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COMPARATIVE STUDY ON IMPACT OF RICE HUSK ASH AND FLY ASH IN CONCRETE MIX DESIGN FOR DIFFERENT GRADES OF CONCRETE

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Abstract

This study is about the addition of furnace incinerated Rice Husk Ash into concrete with fly ash. The primary objective of this research work is to investigate the mechanical properties like compressive strength and to reduce the overall cost of construction. RHA and fly ash was used to replace cement partially at different rates, fly ash is used at the rate of 0%, 5% and 10% and RHA at the rate of 5% and 10%. The physical properties of RHA were determined by particle size analyzer. Pozzolanic reactivity of RHA is dependent on silica form. The silica form in RHA is determined by incineration process. To decide it is in crystalline form optimum cement replacement ratio of RHA and fly ash found at 5%+5%. In this investigation firstly two lower grades concrete M-15 and M-20 were prepared and the best result was found with M--15 grade of concrete, then experiment were done with higher grades i.e. M-30 and M-35 grades and there is slight increase in compressive strength in higher grades.

CASE-I, for M-15 Grade of concrete during the experiment it has been noticed that the maximum 28 day compressive strength of nominal cube obtained was 21.1 N/mm², for a mix with RHA and fly ash of 5%+5%, 26.7 N/mm² compressive strength is found, and hence an increase in strength over normal concrete is 26.54% when we added RHA.

CASE-II, For M-20 Grade of concrete, during the experiment it has been noticed that the maximum 28 day compressive strength of nominal cube obtained was 27.2 N/mm², for a mix with RHA and fly ash of 5%+5%, 34.5N/mm² compressive strength is found, and hence an increase in strength over normal concrete is 26.83% when we added RHA. In case of higher grades in CASE-III, there is 11.33% increase in compressive strength of M-30 grade concrete and in CASE-IV, there is 12.49% increase in compressive strength of M-35 grade concrete. It has been found during experiments that as the percentage of RHA increases the compressive strength increases initially, on further increase in its percentage compressive strength will be reduced.

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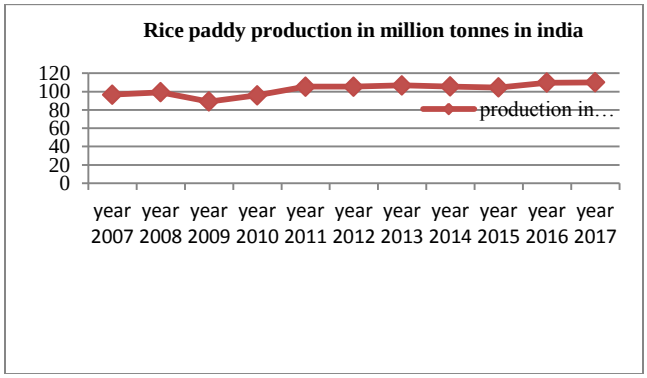
Key words: - RHA, FA, compressive strength, compaction factor, workability, incineration

I. Introduction

In the construction industry cement is a fundamental building material used as a binder. In India the demand of Cement is increasing very fast due to the rapid development. Limestone and 1400^0C heat in the kiln are required as the primary products for the production of cement. The byproduct releases in the production of cement is CO_2 which is considered as directly emission. The amount of energy required to produce one ton of cement is approximately 4.9 million Kilo jule. 1 ton of cement production also generates approx a ton of CO_2. As we know CO_2 is a greenhouse gas that attributed to global warming and greenhouse effect. In India rice plays an important role as a primary food product for millions of peoples

In India, rice paddy production according to FAO.



RHA as Supplementary Binder: - As the RHA has good reactivity so can be utilized as a partial substitute for cement. That country which produces a huge amount of rice husk can utilized as a replacement of cement in various construction works, as we know the properties found in rice husk ash are similar for some extend.

Rice husk ash consists of the following:

1. Cellulose ($C_5H_{10}O_5$)
2. Lignin ($C_7H_{10}O_3$)
3. Hemi cellulose
4. SiO_2
5. Holocellulose.

These are compounds within them in common. The composition of RHA also depends on the type of treatment as well as on the source. Treatment means the process used to burn the rice husk, so the method of burning also brings some changes in the properties of rice husk ashes. And make changes in the chemical composition of RHA.

II. Objectives of Mix Design

Objectives of the study are as follows-

1. To reduce the weight of concrete
2. To analyze the cost of concrete and also reduce the total construction cost.
3. To determine the properties of Furnace Incinerated Rice Husk Ash with different temperatures.
4. To optimize the replacement ratio of Rice Husk Ash in blended cement.
5. To reduce the cost of concrete.
6. To utilize the rice husk as it is agriculture generated waste.

III. Methodology and Experimental Program

The mechanical properties of Rice husk ash and partial replacement of cement with fly ash and rice husk ash at different percentages are determined in this study. The physical characteristics determined by particle size analysis. Also the chemical composition of RHA is determined in table. Different ratio of partial replacement of cement with fly ash will be carried out by mixing concrete. The mechanical properties of RHA concrete which include compressive strength and microstructure will be tested.

IMAGE NO: Rice husk before incineration

Number of samples:-

- Compressive strength test design procedure: fly ash at the rate of 5%, 10% and 15% is taken to replace the amount of cement with two percentages of RHA (5% and 10%).
- Conventional mix tests (0% RHA and 0% fly ash) = 4 samples = 4x3x3 (7days, 14days, 28days) =36 cubes.
- Samples prepared in mix with RHA and fly ash = 24x3x3 (7days, 14days, 28days) =36+216=252 samples.
- Samples made= approximately 63 specimen for each mix.
- M-15 Grade of concrete=7 sample =63 cubes
- M-20 Grade of concrete=7 sample =63 cubes
- M-30 Grade of concrete=7 sample =63 cubes
- M-35 Grade of concrete=7 sample =63 cubes

Laboratory Test Procedure:-

Mixing procedure:- Mixing of concrete was carried out in the laboratory. In this study hand mixing was used to mix the concrete. This concrete mixing was done on a piece of plywood. Before mixing all the materials were weighted. To reduce the water loss the surface of plywood was wetted before putting the materials.

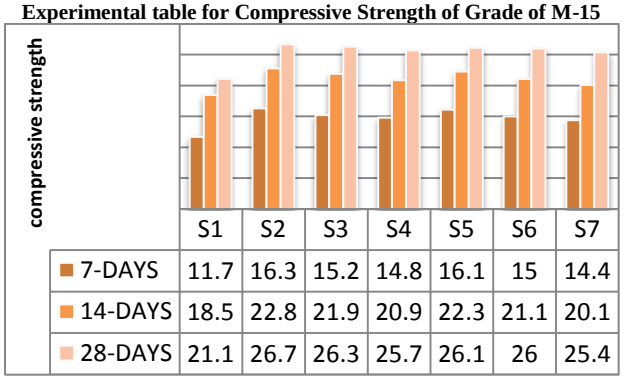
Preparation of RHA: - A muffle furnace is used to burn rice husk collected from local mills, which is located in the EV laboratory. RHA is burnt under a controlled temperature of 6000C and 7000C for the minimum period of two hours respectively. The rice husk ash is a very fine material this fineness of RHA directly influences the amount of total C-S-H gel formed in the concrete. This fineness of rice husk ash helps in increasing strength of concrete but also reduces the workability of concrete due to the increase the water demand.

Slump test:- Slump cone test was used to find out the workability of fresh concrete in this study. The apparatus used in this test consist of a base plate, compacting rod and mould. A steel mould was used in the test having dimensions, height=300mm, diameter of bottom base=200mm, diameter of top=100mm.The mould and base place must be damped before testing workability. Then the fresh concrete mixture was filled into the mould in three layers and each layer was compacted by using compacting rod for 25 times. After filling up to the top surface the mould was lifted upward steadily with no lateral or torsion motion. The difference between the highest point of the sample and the height of the mould is defined as the slump value.

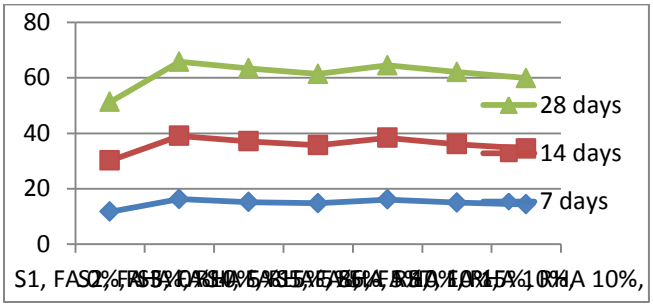
Compression Strength Test:-Compressive strength is the main property of concrete as mentioned before. Universal testing machine present in the workshop was used for testing the compressive strength of concrete. Cube test which according to British Standard (BS EN 12390-3: 2002) was conducted with the standard dimension of 150 mm × 150 mm × 150 mm. sample was placed in the UTM and

loaded to the failure, and the maximum value of load was noted sustained by concrete. The capacity of this machine is 200kN with the rate of 40 KN/s. The weight of concrete sample was recorded before conducting the test for reference purpose. The surface of the sample and the platen of the machine were wiped before testing to ensure the accuracy. After the sample was placed and locked, the load was started until no greater load can be sustained by the concrete and the data was recorded.

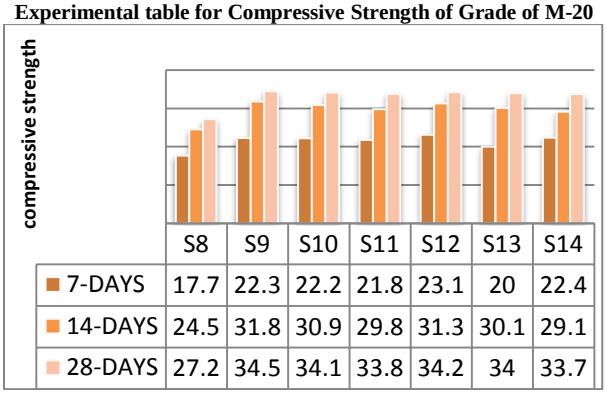
Experimental table for Compressive Strength of Grade of M-15



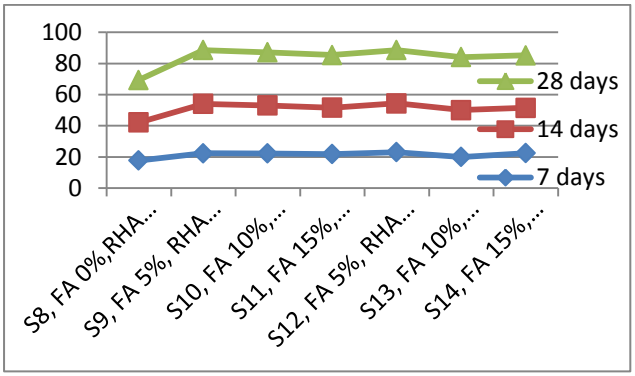
	S1	S2	S3	S4	S5	S6	S7
7-DAYS	11.7	16.3	15.2	14.8	16.1	15	14.4
14-DAYS	18.5	22.8	21.9	20.9	22.3	21.1	20.1
28-DAYS	21.1	26.7	26.3	25.7	26.1	26	25.4



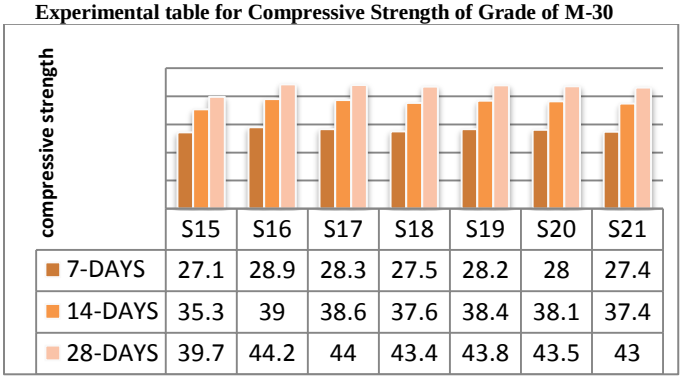
Experimental table for Compressive Strength of Grade of M-20



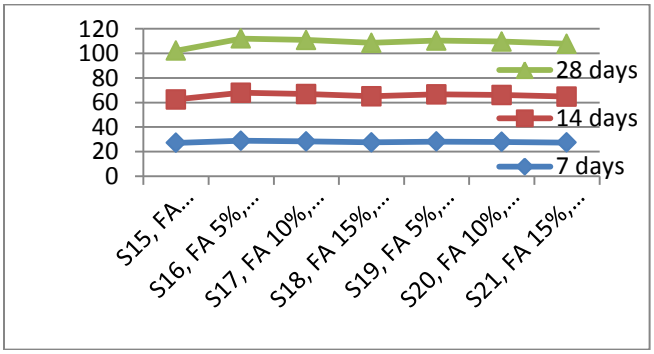
	S8	S9	S10	S11	S12	S13	S14
7-DAYS	17.7	22.3	22.2	21.8	23.1	20	22.4
14-DAYS	24.5	31.8	30.9	29.8	31.3	30.1	29.1
28-DAYS	27.2	34.5	34.1	33.8	34.2	34	33.7



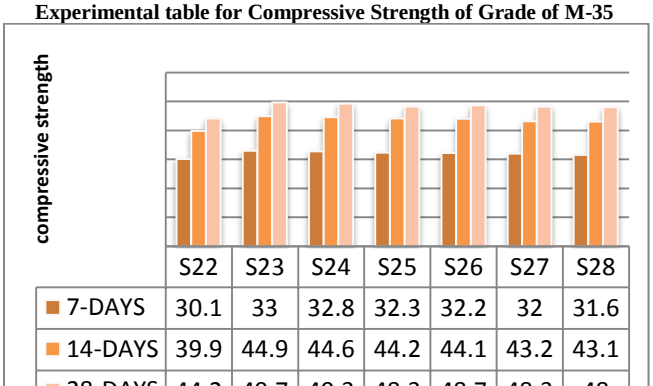
Experimental table for Compressive Strength of Grade of M-30



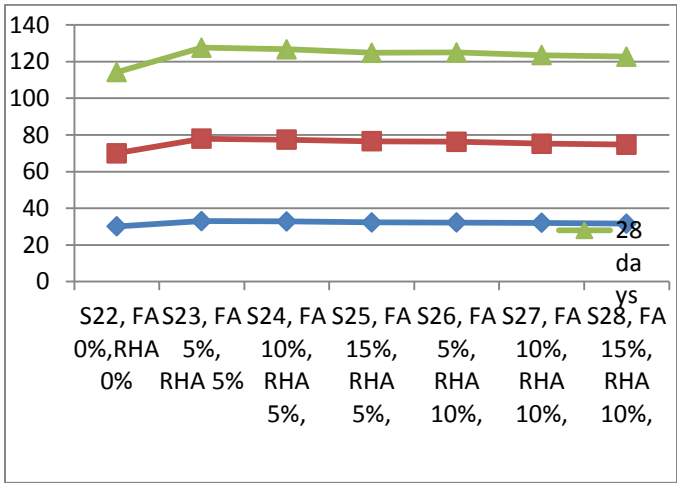
	S15	S16	S17	S18	S19	S20	S21
7-DAYS	27.1	28.9	28.3	27.5	28.2	28	27.4
14-DAYS	35.3	39	38.6	37.6	38.4	38.1	37.4
28-DAYS	39.7	44.2	44	43.4	43.8	43.5	43



Experimental table for Compressive Strength of Grade of M-35



	S22	S23	S24	S25	S26	S27	S28
7-DAYS	30.1	33	32.8	32.3	32.2	32	31.6
14-DAYS	39.9	44.9	44.6	44.2	44.1	43.2	43.1
28-DAYS	44.2	49.7	49.3	48.3	48.7	48.3	48



IV. RESULTS

Laboratory test results are summarized and explained in the tables. Compressive strength of Concrete Cube (cement is replaced by various combinations of fly ash and rice husk ash at different percentage) specimens were higher than the normal Mix at all durations i.e. 7days ,14 days and 28days. Differences of compressive strength between the specimens having no RHA and after adding RHA in mix aggregate and concrete specimens became more distinct after at 28 days.

CASE-I, For M-15 Grade of concrete, nominal mix and control mix has been prepared and results are obtained and presented in the charts.

During the experiment it has been noticed that the maximum 28 day compressive strength of nominal cube obtained was 21.1 N/mm², for a mix with RHA and fly ash of 5%+5%, 26.7N/mm² compressive strength is found, and hence an increase in strength over normal concrete is 26.54% when we added RHA.

CASE-II, For M-20 Grade of concrete, nominal mix and control mix has been prepared and results are obtained and presented in the charts.
During the experiment it has been noticed that the maximum 28 day compressive strength of nominal cube obtained was 27.2 N/mm², for a mix with RHA and fly ash of 5%+5%, 34.5N/mm² compressive strength is found, and hence an increase in strength over normal concrete is 26.83% when we added RHA.
CASE-III, For M-30 Grade of concrete, nominal mix and control mix has been prepared and results are obtained and presented in the charts.
During the experiment it has been noticed that the maximum 28 day compressive strength of nominal cube obtained was 39.7 N/mm², for a mix with RHA and fly ash of 5%+5%, 44.2N/mm² compressive strength is found, and hence an increase in strength over normal concrete is 11.33% when we added RHA.
CASE-IV, For M-35 Grade of concrete, nominal mix and control mix has been prepared and results are obtained and presented in the charts.
During the experiment it has been noticed that the maximum 28 day compressive strength of nominal cube obtained was 44.2 N/mm², for a mix with RHA and fly ash of 5%+5%, 49.7N/mm² compressive strength is found, and hence an increase in strength over normal concrete is 12.44% when we added RHA
It has been seen during experiments that as the percentage of RHA increases the compressive strength increases initially, on further increase in its percentage compressive strength will be reduced.

V- RECOMMENDATIONS

Following recommendations are: -

- Specific surface areas have to be tested in order to investigate the degree of incineration and reactivity.
- Research can be carried out to determine the optimization of average size particle of RHA.
- Research can be carried out to investigate the compressive strength of combination of more types of pozzolans inside concrete.

VII-REFERENCES

[1] **Abadi, M.H.S., Delbari, A., Fakoor, Z. & Baedi, J., 2015**. Effects of Annealing Temperature on Infrared Spectra of SiO_2 Extracted From Rice Husk. *J. Ceram. Sci. Tech.*, 06(01), pp. 41-46.
[2] Adam, F., Saraswathy, B. & Wong, P.L., 2006. Rice Husk Ash Silica as a Support Material for Ruthenium Based Heterogenous Catalyst. *Journal of Physical Science*, Vol. 17(2), pp. 1–13.
[3] Ali, F. & Al-Shawabkeh., 2015. Evaluation of the Potential Use of Waste Tires as Supplementary Fuel in Jordan Cement Industry. *Council for Innovative Research*.
[4] Ali, M.B., Saidur, R. & Hossain, M.S., 2011. A Review on Emission Analysis in Cement Industries. *Renewable and Sustainable Energy Reviews*.
[5] Anderson, J.E., Wulfhorst, G. & Lang, W., 2015. Energy Analysis of the built Environment—A Review and Outlook. *Renewable and Sustainable Energy Reviews.*
[6] Antiohos S.K., Papadakis V.G. & Tsimas, S., 2014. Rice husk ash (RHA) effectiveness in cement and concrete as a function of reactive silica and fineness. *Cement and Concrete Research.*
[7] Aprianti, E., Shafigh, P., Bahri, S. & FarahanI, J.N., 2014. Supplementary cementitious materials origin from agricultural wastes. *Construction and Building Materials 74*, pp. 176–187.
[8] Bie, R.S., Song, X.F., Liu, Q.Q. Ji, X.Y. & Chen, P., 2014. Studies on effects of burning conditions and rice husk ash (RHA) blending amount on the mechanical behavior of cement. *Cement & Concrete Composites 55*, pp. 162–168.
[9] British Standard Institution, 2009. *BS EN 12350-2: 2009 Testing fresh concrete Part 2: Slump-test*.
[10] Guneyisia, E., Ozturanb, T. & Gesoglu, M., 2007. Effect of initial curing on chloride ingress and corrosion resistance characteristics of