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TECHNICAL ADVANCEMENT BY RICE HUSK ASH IN LOW COST HOUSING CONSTRUCTION

S.VenkataSai Kumar*
M.Chiranjeevi**
A.Udaykumar***
K.GangadharRao****

Abstract

The improvement of concrete technology can able to decrease the pollutants on environment and usage of natural resources. This paper explains the usefulness of using Rice husk ash (RHA) in concrete production as a partial replacement of cement. After replacement, this can improve the strength as well as durability properties of concrete. RHA has high reactivity and pozzolonic property and this property depends on temperature. Concrete mixtures were produced and tested both with RHA and without RHA replacement in terms of compressive strength and results have been compared between both of them. 30% replacement of cement with RHA has been done in all cases. Soil stabilization and ground improving techniques have become a important issue in construction field now a days. The common soil stabilization methods are becoming more costly because of high cost of stabilizing agents like lime, cement etc. The cost of the stabilization may be decreased by proper replacement of RHA with suitable proportion. Soil replacement with RHA and also different tests have been conducted to check the effectiveness of RHA in the soil stabilization aspect. So that RHA usage can reduce the cost of the total construction.

Keywords:

Rick husk ash (RHA);
Soil stabilization;
Replacement of Cement;
Concrete technology;
Pozzolonic.

Author correspondence:

S.VenkataSai Kumar,
M.Tech, Structural Engineering
Assistant Professor, Baba Institute of Technology and sciences (BITS Vizag)

1. Introduction (10pt)

The utilization of RHA as a pozzolanic material in cement and concrete provides several benefits, such as enhanced strength and durability aspects, minimize materials price due to cement savings, and environmental benefits related to the disposal of waste materials. In the present investigation cement was replaced by Rice Husk Ash at various percentages and its effect on the compressive Strength and its Durability properties like water absorption, porosity, permeability, resistance to acid attack, alkaline attack and sulphate attack was studied. In this paper the proper percentage of RHA replacement has been found out.

*Assistant Professor, Baba Institute of Technology and sciences (BITS Vizag)
**Assistant Professor, Baba Institute of Technology and sciences (BITS Vizag)
***Assistant Professor, Baba Institute of Technology and sciences (BITS Vizag)
****B.Tech graduate, Civil engineering department, AP IIIT Nuzvid

This RHA also helpful in the soil stabilization process and reduce the cost also. The soil can stabilized with different percentages of Rice Husk Ash and a small amount of cement. The RHA which is using in this paper is an admixture to enhance different properties of the concrete, which includes workability and strength and durability as main considerations. Workability, strength and durability are three main properties of concrete. In this paper the admixture rice husk ash is playing an important role to determine the improved strength of the concrete which we are taking 30% by weight of cement.

The RHA which is using in this project is an admixture to improve different properties of the concrete, which includes workability and strength and durability as main considerations. Workability, strength and durability are three basics properties of concrete. Amount of useful internal work necessary to overcome the internal friction to produce full compaction is termed as workability. Size, shape, surface texture and grading of aggregates, water cement ratio, use of admixtures and mix proportion are important factors in affecting workability. Here in this project the admixture rice husk ash is playing an important role to determine the improved strength of the concrete which we are taking 30% by weight of cement.

The factors affecting the strength are mainly cement, water cement ratio, grading of aggregates, effectiveness of curing, and age at the time of testing. Durability is the sustenance of shape, size and strength, resistance to exposure conditions, disintegration and wearing under adverse conditions.

During service life of structures, penetration of water and aggressive chemicals, carbonation, chloride ingress, leaching, sulphate attack, alkali-silica reaction and freezing-thawing are resulting deterioration. Loading and weathering inter link voids and micro-cracks present in transition zone and network of same micro cracks gets connected to cracks on concrete surface which provides primary mechanism of the fluid transport to interior of concrete. Subsequent increase of penetrability leads to easy ingress of water, oxygen, carbon dioxide and acidic ions etc., into concrete resulting cracking, loss at mass, strength and stiffness.

Rama Krishna Bolla et al. observed that 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. 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, 60, 90 and 180 days have reached the target mean strength [1].

M.R.Satat concluded that at the early ages of hydration rice husk ash acts as a filler whereas at later ages it acts as pozzolana. Increasing rice husk ash content makes a dilution effect, requires higher water demands and forms a layer of rice husk ash particles around anhydrous cement grains which delays the hydration of cement [2]. **AlirezaNajiGivi et al** concluded that RHA blended concrete can decrease the temperature effect that occurs during the cement hydration. RHA blended concrete can improve the workability of concrete compared to OPC. It can also increase the initial and also final setting time of cement pastes. Additionally, RHA blended concrete can decrease the total porosity of concrete and modifies the pore structure of the cement [3].

SeyedAlirezaZareei et al.,concluded that usage of additives to cement can serve to create mechanical and pro- mechanical aspects of that can be asource of economical and biological benefits, higher levels of slump flow, cohesion of fresh mixture, and strength during hardened state. Theses aspects leads to more potential opportunities can be understood in it are entirely and exploited to improve concrete properties. Here, 6 mix plans varies in RHA proportions by about 0–25% also a control mix prepared to. Although there is a significant number of a study focused on application and workability of partial replacement of mineral additions in concrete, the present study aimed to present an analysis based on benefits resulting from different contents of RHA.

2. Research Method

2.1 Materials used

2.1.1 Cement

The ingredients of cement primarily consist of calcareous materials in the form of limestone, chalks and marl and argillaceous materials. The ordinary Portland cement of 53 Grade is used. The specific gravity of cement is 3.15. For ordinary Portland cement, the initial setting time is 55 minutes and the final setting time is 600 minutes.

2.1.2 Aggregates

2.1.2.1 Fine Aggregates

Fine aggregate is a material such as sand, crushed stones or crushed gravel passing through 4.75 mm size. Locally available sand is used as fine aggregate in the concrete mix. The specific gravity of fine aggregate is 2.65.

2.1.2.2 Coarse Aggregates

Material which retained on 4.75 mm size is classified as coarse aggregate. For most works, 20 mm aggregate is suitable. The locally available 20 mm size of aggregate is used. The specific gravity of coarse aggregate is 2.94.

2.2. Tests to find out concrete strength with and without RHA

Cement tests are useful to check the properties of the cement which is used in the construction work whether the taken cement is usable or not. The following tests are conducted. Now these tests are performed with the cement with the addition of 30% of RHA by weight has given good results.

Consistency test, setting time, specific gravity test, soundness test, compressive strength tests has been done with and without replacement of cement with RHA. And results have been compared to check the effect of RHA on compressive strength and durability aspects.

The compressive strength gives a good and clear indication that how the strength is affected with the increase of fibre volume dosage rate in the test specimens. In India, concrete specimens for compressive strength test were 150mm diameter and 300mm height. Although in IS456 stated that the specimens for compressive strength can be 150mm diameter and 150mm height, but this only applies to the maximum aggregate size more than 20mm. The test procedure was carried out accordance with IS456.

Cube compressive test was performed and compare the results with RHA contained cubes. Split tensile test was carried out to find out tension capacity of concrete and also RHA effect on that strength. Flexural strength of a concrete is a measure of its ability to resist bending. Flexural strength can be expressed in terms of 'modulus of rupture'. Concrete specimens for flexural strength were cross sectional area of 150mm width with 150mm depth and length of 700mm concrete beam. The specimen is subjected to bending, using four point loading until it fails. Flexural capacity also found out with help of flexural strength test.

2.3. Tests to find out soil strength with and without RHA

Compaction test and California bearing ratio tests have carried out for addition of cement and RHA. The tests have been conducted for only soil to understand bearing capacity. And after that it has extended to cement and soil, finally tests also have been conducted for soil cement and RHA combination.

3. Results and Analysis

3.1. Tests for concrete

In this section of paper, I have compared the results of tests conducted for both two cases

i. Without RHA addition

ii. With RHA addition

3.1.1. Test reulst of concrete for both cases

S.No	Tests for concrete	Without RHA addition	With RHA addition
1	Average Cube compressive strength	31.28 N/mm^2	36.97 N/mm^2

2	Split tensile strength	2.4 N/mm^2	2.3 N/mm^2
3	Flexural strength of concrete	4.8 N/mm^2	5.12 N/mm^2

By comparing the above results, it was observed that the average cube compressive strength increased when 30% of cement replaced with RHA. And the split tensile strength of concrete more are less same in both cases and again the flexural strength of concrete increased with RHA.

3.2. Tests for soil with cement and RHA

In this section of paper, I have compared the results of tests conducted for both two cases

i. Only Soil

ii. Soil+cement

iii. Soil+cement+RHA

3.2.1 Compaction test for only soil

Test No.	**1**	**2**	**3**	**4**	**5**
Mass of mould+compacted soil (g)	5724	5913	6179	6156	6130
Mass of compacted soil, W_t(g)	1468	1657	1923	1900	1874
Bulk density	1.471	1.661	1.928	1.904	1.878
Average water content w (%)	11.3	16.6	18.18	20.08	29.03
Dry density (g/cc)	1.322	1.424	1.631	1.580	1.455
Dry density at 100% saturation (g/cc)	1.913	1.736	1.690	1.639	1.428

3.2.2 Compaction test of soil with cement

Test No.	**1**	**2**	**3**	**4**	**5**
Mass of mould+compacted soil (g)	6067	6092	6125	6103	6089
Mass of compacted soil, W_t(g)	1813	1838	1871	1846	1835
Bulk density	1.817	1.842	1.874	1.850	1.839
Average water content w (%)	20.51	22.415	27.74	26.57	29.68
Dry density (g/cc)	1.506	1.508	1.511	1.461	1.418
Dry density at 100% saturation (g/cc)	1.758	1.701	1.636	1.588	1.514

3.2.3 Compaction test of soil with both cement and RHA

Test No.	**1**	**2**	**3**	**4**	**5**
Mass of mould+compacted soil (g)	6000	6016	6028	6017	5900
Mass of compacted soil, W_t(g)	1746	1762	1774	1763	1646
Bulk density	1.750	1.766	1.778	1.763	1.650
Average water content w(%)	41.4	42.5	43.85	45.55	46.60
Dry density (g/cc)	1.237	1.239	1.241	1.211	1.125
Dry density at 100% saturation (g/cc)	1.233	1.216	1.197	1.173	1.158

The above results of soil shows that moisture content more in case of soil with both cement and RHA sample than the only cement and soil sample. And also dry density minimal in case of soil with cement and RHA.

3.2.4 California Bearing ratio test (CBR) value of soil:

S.No	**Property**	**Result value**
1.	CBR (%) Un-Soaked	9.08
2.	CBR (%) Soaked (4 days)	2.159
3.	CBR (%) Soaked (7days)	1.238

3.2.4 California Bearing ratio test (CBR) value of Soil with cement:

S.No	**Property**	**Result value**
1.	CBR (%) Un-Soaked	38.47

2.	CBR (%) Soaked (4 days)	17.64
3.	CBR (%) Soaked (7days)	1.238

3.2.5 California Bearing ratio test (CBR) value of Soil with cement and RHA:

S.No	Property	Result value
1.	CBR (%) Un-Soaked	61.45
2.	CBR (%) Soaked (4 days)	22.99
3.	CBR (%) Soaked (7days)	19.23

CBR value seems to be good in third case i.eSoil+Cement+RHA for both 4 days and 7 days of soaking.

4. Conclusion

It was concluded that 30% replacement of cement with RHA in concrete can increase the effectiveness in the form of compressive and flexural strengths. But the split tensile strengths more are less same in all cases. Soil strength also increases with RHA product. Cost of the total project can be reduced with replacement of cement with RHA and RHA soil stabilization. So it is advisable to use this technique to construct low cost houses.

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