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A STUDY ON STRENGTH CHARACTERISTICS OF CONCRETE BY PARTIAL REPLACEMENT OF FINE AGGREGATE BY USING RICE HUSK ASH

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Abstract:
This study is aimed to know the characteristic strength of concrete with the partial replacement of fine aggregate with rice husk ash. fine aggregate is to be proportionally replaced with 0%, 5%, 10%, 15%, 20% rice husk ash and the strength tests of compressive strength , flexural strength , and split tensile tests is to be carried out in 7, 14 and 28 days. Rice hush ash is used as replacement of fine aggregate as this is most commonly available agricultural waste. Rice husk are being abundantly produced from rice industry which are usually dumped in the open there by impacting the environment negatively without any economic benefits. The main purpose of this study is to find the possibility of agricultural waste as construction material for economy, light weight and eco-friendly construction.

Keywords: Rice Husk Ash, Compressive Strength, Flexural Strength, Split Tensile Strength

I.INTRODUCTION

Concrete is one of the most important materials employed in public works and building construction projects. We have utilized a tremendous amount of concrete and we will have to continue to use it. On the other hand, sustainable development has become more and more important. The human race is steadily transitioning its socio-economic system in an effort to solve its resources, energy and environmental problems. It is obvious that the concrete industry also have to introduce environmental axis into technologies.

Concrete is a widely used construction material for various types of structures due to its structural stability and strength All the materials required producing such huge quantities of concrete come from the earth's crust. Thus, it depletes its resources every year creating ecological strains. On the other hand, human activities on the Earth produce solid waste in considerable quantities of over 2500/MT per year, including .Industrial wastes, agricultural wastes and wastes from rural and urban societies. Resent technological development has shown that these materials are valuable as inorganic and organic resources and can produces various useful products. Amongst the solid wastes, the most prominent ones surrounds the paddy grain. During the milling of paddy about 78% of weight is received as rice, broken rice and bran. The rest 22% of the weight of paddy is received as husk.

Presently, the energy needed to provide comfortable conditions in building is the most costly component. Therefore, component for future consideration in construction design should be heat isolation. To provide the needed thermal comfort in shelters such that temperature effects do not negatively affect buildings and living being are relaxed and comfortable, it is necessary to consider the heat isolation properties when constructing building. Several factors must be considered in building construction. Material selection is the most important factor.

II.LITERATURE REVIEW

M.U Dabai, 2009 Investigated that compressive strength tests which were carried out on six mortar cubes with cement replaced by rice husk ash (RHA) at five levels (0, 10, 20, 30, 40 and 50%). After the curing age of 3, 7, 14 and 28 days. His findings that the compressive strengths of the cubes at 10% replacement were 12.60, 14.20, 22.10, 28.50 and 36.30 N/mm2 respectively and increased with age of curing but decreased with increase in RHA content for all mixes. The chemical analysis of rice husk ash revealed high amount of silica (68.12%), alumina (1.01%) and oxides such as calcium oxide (1.01%) and iron oxide (0.78%) responsible for strength, soundness and setting of the concrete. It also contained high amount of magnesia (1.31%) which is responsible for the unsoundness. this indicated that RHA can be used as cement substitute at 10% and 20% replacement and 14 and 28 day curing age.

Alvin Harrison, 2014 Investigated out to study the utilization of non-conventional building material (fly ash) for development of new materials and technologies. It is aimed at materials which can fulfil the expectations of the construction industry in different areas. In this study, cement has been replaced by fly ash accordingly in the range of 0% (without fly ash), 10%, 20%, 30%, 40%, 50% and 60% by weight of cement for M_{25} mix with 0.46 water cement ratio. Concrete mixtures were produced, tested and compared in terms of

compressive strength. It was observed that 20% replacement Portland Pozzolana Cement (PPC) by fly ash strength increased marginally (1.9% to 3.2%) at 28 and 56 d respectively. It was also observed that up to 30% replacement of PPC by fly ash strength is almost equal to referral concrete after 56 d. PPC gained strength after the 56 d curing because of slow hydration process.

S L Patil, 2012 Investigated out to study the utilization of fly ash in cement concrete as a partial replacement of cement as well as an additive so as to provide an environmentally consistent way of its disposal and reuse. This work is a case study for Deep Nagar thermal power plant of Jalgaon District in MS. The cement in concrete matrix is replaced from 5% to 25% by step in steps of 5%. It is observed that replacement of cement in any proportion lowers the compressive strength of concrete as well as delays its hardening. This provides an environmental friendly method of Deep Nagar fly ash disposal.

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%; 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

Rice is generally considered as a semi-aquatic annual plant, although it can survive as a perennial in the tropic or subtropics. Cult wars of the two cultivated species can grow in a wide range of water soil region from prolonged period of flooding in deep water to dry land on hilly slopes.

Rice chaff is realized during the process of threshing and shelling operations, which is aimed at removing the grains from the protecting casting. These operations can be carried out by hand or by use of threshing machine. The threshing of rice by hand (manually) entails the beating of small bunches by hand, 6 to 8 times against a hard-surface (stones, metal drum,). If the cereals have been harvested when sufficiently ripe and the grain is dry, it detaches itself easily with a little fraction scattered around. Rice chaff ash is classified into: High carbon (char) ash, Low carbon (grey) ash and Carbon free (Pinker white) ash according to Houston (1972). The properties of rice chaff ash depend on whether the husk has undergone complete destruction crystallization or had only been partially burnt in the presence of adequate air. Carbon-free or low carbon ash can substitute equally well for high carbon (black) ash in many potential uses. Rice husk ash is generated from burning of rice chaff. The drum used for the burning was opened at one end and closed at another end. The drum is about O.4m in diameter with a height of about 0.8m

III.MATERIALS

MATERIALS

CEMENT

In this work, Ordinary Portland cement (OPC) of Deccan (53 grade) brand obtained from a single batches was used. The cement satisfies the requirement of IS: 8112-1989. The specific gravity was 2.99 and fineness was 93%.

AGGREGATES

Aggregates of different sizes are used to achieve greater bulk density namely, coarse aggregates and fine aggregates.

Coarse Aggregates

These are crushed, uncrushed or partially crushed gravel of which is retained on 4.75mm sieve. They should be hard, strong dense, durable and free from adherent coatings and also free from injurious amount of disintegrated pieces, alkali, organic matter and other deleterious substances. Flaky and elongated aggregates should be avoided as far as possible

Course Aggregate

Fine Aggregate

Fine aggregate is an accumulation of grains of mineral matter derived from the disintegration of rocks. It is distinguished from gravel only by the size of grain or particle, but is distinct from clays which contain organic minerals. Sands that have been sorted out and separated from the organic material by the action of currents of water or by winds across arid lands are generally quite uniform in size of grains. Usually commercial sand is obtained from river beds

or from sand dunes originally formed by the action of winds.

Fine Aggregate

Rice Husk Ash

Obtained from burning protecting outer cover of rice. It consists of non-crystalline silicon dioxide (SiO_2) with high specific surface area and high pozzolanic reactivity. The RHA can be found as natural by-products material so far closer to micro silica, silica fume

RICE HUSK ASH

WATER

Potable water is used for mixing and curing. On addition of higher percentage of demolished waste the requirement of water increases for the same workability.

EXPERIMENTAL RESULTS

CEMENT:

In the present study on ordinary Portland cement (Deccan OPC 53 grade) was used. The physical properties of the cement tested according to Indian standard procedure conforming to requirements of IS 12269:1982. The properties are given below.

Properties of Cement

S.NO	Properties	Results
1	Specific gravity	2.99
3	Fineness of cement	93
4	Initial setting time	30 minutes
5	Final setting time	10 hrs

FINE AGGREGATE:

SAND:

The River Sand Conforming to zone 2 as per IS383-1987 was used making reference concrete and its specific gravity was found to be 2.281,bulking density 1.54.

S. No	IS Sieve size	Wt. Retained in kg	Cumulative wt. Retained in kg	% of cumulative wt. Retained	% of cumulative wt. passing
1	4.75 mm	0.0	0.0	0	100
2	2.36 mm	0.013	0.013	1.3	98.7
3	1.18 mm	0.035	0.048	4.8	95.2
4	600 µ	0.587	0.635	63.5	36.5
5	300 µ	0.210	0.845	84.5	15.5
6	150 µ	0.080	0.925	92.5	7.5
7	90 µ	0.075	1.00	100	0

COARSE AGGREGATE:

Crushed granite coarse aggregate conforming to IS 383-1987 of size 20 mm and down having specific gravity 2.92 and water absorption is 0.2 %, bulk density 1.72

Properties of Coarse Aggregate

S.No	Test	Results	IS Code Used	Acceptable Limit
1	Fineness Modulus	6.5	IS:2386:1963	6.0 to 8.0mm
2	Specific Gravity	2.92	IS:2386:1963	2 to 3.1mm
3	Porosity	46.83%	IS:2386:1963	Not greater than 100%
4	Voids Ratio	0.8855	IS:2386:1963	Any value
5	Bulk Density	1.72 g/cc	IS:2386:1963	-
6	Aggregate Impact Value	37.5	IS:2386:1963	Less than 45%
7	Aggregate Crushing Value	26.6%	IS:2386:1963	Less than 45%

PROPERTIES OF RICE HUSK ASH

Physical Properties of Rice Husk Ash

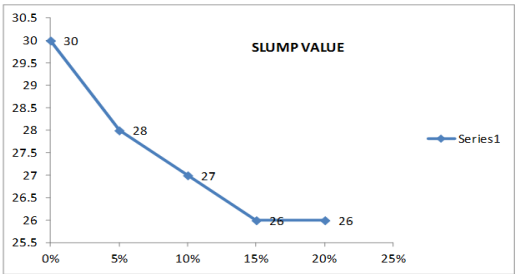
Blaine Specific Surface (cm^2/g)	13150
Specific Gravity (cm^2/g)	2.21
Mean Particle size (µm)	10.61
Passing # 325 (%)	95.10

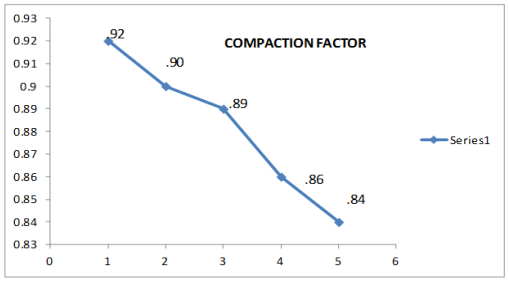
Chemical Properties of Rice Husk Ash

SiO_2	90.16
Fe_2O_3	0.41
Al_2O_3	0.11
CaO	1.01
MgO	0.27
SO_3	0.12
$Al_2O_3 + Fe_2O_3$	0.52
$SiO_2 + Al_2O_3 + Fe_2O_3$	0.93
Na_2O	0.01
K_2O	0.65

TESTING ON FRESH CONCRETE

SLUMP CONE AND COMPACTION TEST



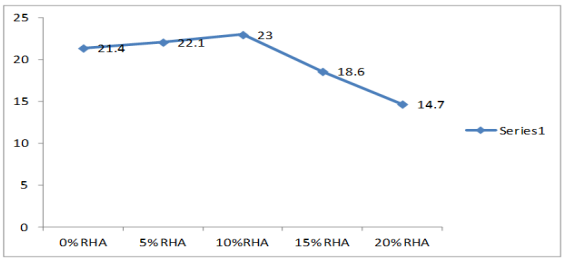


COMPRESSION TEST

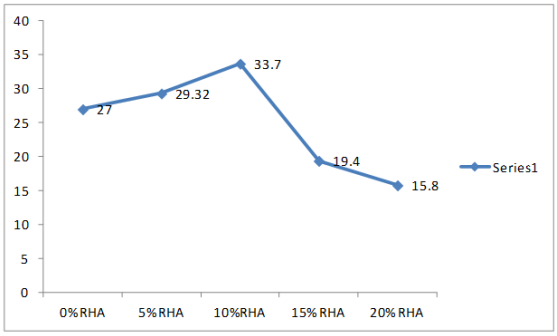
These are the test results for 7,14,28 days curing with 0%,5 %,10% and 20% of rice husk ash replacement with fine aggregate.

Type of Mix	Compressive Strength in(N/mm^2)		
	7 Days	14 Days	28 Days
0%R.H.A	21.4	27	29.84
5%R.H.A	22.1	29.32	31.52
10%R.H.A	23	33.7	35.99
15%R.H.A	18.6	19.4	20.52
20%R.H.A	14.7	15.8	16.95

Husk Ash replacement in Normal Sand for 7 days Curing



Compressive Strength of M25 Grade Concrete with Different Percentages of replacement Rice husk ash in Normal Sand for 14 days curing.



The above graph represents the compressive strength results for 14 days curing. The results shows that the strength gradually increasing with increasing in percentage of Rice husk ash. So it is advisable to use up to 10%Rice husk ash to get desired strength.

Compressive Strength of M25 Grade Concrete with Different Percentages of Rice husk ash replacement in Normal Sand for 28 days Curing

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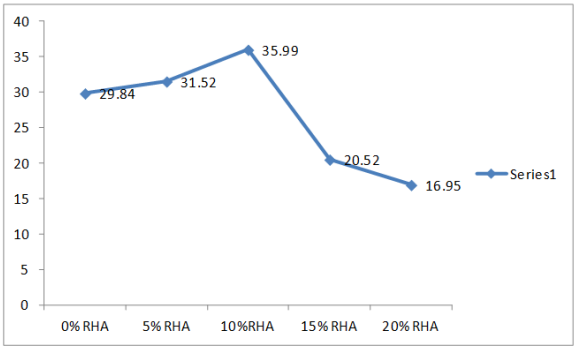
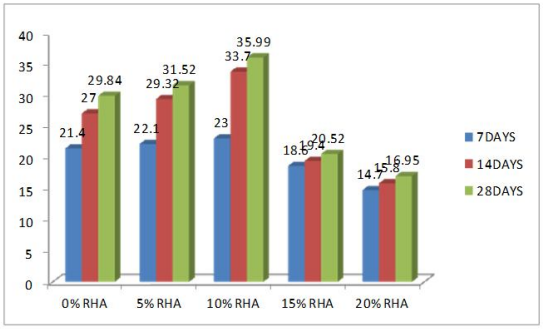


The above graph represents the compressive strength results for 28days curing. The results shows that the strength gradually increasing with increasing in percentage of Rice husk ash. So it is advisable to use up 10% Rice husk ash to get desired strength. .

COMPARISON OFCOMPRESSIVES TRENGTH OF MODIFIED CONCRETE



The chart shows the compressive strength of concrete at 7 days 14 days 28 days of curing period. from the

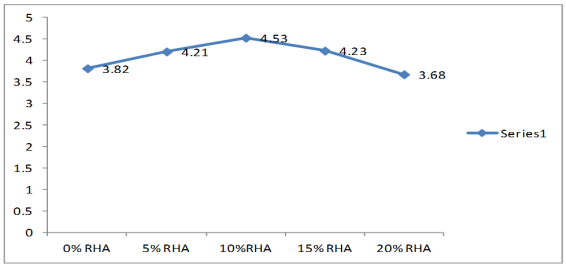
above chart it can be seen that , the strength of 10% of mixed concrete is greater than that of remaining modified concrete.

SPLIT TENSILE TEST

Test results for 7, 14 and 28 days curing with 0%, 5%, 10% and 20% of rice husk ash replacement with fine aggregate.

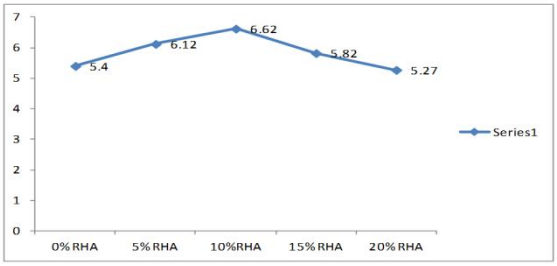
Type of Mix	Split Tensile Strength (N/mm^2)		
	7Days	14 Days	28 Days
0% R.H.A	3.82	5.4	6.38
5% R.H.A	4.21	6.12	7.36
10% R.H.A	4.53	6.62	7.84
15% R.H.A	4.23	5.82	6.62
20% R.H.A	3.68	5.27	5.96

Split tensile Strength of M25 Grade Concrete with Different Percentages of Rice husk ash replacement in Normal Sand for 7 days Curing

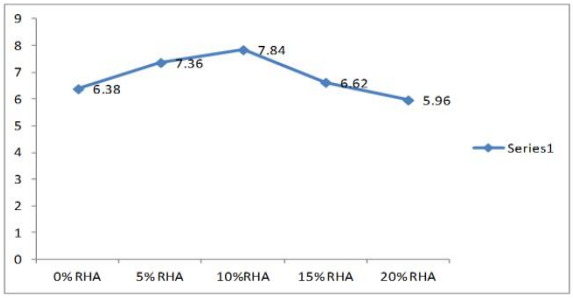


The above graph represents the split tensile strength results for 7days curing. The results shows that the strength gradually increasing with increasing in percentage of Rice husk ash. So it is advisable to use up to 10%Rice husk ash to get desired strength.

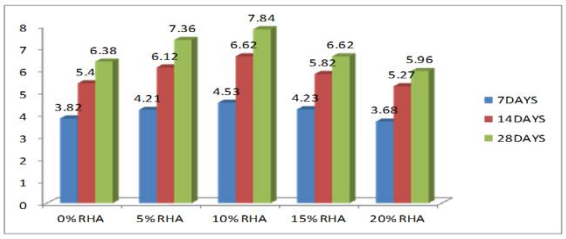
Split tensile Strength of M25 Grade Concrete with Different Percentages of Rice husk ash replacement in Normal Sand for 14 days curing.



The above graph represents the spilt tensile strength results for 14 days curing. The results shows that the strength gradually increasing with increasing in percentage of Rice husk ash. So it is advisable to use up to 10%Rice husk ash to get desired strength.



COMPARISON OF SPLIT TENSILE STRENGTH OF MODIFIED CONCRETE

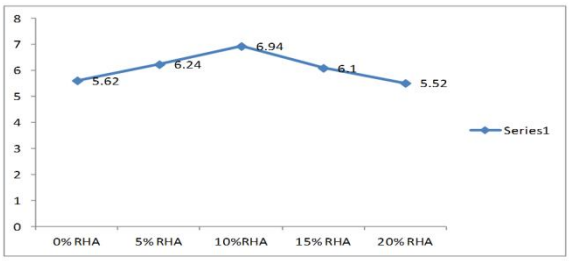


FLEXURAL STRENGTH

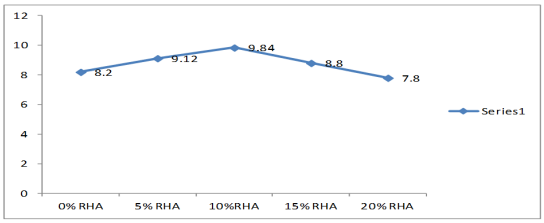
Test results for 7, 14&28 days curing with 0%,5%,10%and 20% of rice husk ash replacement with fine aggregate.

Type of Mix	Flexural Strength (N/mm^2)		
	7Days	14 Days	28 Days
0% R.H.A	5.62	7.84	8.2
5% R.H.A	6.24	8.9	9.12
10% R.H.A	6.94	9.5	9.84
15% R.H.A	6.1	8.4	8.8
20% R.H.A	5.52	7.48	7.8

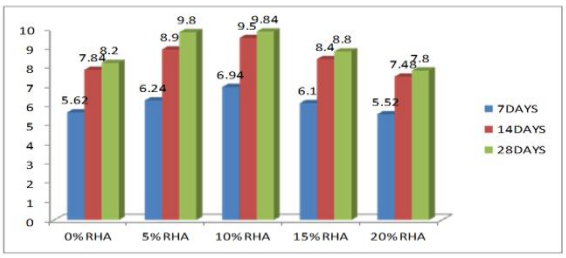
7 DAYS TEST



14 DAYS STRENGTH



COMPARISON OF FLEXURAL STRENGTH OF MODIFIED CONCRETE



IV.CONCLUSION

Based on this project for M_{25} grade concrete compressive strength is highly increased at 10% replacement with rice husk ash as fine aggregate compared to other replacements of 0%, 5%, 15% and 20%.

Based on this project for M_{25} grade concrete split tensile strength is highly increased at 10% replacement with rice husk ash as fine aggregate compared to other replacements of 0%, 5%, 15% and 20%.

Based on this project for M_{25} grade concrete flexural strength is highly increased at 10% replacement with rice husk ash as fine aggregate compared to other replacements of 0%, 5%, 15% and 20%.

Comparing all the results shows that we get the optimum results in 10% of RHA According to study, addition of Pozzolana like rice husk ash to the concrete, can improve the mechanical properties of specimens.

Based on this experimental investigation it is found that Rice husk ash as an alternative material to the natural sand

The physical and chemical properties of Rice husk ash are satisfied the requirements of fine aggregate.

The waste usage of Rice husk ash decreases the cost of fine aggregate and also increases the strength.

There exists a high potential for the use of rice husk as fine aggregate in the production of lightly reinforced concrete.Weight-Batched Rice Husk Concrete and Volume-Batched Rice Husk Concrete show similar trends in the variation of bulk density, workability and compressive strength. Loss of bulk density, workability and compressive strength is higher for Weight-Batched Rice Husk Concrete than Volume-Batched Rice Husk Concrete.

Moreover with the use of rice husk ash, the weight of concrete reduces, thus making the concrete lighter which can be used as light weight construction material.

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