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STRENGTH STUDIES ON RICE HUSK ASH CONCRETE AS PARTIAL REPLACEMENT OF CEMENT

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ABSTRACT: The production of rice is significant worldwide; the husk produced is generally used as a combustible material for the preparation of paddies, delivering energy through direct combustion as well as by gasifying. Annually, 7.4 million tons of Rice Husk Ash (RHA) is produced and poses an incredible danger to the environment, harming the land and the encompassing zone where it is unloaded. In the transformation of rice husk to ash, the ignition cycle eliminates the natural products, leaving silica-rich remains. These silica-rich remains have proven to have potential to be utilized in concrete as a limited substitution of cement to enhance the concrete compressive strength. RHA is an environmentally friendly and cost- effective alternative cementitious material. In this experimental study Strength tests such as compressive strength,splitting tensile strength,and flexural strength with 5, 10, 15, and 20% percentages of RHA replacing the cement have been targeted.Based on the experimental results it was noted that RHA 10%-PPC 90% mix combination is having enhanced mechanical properties compared to conventional concrete.

KEYWORDS: RHA fresh concrete properties; concrete mechanical properties; green concrete

I. INTRODUCTION:

Rice husk ash (RHA) is an abundantly available and renewable agriculture by-product from rice milling in the rice-producing countries. It has the highest proportion of silica content among all plant residues. Rice husk constitutes about 20% of the weight of rice and its composition is as follows: cellulose (50%), lignin (25%–30%), silica (15%–20%), and moisture (10%– 15%). Bulk density of rice husk is low and lies in the range 90–150 kg/m3.Sources of rice husk ash (RHA) will be in the rice growing regions of the world, as for example China, India, and the far-East countries. RHA is the product of incineration of rice husk. RHA is the most of the evaporable components of rice husk are slowly lost during burning and the primary residues are the silicates.The characteristics of the ash are dependent on (1) composition of the rice husks, (2) burning temperature, and
(3) burning time. Every 100 kg of husks burnt in a boiler for example will yieldabout 25 kg of RHA.

The production of rice is significant worldwide; the husk produced is generally used as a combustible material for the preparation of paddies, delivering energy through direct combustion poses an incredible danger to the environment, harming the land and the encompassing zone where it is unloaded. In the transformation of rice husk to ash, the ignition cycle eliminates the natural products, leaving silica-rich remains.

Rice husk ash is an active pozzolana and has several applications in the cement and concrete industry. RHA can be used as an economical substitute for silica fume as SCM having almost thesame properties as that of micro silica. Therefore the use of less-expensive RHA is more desirable to decrease the overall production cost of concrete, reduce the cement requirement leading to less environmental pollution by cement factories thus providing economic and environmental benefits along with providing a way of disposing this agricultural waste product which otherwise has little alternative use. This paper reviews the experimental studies carried on RHA as partial replacement of cement in concrete and its effect on properties of concrete

II. METHODOLOGY:

II.1 Materials:

- Cement – (PPC 43 grade)
- River sand
- Coarse aggregate (20mm)
- Rice husk ash (RHA)
- Superplasticizer-Conplast Sp430 (Sulphonated Napthalene polymers)

An experimental program related to strength characteristics of high strength concrete mix performed in this study. Portland pozzolona cement of 43 grade confirming to IS 269-1976 was used along with Rice Husk Ash (RHA).

Locally available river sand was used as Fine aggregate passing through IS 4.75 mm size. Crushed Granite stone used as coarse aggregate of size 20mm. Polycarboxylate ether based super plasticizer (CONPLAST-SP430) was used as to enhance the workability and to decrease the water content.

II.2 Preparation of Test Specimens

Totally 90 specimens have been casted to study the hardened properties of Rice Husk Ash Cement Concrete. Around 30 cubes of size 150mm*150mm*150mm, 30 cylinders of size 100mm*200mm and 30 prisms of size 100mm*100mm*500mm were casted for 7 days and 28 days, the detrmination of Compressive Strength, Splitting Tensile Strength and Flexural Strength. As per IS: 10262, concrete of grade M25 has been designed with the mix proportion of 1:1.90:3.18.

II.3 Compressive strength Test

The quality of concrete is typically characterized and controlled by the compressive strength of 150*150*150mm at 7 days and 28 days curing. Steel mould of size 150*150*150mm utilized for casting of concrete cubes loaded up with the proportions of PPC 100%,RHA 5%-PPC 95%,RHA 10%-PPC 90%,RHA 15%-PPC 85%,RHA 20%-PPC 80%. The most extreme compressive load connected to the sample was then recorded according to IS: 516- 1959.The testing course of action of compressive strength for 7 days and 28 days the testing the cube under compression was appeared in figure

Compressive strength(Mpa)=Compressive load /Area of cross section

II.4 Splitting tensile strength Test

The test was directed according to IS 5816:1999. For rigidity test cylindrical sample of measurement 100 mm distance across and 200 mm length were cast. The samples were demoulded following 24 hours of casting and were exchanged to curing tank where they were permitted to curing for 7 days and 28 days. The splitting tensile tension test was directed in the compression machine having 2000KN limit. Splitting tensile strength was determined utilizing equation

$$T=2p/\pi dl$$

II.5 Flexural Strength Test

It is characterized as the maximum bending stress that can be continued before the prism fails. The samples were demoulded after 24 hours of casting and were exchanged to curing tank where they were permitted to curing for 7 days and 28 days. A prism of determined measurement 100*100*500mm is made to fail under bending by applying load along the length of the prism. The prism was tested for their 7 days and 28 days of flexural strength in universal Testing Machine is determined utilizing the equation,

$F = pl/bd^2$

III. RESULTS AND DISCUSSIONS

III.1 Compressive strength Test

Based on Compressive Strength:

The test outcomes showed that, the percentage enhancement in compressive strength varies from 5% to 12% as compared to conventional concrete. The compressive strength of RHA 10% mix improved as 11.30% more than conventional concrete cured at 28 days, it was found that RHA 20%-PPC 80% is having lower % of improvement as compared to other combinations. From the test results RHA 15%-PPC 85% mix compressive strength is equal to the strength of conventional concrete

TABLE III.1.1:COMPRESSIVE STRENGTH RESULT

Mix Id	**7 Days Of Avg. Compressive Strength(N/mm²)**	**28 Days Of Avg. Compressive Strength (N/mm²)**	**% Increase In Strength**
PPC 100	27.71	32.74	-
RHA 5-PPC 95	28.59	34.53	5.47
RHA 10-PPC 90	29.63	36.44	11.30
RHA 15-PPC 85	27.11	32.74	0
RHA 20-PPC 80	26.67	31.55	-3.63

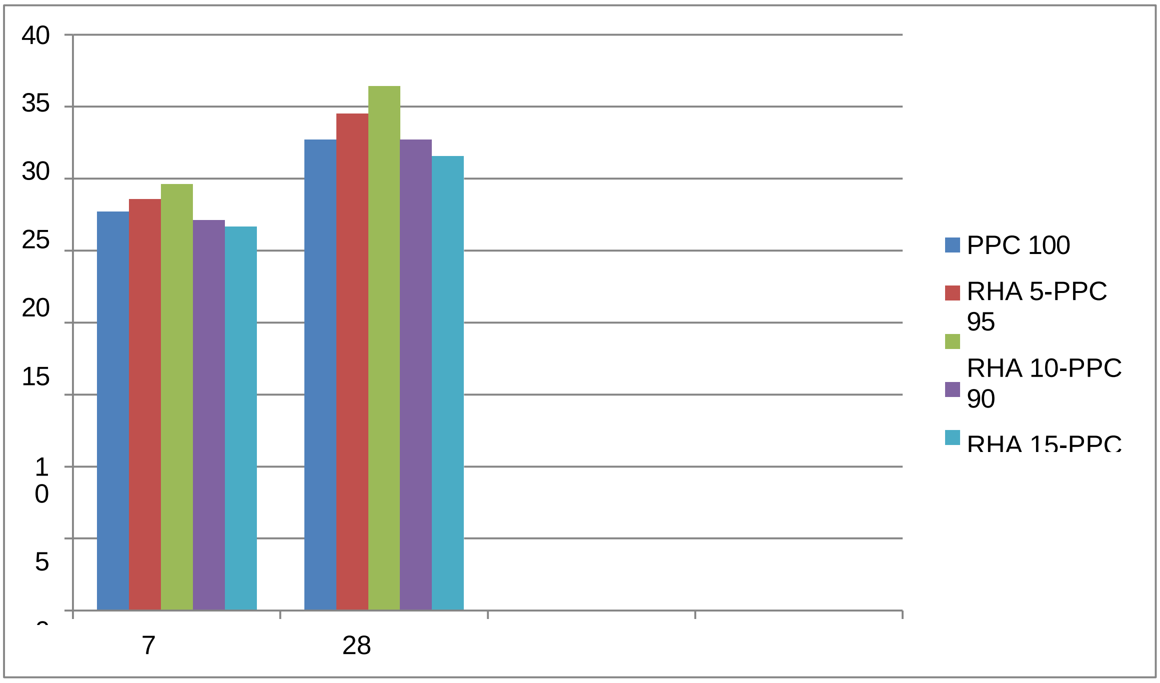

CHART-1:COMPRESSIVE STRENGTH TEST

The Compression Strength Test results for PPC 100%,RHA 5%-PPC 95%,RHA 10%-PPC 90%,RHA 15%-PPC 85%,RHA 20%-PPC 80% variation of PPC and RHA Cement in Concrete for 7 days and 28 days Average Compression Strength Test values are presented in table III.1.1.

III.2 Results for Splitting Tensile Strength

Based on Splitting Tensile Strength:

The test outcomes showed that, the percentage enhancement in Splitting Tensile Strength varies from 3% to 7% as compared to conventional concrete. The splitting tensile strength of RHA 10%-PPC 90% mix improved as 6.51% more than conventional concrete cured at 28 days, it was found that RHA 20% is having lower % of improvement as compared to other combinations. From the test results RHA 5%-PPC 95% mix Split tensile strength gives 3.25% more than conventional concrete.

TABLE III.2.1:SPLITTING TENSILE STRENGTH RESULT

Mix Id	**7 Days Of Avg. Splitting tensile Strength(N/Mm²)**	**28 Days Of Avg. Splitting tensile Strength (N/Mm²)**	**% Increase In Strength**
PPC 100	2.64	3.38	-
RHA 5-PPC 95	2.86	3.49	3.25
RHA 10-PPC 90	2.96	3.6	6.51
RHA 15-PPC 85	2.65	3.17	-6.21
RHA 20-PPC 80	2.65	2.86	-15.38

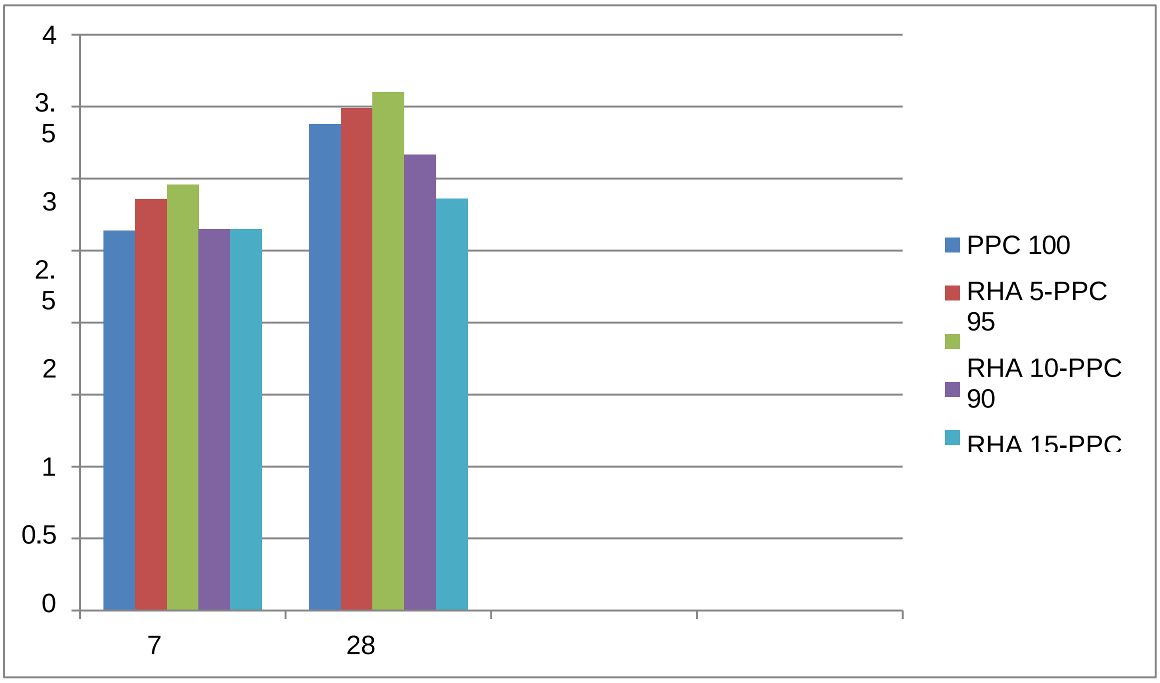

CHART 2:SPLITTING TENSILE STRENGTH TEST

The Split Tensile Test results for PPC 100%,RHA 5%-PPC 95%,RHA 10%-PPC 90%,RHA 15%-PPC 85%,RHA 20%-PPC 80% variation of PPC and RHA Cement in Concrete for 7 days and 28 days Average Split Tensile Test values are presented in table III.2.1.

III.3 Flexural Strength Test

Based on Flexural Strength:

The test outcomes showed that, the percentage enhancement in Flexural Strength varies from 2% to 25% as compared to conventional concrete. The flexural strength of RHA 10% mix improved as 24.45% more than conventional concrete cured at 28 days, it was found that RHA 5%-PPC 95% is having lower % of improvement as compared to other combinations. From the test results RHA 15%-PPC 85% mix flexural strength gives 17.13% more than conventional concrete.

TABLE III.3.1:FLEXURAL STRENGTH RESULT

Mix Id	7 Days Of Avg. Flexural Strength(N/Mm²)	28 Days Of Avg. Flexural Strength (N/Mm²)	% Increase In Strength
PPC 100	4.16	6.83	-
RHA 5-PPC 95	4.33	7	2.49
RHA 10-PPC 90	4.5	8.5	24.45
RHA 15-PPC 85	4	8	17.13
RHA 20-PPC 80	3.5	7.33	7.32

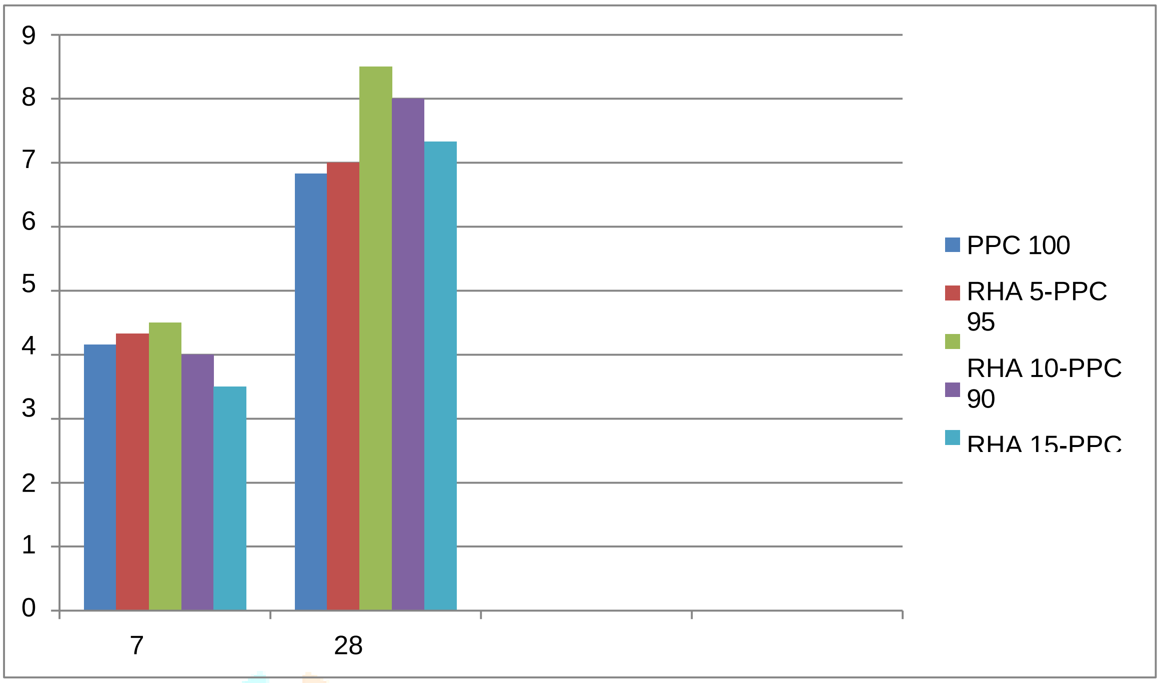

CHART 3:FLEXURAL STRENGTH TEST

The Flexural Strength Test results for PPC 100%,RHA 5%-PPC 95%,RHA 10%-PPC 90%,RHA 15%-PPC 85%,RHA 20%- PPC 80% variation of PPC and RHA Cement in Concrete for 7 days and 28 days average flexural strength values are presented in table III.3.1.

IV. CONCLUSIONS

From the above experimental work the following conclusions were drawn:

- Based on the above experimental results, it was found that RHA 10% -PPC 90% mix proportion gives enhance Mechanical Properties than conventional concrete.
- From the test outcomes on Compressive Strength of Concrete RHA 10%-PPC 90% mix proportion gives 11.30% more than conventional concrete at the age of 28 days curing.
- From the test outcomes on Split Tensile Strength of Concrete RHA 10%-PPC 90% mix proportion gives 6.51% more than conventional concrete at the age of 28 days curing.
- From the test outcomes on Flexural Strength of Concrete RHA 10%-PPC 90% mix proportion gives 24.45% more than Conventional concrete at the age of 28 days curing.
- It is found that RHA Concrete has more Mechanical Properties in 10% RHA-90% PPC than the Portland Pozzolana Cement Concrete.

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