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Effect of Rice Husk Ash as a Partial Replacement of Ordinary Portland cement in Concrete

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Abstract - ***This research was experimentally carried out to investigate the properties of Rice Husk Ash (RHA) when used as a partial replacement for Ordinary Portland cement (OPC) in concrete. Ordinary Portland cement (OPC) was replaced with Rice hush Ash (RHA) by weight at 0%, 5%, 10%, 15%, 20% and 25%. On fresh concrete, compacting factor test was carried out and on hardened concrete cubes of 150mm Compressive Strength test was carried out after 7, 14 and 28 days of curing. The results revealed that the Compacting factor decreases as the percentage replacement of Ordinary Portland cement (OPC) with Rice hush Ash (RHA) increases, which indicate less workable concrete. The compressive strength of the hardened concrete also decreases with increasing Ordinary Portland cement (OPC) replacement with Rice hush Ash (RHA). This study therefore is an investigation of the performance of the concrete made of partially replacing Ordinary Portland cement (OPC) with Rice hush Ash (RHA) on the properties of Rice hush Ash (RHA) concrete.***

Key Words: *Compacting factor, Compressive strength, Concrete, Rice Husk Ash, etc.*

1. INTRODUCTION

Cement will remain the key material to satisfy global housing and modern infrastructure needs. The need to reduce the high cost of Ordinary Portland Cement in order to provide accommodation for the populace has in-depth study into the use of some locally available materials that could be a partial replacement for Ordinary Portland Cement (OPC) in Construction Engineering Works. Supplementary cementitous materials have been proven to be effective in meeting most of the requirements of durable concrete and blended cements are now used in many parts of the world.

The main aim of this research is to put Rice Hush Ash (RHA) into effective use a local additive, as it has been investigated to be super pozzolanic in a good proportion to reduce the high cost of structural concrete. Rice Husk Ash (RHA) is an agricultural by-product and a good pozzolans. The disposal of RHA is the bothering question for waste managers. Today, Concrete is widely used building material world-wide. The most expensive concrete material is the binder (cement) and if such all-important expensive material is partially replaced with more natural, local and affordable material like RHA will not only take care of waste management but will also reduce the problem of high cost of concrete and housing.

This research work examined and involved the determination of workability and compressive strength of the concrete at different level using Rice Husk Ash as partial replacement for Ordinary Portland Cement in concrete.

2. MATERIALS AND METHODS

2.1. Materials

2.1.1. Rice Husk Ash (RHA)

The Rice Husk obtained, was burnt under guided or enclosed place to limit the amount of ash that will be blown off.. The ash was ground to the required level of fineness and sieved through 600 µm sieve in order to remove any impurity and larger size particles. Batching was done by volume at replacement percentages of 0, 5, 10, 15, 20, and 25%

2.1.2. Coarse Aggregate

The granite used for this research work was 12mm size. Proper inspection was carried out to ensure that it was free from deleterious materials as per the requirements of IS: 383 (1970).

2.1.3. Fine Aggregate

The project work is restricted to sand collected from the river. The impurities were removed and it conformed to the requirements of IS: 383 (1970).

2.1.4. Cement

The cement used was Ordinary Portland Cement and it confirmed t the requirements of Indian Standards as per the requirements of IS: 8112 (1989).

2.1.5. Water

The water used for the study was obtained from a free flowing stream. The water was clean and free from any visible impurities. It conformed to IS: 10262 (2009) requirements.

2.2 Batching and Mixing of Materials

Batching of materials was done by weight. The percentage replacements of Ordinary Portland cement (OPC) by Rice Husk Ash (RHA) were 0%, 5%, 10%, 15%, 20% and 25%. The 0% replacement was to serve as control for other samples.

Concrete is a mixture of water, cement, aggregate (coarse and fine) and admixture. It is important that the constituent material remain uniformly distributed within the concrete mass during the various stages of handling and that full compaction is achieved, and making sure that the characteristics of concrete which affect full compaction like consistency, mobility and compatibility are in conformity with relevant codes of practice.

3. RESULTS AND DISCUSSIONS

3.1 Compacting Factor Test

The results obtained from the compacting factor test on fresh concrete samples are given in Table 1.

Table -1: Compacting factor values of RHA concrete

Sr. No.	Percentage replacement of RHA (%)	Compacting Factor Values
1	0	0.92
2	05	0.91
3	10	0.90
4	15	0.89
5	20	0.88
6	25	0.88

The table indicates that the compacting factor values get reduced on increasing the RHA content. The compacting factor values reduced from 0.92 to 0.88 as the percentage RHA replacement increased from 0% to 25%. These results indicate that the concrete becomes less workable (stiff) as the RHA percentage increases meaning that more water is required to make the mixes more workable. The high demand for water as the RHA content increases is due to increased amount of silica in the mixture.

3.2 Bulk Densities of Concrete Cubes

The Bulk Densities of the Concrete Cubes are shown in Table 2 as well as graphically explained in Figure 1.

Table -2: Bulk Densities of concrete cubes

Percentage replacement of RHA (%)	Bulk Density (g/cm³)		
	7 days	14 days	28 days
0	2.32	2.35	2.43
5	2.31	2.31	2.33
10	2.28	2.30	2.30
15	2.28	2.28	2.30
20	2.13	2.23	2.28
25	2.08	2.16	2.27

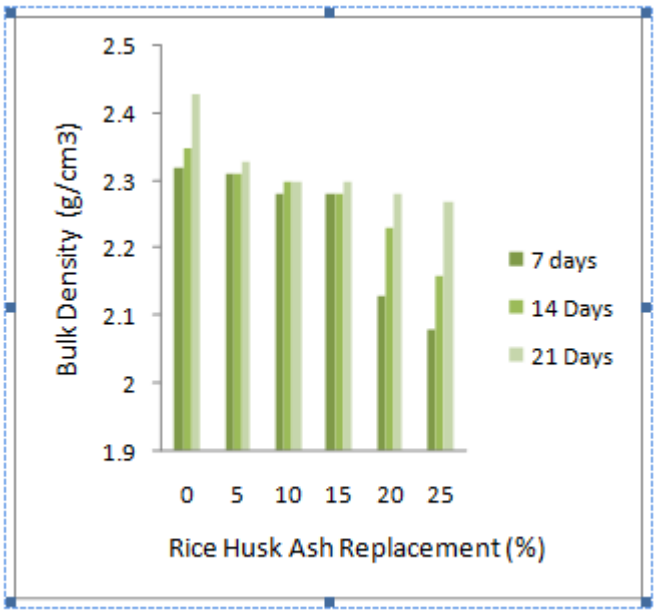

Fig -1: Bulk Density vs. RHA replacement

The results of the bulk densities show that the bulk density is reducing as the percentage RHA increases. This could be attributed to the increase in voids in the concrete cubes as the percentage RHA increases. However, the bulk densities increase as the number of days of curing increase as the concrete cubes become denser.

3.3 Compressive Strength Tests on concrete cubes

The results of the compressive strength tests on concrete cubes are shown in Table 3 as well as graphically explained in Figure 2

Table -3: Compressive Strength of concrete cubes

Percentage replacement of RHA (%)	Compressive Strength (N/mm2)		
	7 days	**14 days**	**28 days**
0	18.51	21.60	28.15
5	16.82	17.87	26.86
10	12.70	13.43	20.11
15	11.56	12.65	18.65
20	10.64	12.02	18.52
25	7.84	8.22	11.26

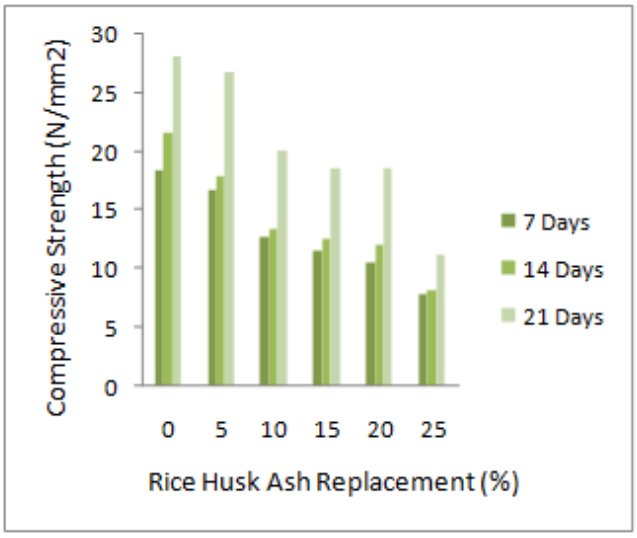

Fig -2: Compressive strength vs. RHA replacement

The results of the compressive strength of concrete cubes shown in Table 3 conclude that, as the percentage RHA increased, the compressive strengths get reduced. Despite, the compressive strengths increased as the number of days of curing increased for each percentage RHA replacement. It is noted from Table 3 that for the control cube, the compressive strength increased from 18.51 N/mm2 at 7 days to 28.15 N/mm2 at 28 days (68% increment). The 28 day strength was above the specified value of 25N/mm2 for grade 25 concrete. The strength of the 5% replacement by rice husk ash showed increase in compressive strength from 16.82 N/mm2 at 7 days to 26.86 N/mm2 at 28 days (63% increment). The 28 day strength was above the specified value of 25N/mm2 for grade 25 concrete. The strength of the 10% replacement by rice husk ash showed increase in compressive strength from 12.70 N/mm2 at 7 days to 20.11 N/mm2 at 28 days (63% increment). The 28 day strength was above the specified value of 20N/mm2 for grade 20 concrete. The strength of the 15% replacement by rice husk ash showed increase in compressive strength from 11.56 N/mm2 at 7 days to 18.65 N/mm2 at 28 days (62% increment). The 28 day strength was above the specified value of 15N/mm2 for light weight concrete. The strength of the 20% replacement by rice husk ash showed increase in compressive strength from 10.64 N/mm2 at 7 days to 18.52 N/mm2 at 28 days (58% increment). The 28 day strength was above the specified value of 15N/mm2 for light weight concrete.

4. CONCLUSIONS

Study of the investigation has concluded the following,

- The optimum addition of RHA as partial replacement for cement for better performance is between the range of 0-20%.
- The compacting factor values of the concrete reduced as the percentage of RHA increased.
- The Bulk Densities of concrete reduced as the percentage RHA replacement increased.
- The Compressive Strengths of concrete reduced as the percentage RHA replacement increased.

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