International Journal of Engineering & Technology, 7 (4.5) (2018) 522-525

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper

Experimental study on concrete with rice husk ash under sulphuric ACID solutions

R. Ramya Swetha [1] *, Dr. G. Venkata Ramana [1], K. Anusha Hadassa [1]

[1] Department of Civil Engineering, Institute of Aeronautical Engineering, Hyderabad, India
**Corresponding author E-mail: ramyavarma115@gmail.com*

Abstract

This investigation shows the results on aggressive sulphuric acid on the concrete combined with rice husk ash (RH) when partially replaced for ordinary Portland cement. The husk ash, which mainly contains aluminum ion, silica, iron and calcium oxides, is an industrial waste and poses disposal problems. In this study, the effect of various concentrations (1%, 3%, 5%) of sulphuric acid (H2SO4) on Concrete replaced with various percentages (0%,5%,10%,15% and 20% by weight of cement) of RH is evaluated in-terms of residual compressive strength. The loss of compressive strengths of concrete immersed in various H2SO4 solutions for 7 days 28 days and 60 days indicates that at upto 10% replacement increase in strength was observed after which strengths were decreasing. This increase in strength is attributed to pozzolanic activity of RH.

Keywords: *Compressive Strength; Grade of Concrete; H2SO4 Solution; Pozzolanic Activity; Rice Husk.*

1. Introduction

Concrete when attacked with sulpuric acid gets reacted due to the atmospheric conditions in the atmosphere and reactions that take place when a chemical is mixed. This may be due to high attack of alkalinity and changes in weight loss, increase or decrease in compressive strength and change in dynamic modular of elasticity were used to evaluate the extent of concrete deterioration due to sulphuric acid attack this information is necessary to accurately estimate the minimum thickness of the concrete cover in reinforced concrete structures[1-2].

Previous studied generally shown that weight loss of the test specimens increases with a decreasing PH level of the acid solutions. Increase in H2so4 concentration leads to retardation in intial and final setting time of concrete Cement (BC). Source water has higher sulphur content both as sulphate or sulphide, and from hydrogen sulphate H2S. The hydro sulphate gas comes out of the solution & from sulphate acid is the air space ,sulphuric acid is highly reactive and reacts with calcium compounds to from gypsum which causes the concrete to soften, ultimately leading to roof collapse[3-4].

Organic matter +So 2-□s2-+H O+Co

In case of sulphuric acid attack although the formation of gypsum has been reported frequently there is no agreement on this consequences.

2. Study area

The study area represents the concrete mix with M40 with normal concrete taking as 5%, 10%,15% and 20% by weight of cement of RH[5-6]. This study was conducted for 7, 28 and 60days.it includes specimens on concrete by partial replacement of cement with RH which were exposed of H2SO4 solution with different concentrations under environment for example acid rain causes concrete un except ability short service lift due to damages concrete cover. In case of H_2SO_4 reaction with concrete and rice husk change it physical properties [7-8]. Concrete is susceptible to attack by sulphuric acid produced from either sewage or sulphur dioxide.

3. Methodology

To understand the mechanism of attack on concrete with sulpuric acid. Due to low penetration of sulphuric acid, the chemical changes of cement matrix are restricted to the region close to the surface. However in some cases it is observed that deterioration process occurs accompanied by the scaling and softening of the matrix due to early decomposition of calcium hydroxide and subseques formation of large of gypsum .the chemical reactions involved in sulphuric acid attack on cement based materials can be as follow

$Ca(OH)_2 + H_2So_4$□$Caso_4.2H_2O$

$3CaO.2Sio_2.3H_2o+H_2So4$□$CaSo_4$, 2H2O

3.1. Mix proportions by weight

The present investigation describes the w/c ratio for the sample is 0.39 given in table 1. Empirical relation for the mix design of the sample is fallows as given in table 1.

Table 1: Different Parameters Based on Various Empirical Relations

Cement	Fine aggregate	Coarse aggregate	w/c ratio
1	1.12	2.28	0.39

3.1.1. MIXING

Mixing of ingredients is done in grinder mixer of capacity 40 liters. These cementitious materials are thoroughly blended and the aggregate is added and mixed followed by gradual addition of water and mixing [9]. Wet mixing is done until a constant uniform color is appeared and compaction factor test is done therefore the mix is ready for casting.

3.1.2. Casting of specimens

Before casting the concrete the moulds are been with dust particals and oil is been applied to all sides of the moulds and the concrete mix is poured in to the moulds and these moulds are to be placed on a level platform The well mixed green concrete is filled with a needle vibrator and the Excess concrete was removed with trowel and top surface should be a finished level and smooth as per IS 516-1969.

3.1.3. Curing of the specimens

These specimens are been cured for 24 hours at room temperature and are replaced to a curing pond containing of clean water and the water should be fresh.

3.2. Experimental programmer

This experiment investigation is produced by producing RH (RH) concrete by replacing cement with a range of 0%, 5%, 10%, 15%, and 20% by weight of cement and tested for 7, 28 and 60 days for compressive strengths when exposed to H_2SO_4 solution of 1%, 3%, 5% to give effect on the sulphuric acid attack [10].Results and discussions.
The following table gives the specifications of RH:

Table 2: Physical Properties of Rice Hush Ash

Density	96Kg/m3
Physical state	Solid non Hazardous
Specific Gravity	2.2
Mean particle size	25 microns
Appearance	Very fine powder
Color	Gray

The above table gives the physical properties like density, color, appearance and specific gravity of RH with concrete.

Table 3: Chemical Composition of Rh

Characteristic	Test Results %
SiO2 % by mass	88.45
A12O3by mass	0.46
Fe2O3 % by mass	0.67
MgO % by mass	0.44
Na2O3% by mass	0.12
K2O	2.91
Loss of ignition % by mass	5.81

Table 4:.Workability

% Replacement of cement with RH	Workability compaction factor
0%	0.853
5%	0.834
10%	0.815
15%	0.804
20%	0.776

Chemical composition of the RH given in table 3.
Table 4 describes about Workability for the concrete with 5% to 20% replacement Workability results are showing the permissible limits as per IS: 456-2000.

4. Results and discussions

Table 5: Compressive Strengths of M40 Grade with normal Curing

Sample Identifi-catio n	RH %	7 days Com-pressi ve Strength	28 days com-pressi ve strength	60days com-pressi ve strength
W-0	0	37.38	45.90	56.04
W-05	5	38.09	46.6	56.98
W-10	10	38.88	47.45	57.15
W-15	15	36.2	44.18	55.56
W-20	20	34.98	43.72	53.82

Table 5 represents the compressive strength of the M40 grade with normal curing of concrete in different percentages of RH. The compressive strength, at 7 days will increases gradually till the 10% replacement of cement with RH and after that the compressive strength will decreases at 15% and its continue to 20% replacement of RH with cement the below figure represents graphical representation of the values in fig.1

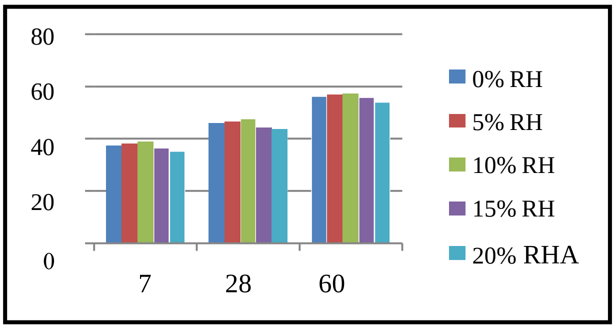

Fig. 1: Represents the Compressive Strengths at Various Percentages.

Table 6: Compressive Strength of M40 with 1% H2SO4 Chemical Solution

Sample Identifi-catio n	R H %	7days compres-siv e strength	28days com-pressiv e strength	60days com-pressiv e strength
H-11	0	34.6	42.62	52.63
H-12	5	35.46	43.28	54.60
H-13	10	36.12	45.96	55.92
H-14	15	35.12	42.92	52.96
H-15	20	33.82	41.26	52.08

Table 6 represents the compressive strength of M40 RH concrete cured with 1% H2So4 Solution under various replacements of RH 0% to 20% with 5% interval. At this point compressive strength at 7 days will gradually increase till 10% replacement of cement with RH and
After that the compressive strength will decreases at 15% and its continue to 20% replacement of RH with cement. In this table the compressive strength of concrete values are less compare to normal curing condition. The graphical representation of the table is shown in below fig.2.

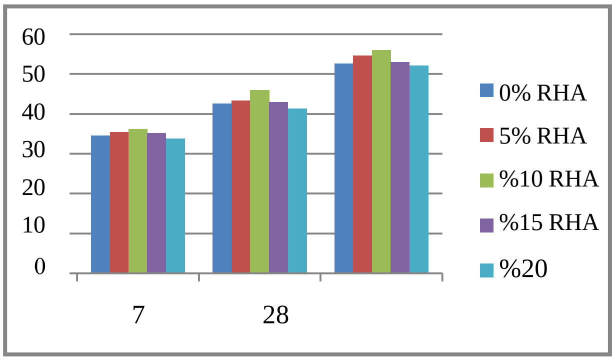

Fig. 2: Compressive Strengths of M40 RH Concrete with Various Replacements In 1% H2SO4.

Table 7: Compressive Strength of M40 in 3% H2so4 Solution

Sample Designa-tion	RH % per-cent-age	7days com-pressive strength	28days com-pressive strength	60days com-pressive strength
H-31	0	34.72	42.80	52.64
H-32	5	35.40	43.48	54.86
H-33	10	36.18	46.02	55.84
H-34	15	35.42	43.04	53.08
H-35	20	33.08	41.24	52.04

Table 7 represents the compressive strength of M40 RH concrete cured for 3% H2So4 Solution under various percentages of RH, 0% to 20% with 5% interval. The compressive strength at 7 days will gradually increase till 10% replacement of cement with RH and after that the compressive strength will decreases at 15% and it continues until 20% replacement of RH with cement. The table represents the compressive strength of concrete at which the values are less compared to normal curing condition and 2% H2So4. The below table fig.3 shows the graphical representation

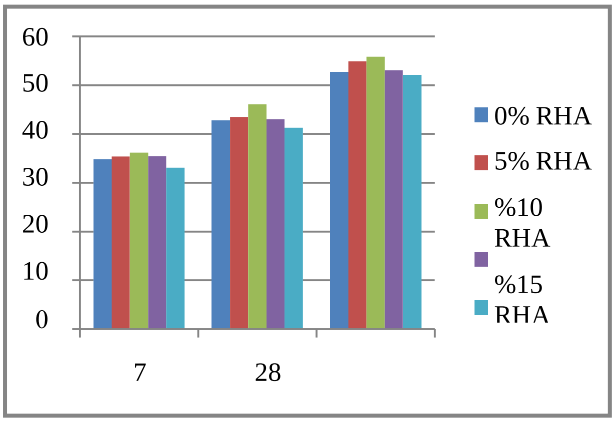

Fig. 3: Compressive Strengths of M40 RH Concrete with Various Replacements with 3% H2So4.

Table 8:.Compressive Strength for 5 % H2SO4 Solution

Sample Identification	RH %	7days compressive strength	28days compressive strength	60days compressive strength
H-51	0	34.96	43.02	52.84
H-52	5	35.62	43.84	55.02
H-53	10	36.46	46.66	56.14
H-54	15	35.64	43.34	52.38
H-55	20	34.86	41.92	52.18

Table 8 represents the compressive strength of M40 RH concrete cured with 5% H2So4 Solution under various replacements of RH 0% to 20% with 5% interval. In this compressive strength at 7 days will gradually increase till 10% replacement of cement with RH and after that the compressive strength will decrease at 15% and its continues until 20% replacement of RH with cement. The compressive strength of concrete values are less comparatively to normal curing condition. The graphical representation of the table above is shown in fig 4.

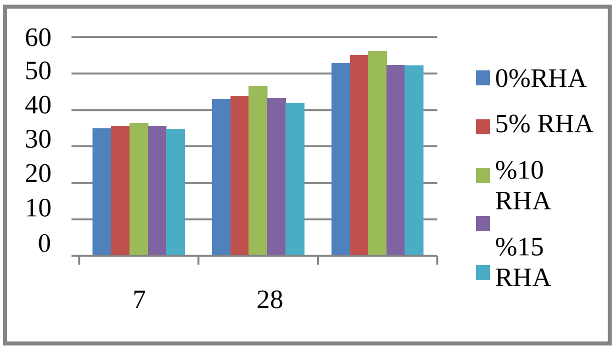

Fig. 4: M40 RH Concrete with Various Replacements in 5% H2So4 Gives Compressive Strength Results.

Fig. 5: Casted Cubes of M40 RH Concrete of 10% Replacement.

Fig. 6:10% Replacement of M40 with RH after Sulfuric Acid Attacks.

5. Conclusions

1) The workability of RH concretes have decreased when compared with ordinary concrete.
2) The compressive strengths of concrete mix with 0%, 5%, 10%, 15% and 20%, weight replacement of cement with RH, cured in fresh water for 7, 28 and 60days have reached the target mean strength.
3) The compressive strengths of concrete with 0%, 5%,10%,15% and 20%, weight replacement of cement with RH, cured at different concentrations of 1%,3%,5% H2So4 solution for 7, 28 and 60 days indicate that at 5% replacement there will be increase in strength and it extended till 10% replacement and then decreased its strength, noticed at 15% and 20% replacements ..
4) In concretes, cement can be replaced with 10% RH without sacrificing strength for important structural elements and for unimportant structural elements use 20% replacement of RH.

Acknowledgement

I would like to thank Ms.Anusha for supporting making this paper.

References

[1] BilodeauA.Sivasundaram V, K.E. Painter, and V.M.Malhotra "Durability of Concrete Incorporating High Volumes of Fly Ash from Sources in the U.S." ACI Material Journal / January - February 1994, pp. 3-12.
[2] Sivakumar, V. and Murthi, P. "Studies on acid resistance of ternary blended concrete." Asian Journal of Civil Engineering (Building and Housing), 2008 Vol. 9, No.5 pp. 473-486.
[3] M. Safiuddin, J.S. West, K.A. Soudki, "Hardened properties of self-consolidating high performanceconcrete including RH." Cem. Concr. Compos, Elsever.32 (9) (2010) 708–717.
[4] G.R. de Sensale, "Effect of RH on durability of cementitious materials." Cem. Concr. Compos.32 (2010) 718–725.
[5] Zerbino, R., Giaccio, G., Isaia, G.C., "Concrete incorporating RH without processing." Constr. Build. Mater.25 (1) 2011, 371–378.

[6] Zain, M.F.M., Islam, M.N., Mahmud, F., Jamil, M.A. "Production of RH for use in concrete as a supplementary cementitious material." Constr. Build. Mater.25 (2) 2011, 798–805.

[7] K. Kartini, "Effects of Silica in RH (RH) in producing High Strength Concrete." International Journal of Engineering and Technology Volume 2 No. 12, pp. 1951–1956, December 2012.

[8] Zerbino, R., Giaccio, G., Marfil, S. "Evaluation of alkali-silica reaction in concretes with natural RH using optical microscopy." Constr. Build. Mater. 71 2014, 132–140.

[9] Divya Chopra, Rafat Siddique and Kunal, "Strength, permeability and microstructure of self-compacting concrete containing RH." bio systems engineering 130 (2015) 72 – 80.

[10] Swaminathen, A.N., Ravi, S.B., 2016. "Use of RH and metakaolin asPozzolans for concrete: a review." Int. J. Appl. Eng.Res.11 (1) 2016, 656– 664.