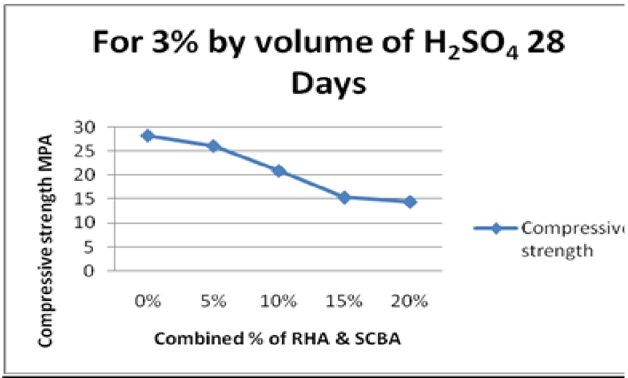
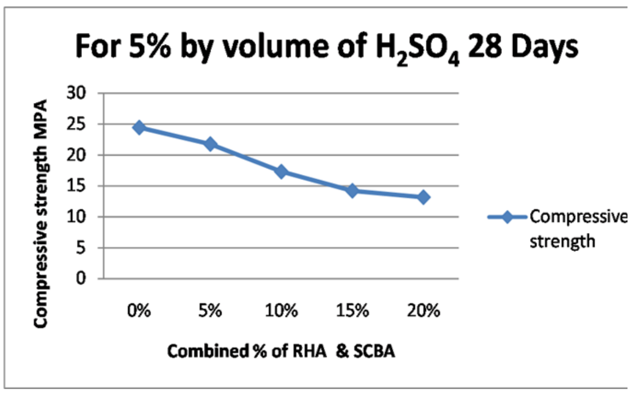
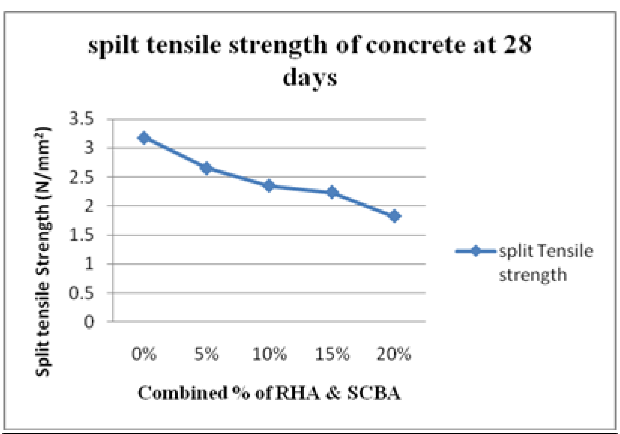


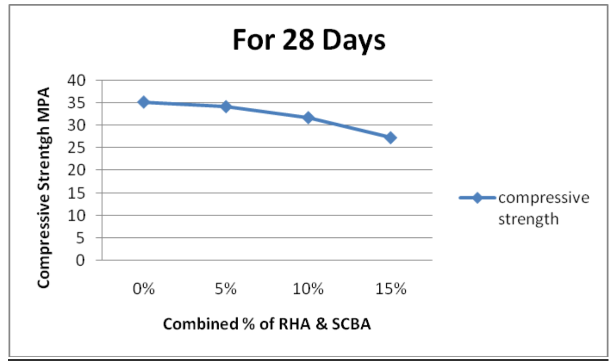
Graphical Representation of Compressive Strength exposed 5% by volume H2SO4 solution



Graphical Representation of Split tensile Strength after 28 days



Graphical Representation of Compressive Strength after 28 days



VI CONCLUSION

- Total 60cubes were cast of which one fourth were placed in normal water, another one fourth were placed in 1% H2SO4 solution, another one fourth were placed in 3% H2SO4 solution and the last one fourth were placed in 5% H2SO4 solution.
- Three samples from each environment were tested at the age of 7, 28 days respectively. The results are presented graphically below. Graph 1 to 4 represent the compressive strength of concrete specimens with cement replacement level by 0%, 5%, 10%, 15%, 20 by RHA and SCBA respectively cured in normal water and indifferent percentages of H2SO4 solution. From all graphs it is seen that the compressive strength increases with the age of days.
- The test results of compressive strength after cured in water for 7 days and28 days with various combined percentages of rice husk ash and sugarcane bagasse ash such as 0%, 5%, 10%, 15% and 20% and produced target mean of the compressive strength for 7 days and 28 days at 0% are 21.27N/mm2, 35.21N/mm2 and

20% are 20.27N/mm2, 22.09N/mm2. The loads of cubes were tested in different trials such T1, T2, T3 calculated average load find out average compressive strength (N/mm2). The sample designation denoted by symbols such as 0-1, 5-1, 10-1, 15-1, and 20-1.

- The graphical representation of compressive strength for 7 days and 28 days plotted between horizontal axis taken combined percentage of rice husk ash and sugarcane bagasse ash and vertical axis taken as target mean compressive strength (N/mm2). The graph represented by the line with various combined percentages of RHA and SCBA such as 0% , 5%, 10%, 15% and 20% and compressive strength (N/mm2).
- The test results of split tensile strength after cured in water for 7 days and 28 days with various combined percentages of rice husk ash and sugarcane bagasse ash such as 0%, 5%, 10%, 15% and 20% and produced target mean of the split tensile strength for 7 days and 28 days at 0% are 2.88N/mm2, 3.18N/mm2 and 20% are 1.002N/mm2, 1.82N/mm2. The loads of cubes were tested in different trials such T1, T2, T3 calculated average load find out average compressive strength (N/mm2). The sample designation denoted by S1,S2 and S3.
- The test results of compressive strength for cubes exposed to 1%, 3%, 5% by volume H2SO4 solution after cured in water for 28 days with various combined percentages of rice husk ash and sugarcane bagasse ash such as 0%, 5%, 10%, 15% and 20% and produced target mean of the compressive strength for 28 days at 0% are 33.26N/mm2, 28.13N/mm2, 24.45N/mm2 and at 20% are 15.17N/mm2, 14.45N/mm2, 13.18N/mm2. The loads of cubes were tested in different trials such T1, T2, T3 calculated average load find out average compressive strength (N/mm2). The sample designation denoted by symbols such as 0-2, 5-2, 10-2, 15-2, and 20-2.

REFERENCES:-

1. Anil Kumar Suman, Anil Kumar Saxena, T. R. Arora (2015), "Assessment of Concrete Strength using Partial Replacement of Cement for Rise Husk Ash", International Journal of Soft Computing and Engineering (IJSCE), ISSN: 2231-2307, Volume-4, Issue-6, January 2015.
2. Ch.Sivanarayana, K Pratyusha, P V Rambabu, G V Ramarao (2014), "A Study on Sulphuric Acid Attack on Concrete with Rice Husk Ash as a Partial Replacement of Cement", International Journal of Engineering Research and Development, e-ISSN: 2278-067X, pISSN: 2278-800X, Volume 10, Issue 4, pp.43-49, April 2014.
3. Deepa G Nair, K. Sivaraman and SJob Thomas, (2013), "Properties of Rice Husk Ash (RHA) - High

strength Concrete", American Journal of Engineering Research (AJER) e-ISSN: 2320-0847, pISSN: 2320-0936, Volume-3, pp-14-19.

4. D. Siva Prasad and Dr. A. Rama Krishna (2011), "Production and Mechanical Properties of A356.2 /RHA Composites", International Journal of Advanced Science and Technology Vol. 33, August, 2011.
5. Ettu L.O, Ajoku C.A, Nwachukwu K.C, Awodiji C.T.G, Eziefula U.G (2013), "Strength variation of OPC-rice husk ash composites with percentage rice husk ash", International Journal of Applied Sciences and Engineering Research, ISSN 2277-9442, Vol. 2, Issue 4; 2013.
6. GhassanAboodHabeeb, Hilmi Bin Mahmud, (2010), "Study on Properties of Rice Husk Ash and Its Use as Cement Replacement Material", Material Research, March 21, 2010; 13(2): 185-190.
7. JosephDavidovits (1994), "Global Warming Impact on the Cement and Aggregate Industries", Published in World Resource Review, Vol. 6, No. 2, pp. 263-278, 1994.
8. K. Gurunaathan and G. S. Thirugnanam (2014), "Effect of mineral admixtures on durability properties of concrete", International Journal of Advance Structures and Geotechnical Engineering, ISSN 2319-5347, Vol. 03, No.01, January 2014.
9. Obilade, I.O (2014), "Use of Rice Husk Ash as Partial Replacement for Cement in Concrete" International Journal of Engineering and Applied Sciences, ISSN 2305-8269, Vol. 5, No. 4, Sept. 2014.
10. S. D. Nagrale, Dr. HemantHajare, Pankaj R. Modak, (2012), "Utilization Of Rice Husk Ash", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622, Vol. 2, Issue 4, July-August 2012s.
11. Cordeiro, G., Toledo, R., Tavares, L., Fairbairn, E.: Ultrafine grinding of sugar cane bagasse ash for application as pozzolanic admixture in concrete, Cement and Concrete Research.