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# Durability Study on Compressive Strength of concrete using Rice Husk Ash as a Partial replacement using Magnesium Sulphate Solution

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**Abstract:-** The advancement of concrete technology can reduce the consumption of natural resources and energy sources and lessen the burden of pollutants on environment. Presently large amounts of RHA are generated in Rural and Small Scale Industries with an important impact on environment and humans. In recent years, many researchers have established that the use of supplementary cementitious materials (SCMs) like fly ash (FA), blast furnace slag, silica fume, metakaolin (MK), and rice husk ash (RHA), hypo sludge etc. can, not only improve the various properties of concrete - both in its fresh and hardened states, but also can contribute to economy in construction costs.

## I. INTRODUCTION

The research work describes the feasibility of using the RHA waste in concrete production as a partial replacement of cement. This present work deals with the effect on strength and mechanical properties of cement concrete by using RHA. The utilization of RHA in concrete as a partial replacement of cement is gaining immense importance today, mainly on account of the improvement in the long term durability of concrete combined with ecological benefits. RHA collection systems have resulted in improving the consistency of RHA. The use of RHA in concrete as a supplementary cementatious material was tested as an alternative to traditional concrete.

The cement has been replaced by rice husk ash accordingly in the range of 0%, 5%, 10%, 15%, and 20% by weight of cement for mix. Concrete mixtures were produced, tested and compared in terms of compressive strengths with the Conventional concrete. These tests were carried out to evaluate the mechanical properties for the test results of 7, 28, 60 days for compressive strengths in $MgSO_4$ solution of 1%,3%,5% and also durability aspect rice husk ash concrete for sulphates attack was tested. The result indicates that the RHA improves concrete durability.

## II. LITERATURE REVIEW

**Ryan (1999)[1]** investigated on Concrete durability.He in his paper through QCL group addresses two aspects of concrete serviceability, which has been the subject of extensive recent discussion and research: sulphate attack and chloride ion penetration. The basic chemistry involved in each of these processes is outlined by him and differentiated and their effects on concrete and reinforcing steel are described. His paper relied for actual test data, showing relative performance of binder options, on experimental work carried out by researchers at the CSIRO Division of Building, Construction, and Engineering.

**Skalny et al (2002)[2]** researched on Concrete subject to sulfate attack undergoes a progressive and profound reorganization of its internal microstructure. These alterations have direct consequences on the engineering properties of the material. As seen from his studies, concrete undergoing sulphate attack is often found to suffer from swelling, spalling and cracking. There is overwhelming evidence to show that the degradation also contribute to significantly reduce the mechanical properties of concrete. He studied the behavior of hydrated cement systems tested under well-controlled laboratory conditions is also distinguished from the performance of concrete in service. He stated that Sulphate attack has significant consequences on the microstructure and engineering properties of concrete. Marked expansion and loss in the mechanical properties of the material often accompany sulphate-induced micro structural alterations.

**Abdullahi et al (2006)[3]** investigated on the compressive strength of some commercial sandcrete blocks in Minna, Nigeria was investigated. Rice Husk Ash (RHA) was prepared from burning firewood. Preliminary analysis of the Constituent materials of the ordinary Portland Cement (OPC) / Rice Husk Ash (RHA) hollow sandcrete blocks were conducted to confirm their suitability for block making. He conducted physical test of the freshly prepared mix. 150mm×450mm hollow sandcrete blocks were cast cured and crushed for 1, 3, 7, 14, 21, and 28 days at 0, 10, 20, 30, 40 and 50 percent replacement levels. He concluded the results of test and indicated compressive strength of the OPC/RHA sandcrete blocks increases with age at curing and decreases as the percentage of RHA content increases. He arrivesd at optimum replacement level of 20%, for a given mix, when the water requirement increases as the rice husk ash content increases. He stated that setting times of OPC/RHA paste increases as the ash content increases.

**Prasad et al (2006)**[4] investigated on Cement concrete which continues to be the pre-eminent construction materials for use in any type of civil engineering structure He concluded in his investigation the blended cements, particularly are better in Sodium Sulphate environment. The blended cement mixes show more deterioration in Magnesium Sulphate exposure in compared to plain cement mixes. The Magnesium Sulphate environment is more severe than Sodium Sulphate environment. The performance of low water/binder ratio mixes is inferior in Sulphate resistance. The little initial air curing of mixes is beneficial for Sulphate resistance. He also stated that The deterioration of cement mixes increases with increase in the concentration of Sulphate. The presence of Chloride ions with Sulphate ions reduces the rate of Sulphate attack on cement mixes. The deterioration rate of mixes due to Sulphate attack is higher at high temperature with alternate wetting and drying cycles.

## III. EXPERIMENTAL INVESTIGATION

The experimental investigation carried out by cement has been replaced by rice husk ash accordingly in the range of 0%, 5%, 10%, 15%, and 20% by weight of cement for mix. Concrete mixtures were produced, tested and compared in terms of compressive strengths with the Conventional concrete. These tests were carried out to evaluate the mechanical properties for the test results of 7, 28, 60 days for compressive strengths in $MgSO_4$ solution of 1%,3%,5% and also durability aspect rice husk ash concrete for sulphates attack was tested. The result indicates that the RHA improves concrete durability.

## IV. TEST RESULTS & DISCUSSION

The following table gives the specifications of Rice Husk Ash

**Table.1 Physical Properties of RHA**

| S. No. | Property | Test Result |
|---|---|---|
| 1. | Density | 96 kg/m$^3$ |
| 2. | Physical state | Solid non-Hazardous |
| 3. | Appearance | Very fine powder |
| 4. | Particle size | 25 microns – mean |
| 5. | Color | Gray |
| 6. | Specific gravity | 2.3 |

**Table.3 Properties of $MgSO_4$**

| Chemical | Volume (%) |
|---|---|
| pH (5% water) | 6.3 |
| Free Alkali sol. (as NaOH) | 0.008 |
| Free Acid (as $H_2SO_4$) | 0.01 |
| Chlorides | 0.02 |
| Heavy metals (Pb) | 0.0005 |
| Arsenic | 0.0002 |
| Iron (Fe) | 0.01 |
| Selenium (Se) | 0.001 |
| Loss of Drying (at 450°c) | 50.4 |

**Compressive strength of concrete:**

**Table 4.0 Compressive Strength results for cubes cured in water**

| Sample Designation | % of RHA | compressive strength at 7 days ($f^1_{cu}$) | compressive strength at 28 days ($f^1_{cu}$) | compressive strength at 60days ($f^1_{cu}$) |
|---|---|---|---|---|
| W-0 | 0 | 36.89 | 45.83 | 55.69 |
| W-05 | 5 | 37.72 | 46.75 | 56.16 |
| W-10 | 10 | 38.79 | 47.69 | 58.63 |
| W-15 | 15 | 35.86 | 44.78 | 56.43 |
| W-20 | 20 | 35.78 | 43.79 | 55.57 |

**DURABILITY STUDIES**

**Table 5. Compressive Strength results cured in 1% magnesium sulphate solution**

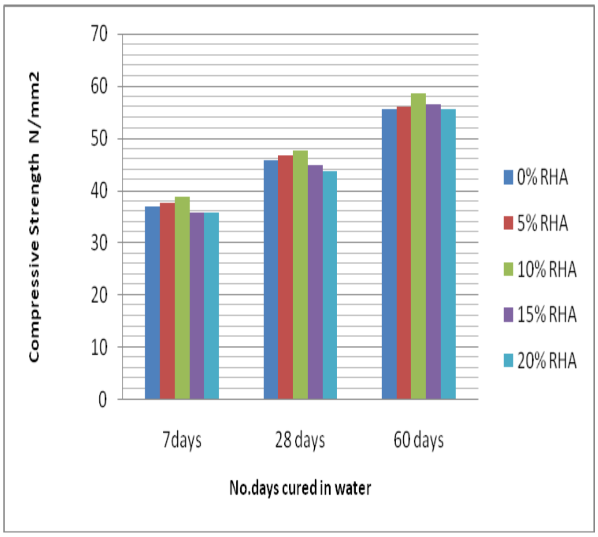
| Sample Designation | % of RHA | compressive strength at 7 days ($f_{cu}$) | compressive strength at 28 days ($f_{cu}$) | compressive strength at 60days ($f_{cu}$) |
|---|---|---|---|---|
| M-11 | 0 | 35.00 | 43.59 | 53.02 |
| M-12 | 5 | 36.03 | 44.57 | 53.57 |
| M-13 | 10 | 37.12 | 45.67 | 56.10 |
| M-14 | 15 | 34.29 | 42.61 | 53.74 |
| M-15 | 20 | 34.10 | 41.72 | 52.96 |

**Table 6. Compressive Strength results cured in 3% magnesium sulphate solution**

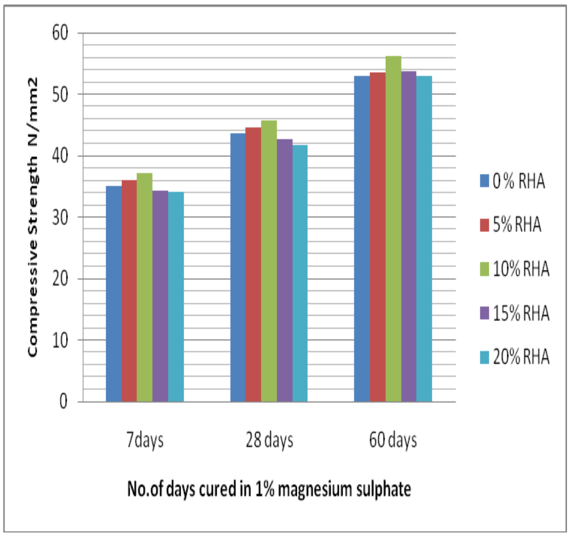
| Sample Designation | % of RHA | compressive strength at 7 days ($f_{cu}$) | compressive strength at 28 days ($f_{cu}$) | compressive strength at 60days ($f_{cu}$) |
|---|---|---|---|---|
| M-31 | 0 | 35.17 | 44.60 | 54.28 |
| M-32 | 5 | 36.54 | 45.67 | 54.93 |
| M-33 | 10 | 37.98 | 46.86 | 57.89 |
| M-34 | 15 | 34.88 | 43.58 | 55.34 |
| M-35 | 20 | 33.68 | 42.68 | 54.47 |

**Table 7. Compressive Strength results cured in 5% magnesium sulphate solution**

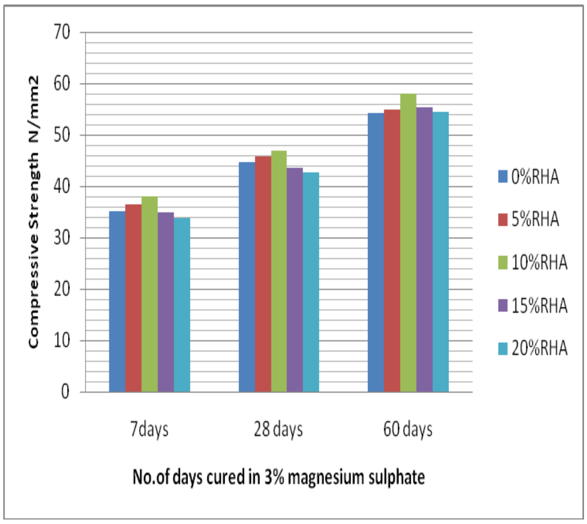
| Sample Designation | % of RHA | compressive strength at 7 days ($f_{cu}$) | compressive strength at 28 days ($f_{cu}$) | compressive strength at 60days ($f_{cu}$) |
|---|---|---|---|---|
| M-51 | 0 | 35.09 | 43.62 | 53.39 |
| M-52 | 5 | 36.21 | 44.81 | 53.90 |
| M-53 | 10 | 37.17 | 45.87 | 57.22 |
| M-54 | 15 | 34.32 | 42.72 | 54.68 |
| M-55 | 20 | 33.26 | 41.89 | 53.78 |



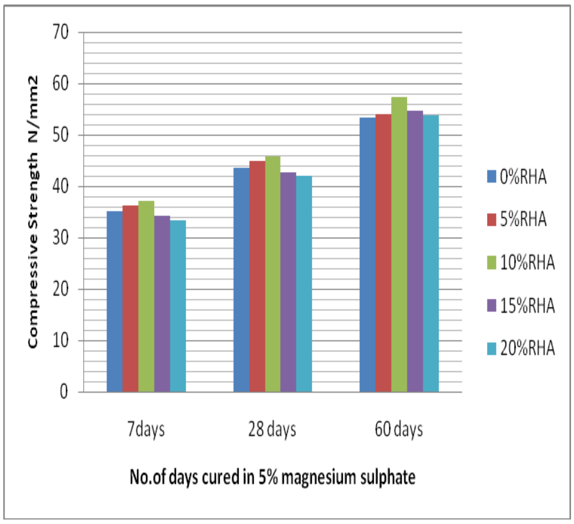

**Graph 1. Compressive strength results cured in water**




**Graph 2. Compressive strength results cured in 1% $MgSo_4$ solution**




**Graph.3 Compressive Strength results in 3% $MgSo_4$ solution**




**Graph.4 Compressive Strength results cured in 5% $MgSo_4$ solution**

**Fig.5 Mixing of cement with RHA**

**Fig.6 Cubes after curing in $MgSo_4$ solution**

## V. CONCLUSIONS

1. The specific surface area of RHA is 420 $m^2$/kg greater than 330 $m^2$/kg of cement. The workability of RHA concretes have decreased in compared with ordinary concrete. It is inferred that reduction in workability is due to large surface area of RHA.
2. The compressive strengths of concrete (with 0%, 5%, 10%, 15% and 20%, weight replacement of cement with RHA) cured in Normal water for 7, 28, 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 RHA ) cured in different concentrations of (1%,2,%,3%,4%,5%) **Magnesium Sulphate** solution for 7, 28, 60 days indicate that at 5% replacement there is increase in strength and it extended in 10% replacement also and then decrease in strength is noticed at 15% and 20% replacements .
4. Due to slow pozzolanic reaction the Rice Husk Ash(RHA) concrete achieves significant improvement in its mechanical properties at later ages.
5. In concretes cement can be replaced with 20% RHA without sacrificing strength.

## REFERENCES

[1]. Mick Ryan, Sulphate Attack and Chloride Ion Penetration: Their Role in Concrete Durability, QCL Group Technical Note, Australia, March 1999.

[2]. Jan Skalny, Jacques Marchand and Ivan Odler, Consequences of sulfate attack on concrete, 2002.

[3]. E. B. Oyetola and M. Abdullahi, The use of rice husk ash in low - cost sandcrete block production, Federal University of Miami, June 2006.

[4]. J. Prasad, D.K. Jain and A.K. Ahuja, factors influencing the Sulphate resistance of cement concrete and mortar, IITR-Roorke, 2006.

[5]. M.R. Gidde and A.P. Jivani Waste to Wealth - Potential of Rice Husk in Indian Literature Review, Bharati Vidyapeeth Deemed University Callege of Engineering,pune,2007.

[6]. Ghassan Abood Habeeb, Hilmi Bin Mahmud Study on Properties of Rice Husk Ash and Its Use as Cement Replacement Material, March 2010.