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AN EXPERIMENTAL INVESTIGATION AND DURABILITY CHARACTERSTICS OF RICE HUSK ASH CONCRETE

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ABSTRACT

In this paper ,the detailed experimental investigation was done to study the effect of partial replacement of cement by rice husk ash (RHA) in proportion started from 15% mix together in concrete by replacement of cement with the gradual increase of RHA 5% .last proportion was taken 15% RHA .the test on hardened concrete were destructive in nature which includes compressive test on cube for size (150*150*150) at 3,7 and 28 days of curing as per IS 10269 2009,.the work presented In this paper reports the effect on the behavior of concrete produced from cement with RHA at different proportion on the mechanical properties of concrete such as compressive strength. Investigation reported that compressive strength increases by 32% were obtained at combinations 5% ,10% and 15% RHA .partial replacement of RHA produces the environmental effects ,produces economical and ecofriendly concrete.

Key Words: RHA, Compressive Strength & Cement.

1. INTRODUCTION

The world at the end of the 20th century that has just been left behind was very different to the world that its people inherited at the beginning of that century. The latter half of the last century saw unprecedented technological changes and innovations in science and engineering in the field of communications, medicine, transportation and information technology, and in the wide range and use of materials.

1.1. INFRASTRUCTURE CRISIS

The unprecedented changes that have occurred in the world and society during the latter half of the last century have placed almost insatiable demands on the construction industry in terms of the world's material and energy resources. Continued population growth and evolutionary industrialization have resulted in an endless stream of global urbanization. It took the world population until the year 1804 to reach the first one billion; yet the increase from 5 to 6 billion has taken just 12 years.

1.2. ROLE OF CEMENT INDUSTRY IN GLOBAL WARMING

Ordinary Portland cement (OPC) consists of 95% clinker and 5% gypsum. The clinker is produced from crushing limestone together with other minerals and then heating them at high temperatures (900-1,450°C). During finishing, the gypsum is added to the clinker as it is ground to a small particle size (typically 10-15 microns). The clinker is the most energy and emissions intensive aspect of cement production, thus it is known as "the clinker factor"; for example, OPC has a clinker factor of 0.95.

1.3. GROWTH OF CEMENT INDUSTRY

Global development and the real estate boom of the past two decades have sharply affected the demand for basic materials, especially cement. Figure 43 also shows an increased need for steel. The ominous cement emissions statistics often raise the following question: "since steel is totally recyclable, why not just use that?" For certain a structure, steel is the appropriate choice; however there are many project-specific factors to consider before determining the right and most sustainable material. Structural steel (usually 90% recycled) has an embodied energy content of 27,500,000 BTUs/ton, (compared to 817,600 BTUs/ton for typical OPC concrete) - so by energy measures alone using steel is far from a sustainable solution..

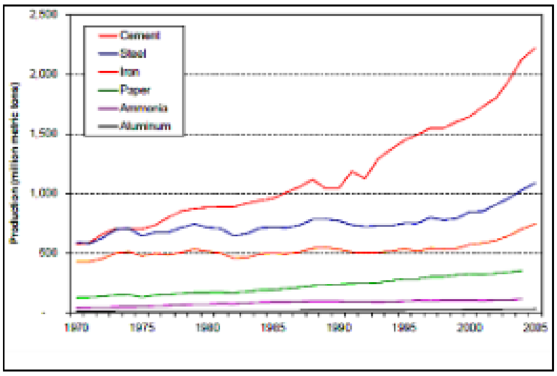

Fig -1: Growth in demand for Primary materials

1.4. CONCRETE AND THE ENVIRONMENT

The answers are simple but wide-ranging. Whatever be its limitations, concrete as a construction material is still rightly perceived and identified as the provider of a nation's infrastructure and indirectly, to its economic progress and stability, and indeed, to the quality of life. It is so easily and readily prepared and fabricated into all sorts of conceivable shapes and structural systems in the realms of infrastructure, habitation, transportation, work and play. Its great simplicity lies in that its constituents are most readily available anywhere in the world; the great beauty of concrete, and probably the major cause of its poor performance, on the other hand, is the fact that both the choice of the constituents, and the proportioning of its constituents are entirely in the hands of the engineer and the technologist.

1.5. ENVIRONMENTAL IMPACTS

Engineers cannot afford to ignore the impact of construction technology on our surroundings - and this applies to our environment at a regional, national and global scale. Compared to metals, glass and polymers, concrete has an excellent ecological profile. For a given engineering property such as strength, elastic modulus or durability, concrete production consumes least amount of materials and energy, produces the least amount of harmful by-products, and causes the least damage to the environment. In spite of this, we have to accept that Portland cement is both resource and energy - intensive. Every tonne of cement requires about 1.5 tonnes of raw material, and about 4000 to 7500 MJ of energy for production.

1.6. CHANGES IN THE CHEMISTRY OF CEMENT

The experience that even when specific building code requirements of durability in terms of concrete cover and concrete quality are achieved in practice, there is an unacceptably high risk of premature corrosion deterioration of concrete structures exposed to aggressive salt-laden environments, directly points to the fact that Portland Cement concretes are not totally resistant to penetration by aggressive ions, even when the water cementations materials (w/cm) ratio is as low as 0.40 (14-19). The strong implication here is that with current design codes, premature deterioration due to steel corrosion is likely to continue. There is thus a need for a fundamental change in thinking about concrete and concrete quality made with Portland cement.

1.7. CRACKING AND QUALITY OF CONCRETE

The three major factors that encourage the transport of aggressive agents into concrete, and influence significantly its service behaviour, design life and safety are cracking, depth and quality of cover to steel, and the overall quality of the structural concrete.

These three factors have an interactive and interdependent, almost synergistic, effect in controlling the intrusion into concrete of external aggressive agents such as water, air, chloride and sulphate ions. Chloride and sulphate ions, atmospheric carbonation, and the corrosive effects of the oxides of nitrogen and sulphur, are recognized to be the most potentially destructive agents affecting the performance and durability of concrete structures, whilst the depth of cover, concrete quality, and cracking are the most critical factors in determining the electrochemical stability of steel in concrete.

1.8. ENVIRONMENTAL ASPECTS

Every tonne of cement clinker requires about 4000-7500 MJ total energy for production whilst slag requires only 700 to 1000 MJ/tonne, and PFA about 150 to 400 MJ/tonne. Replacing 65% of cement with slag having 15% moisture content, for example, will only require 0.5 tonnes of raw material and about 1500 MJ of energy. Each tonne of cement replaced will thus save at least 2500-6000 MJ of energy. Further, since every tonne of cement releases 1.0 to 1.2 tonnes of CO2, for every one tonne reduction in clinker Production, there is an almost equivalent reduction in CO2 emissions.

1.8. 21ST CENTURY CONCRETE CONSTRUCTION

Bearing in mind the technical advantages of incorporating PFA, slag, SF and other industrial pozzolanic by products in concrete, and the fact that concrete with these materials provides the best economic and technological solution to waste handling and disposal in a way to cause the least harm to or environment, PFA, slag, Rice Husk Ash and similar materials thus need to be recognized not merely as partial replacements for PC, but as vital and essential constituents of concrete.

1.9. SCOPE OF THE WORK

The Experimental investigation is planned as under:

1) To obtain Mix proportions of Control concrete by IS method.
2) To conduct Compression test on RHA and Control concrete on standard IS specimen size150 x 150 x150 mm.
3) To conduct Flexural test on RHA and Control concrete on standard IS specimen size 100 x 100 x 500 mm.

2. LITERATURE REVIEW ON RICE HUSK ASH

Rice covers 1% of the earth's surface and is a primary source of food for billions of people. Globally, approximately 600 million tonnes of rice paddy is produced each year. On average 20% of the rice paddy is husk, giving an annual total production of 120 million tonnes. In the majority of rice producing countries much of the husk produced from the processing of rice is either burnt or dumped as waste. Rice husks are one of the largest readily available but most under-utilized biomass resources, being an ideal fuel for electricity generation.

RHA is a general term describing all types of ash produced from burning rice husks. In practice, the type of ash varies considerably according to the burning technique. Two forms predominate in combustion and gasification. The silica in the ash undergoes structural transformations depending on the temperature regime it undergoes during combustion. At 550°C – 800°C amorphous silica is formed and at greater temperatures, crystalline silica is formed. These types of silica have different properties and it is important to produce ash of the correct specification for the particular end use.

Fig -2: Planting of Rice in Fields

Concrete is produced by mixing Portland cement with fine aggregate (sand), coarse aggregate (gravel or crushed stone) and water. Approximately 11% of ready mix concrete is Portland cement. It is the binding agent that holds sand and other aggregates together in a hard, stone-like mass. Cement is made by heating limestone and other ingredients to 1450°C in a kiln to produce clinker; this involves the dissociation 11 of calcium carbonate under heat, resulting in lime (calcium hydroxide) and CO2. The lime then combines with other materials to form clinker, while the CO2 is released to the environment. The pulverized/ground clinker mixed with gypsum is called Portland cement. Small amounts of admixtures are often added. Admixtures are either naturally occurring compounds or chemicals produced in an industrial process, which improve the properties of the cement. Most admixtures are Pozzolana.

2.1. ENHANCED PROPERTIES OF RHA CEMENET

Portland cement produces an excess of lime. Adding a Pozzolana, such as RHA, this combines with lime in the presence of water, results in a stable and more amorphous hydrate (calcium silicate). This is stronger, less permeable and more resistant to chemical attack. A wide variety of environmental circumstances such as reactive aggregate, high sulphate soils, freeze-thaw conditions, and exposure to salt water, de-icing chemicals, and acids are deleterious to concrete.

2.2. ADSORBENT FOR A GOLD-THIOUREA COMPLEX

Gold is often found in nature as a compound with other elements. One way it is extracted is to leach it by pumping suitable fluids through the gold bearing strata. RHA produced by heating rice husks at 300°C has been shown to absorb more gold-thiourea than the conventionally used activated carbon. Ash produced by heating husks to 400° and 500°C was found not to absorb gold thiourea complex.

2.3. SOIL AMELIORANT

There are reports of RHA being used as a soil ameliorant to help break up clay soils and improve soil structure. Its porous nature also assists with water distribution in the soil. It is not sold widely on the commercial market for this use, and is a low value market. RHA has no fertilizing potential as it does not provide the essential nutrients necessary for plant growth. Research in USA has also been carried out on using it as a potting substrate for bedding plants. RHA was found to increase the pH of the soil, and so was recommended for use with plants which require alkaline soil, or in situations where acid irrigation water is present. Wadham Biomass Facility, California sells its ash to environmental remediation companies as an ingredient in a patented environmental process for treating metals-tainted soil and similar waste streams.

3. TECHNICAL REVIEW ON USE OF RICE HUSK ASH

Commercially, it is important to determine and control the type and quality of rice husk ash produced. These can vary depending upon the different combustion techniques used. For example, stoker fired boilers tend to produce higher quantities of crystalline ash, whereas similar boilers with suspension firing produce more amorphous ash.

Fig -3: Rice Husk Piles being burnt

3.1. OVER VIEW OF HUSK TO ASH PROCESSES

The husk surrounding the kernel of rice accounts for approximately 20% by weight of the harvested grain (paddy). The exterior of rice husks are composed of dentate rectangular elements, which themselves are composed mostly of silica coated with a thick cuticle and surface hairs. The mid region and inner epidermis contains little silica.

The high ash content of rice husks and the characteristics of the ash impose restrictions on the design of the combustion systems. For example, the ash removal system must be able to remove the ash without affecting the combustion characteristics of the furnace (especially if the ash produced is mostly bottom ash).

3.2. FLUIDIZED BED COMBUSTORS

The term "fluidized bed combustor" (FBC) encompasses a range of combustion/boiler combinations where combustion of the fuel takes place within a bed of inert material that is kept "fluid" by an upward draught of air. The combustion chamber is similar to conventional boilers, such as stoker fired designs, except that the floor of the boiler is covered with numerous air nozzles and some ash removal outlets. Primary combustion air enters the boiler through the nozzles and in so doing causes the mix of fuel and inert material to mix continuously in a manner similar to a fluid.

3.3. OVERVIEW OF ASH PRODUCTION

The different types of combustion have one common characteristic. They all result in the oxidation of most of the "combustible" portion of the husk while leaving the inert portion. The inert portion is generally called ash or, after gasification, char. The distinction is somewhat blurred. Originally the term "char" referred to the uncombusted residue that had not been taken to a sufficiently high enough temperature to change its state, whereas the term "ash" implied that a higher temperature and change of state had occurred. However, when applied to RHA, the term ash appears to be reserved for all processes apart from gasification irrespective of whether a change of state has occurred.

3.4. METHODS OF ASH ANALYSIS

Typically, the ash will contain some un-burnt components as well as inert components of the husks. The un-burnt component is predominantly carbon. It is typically measured by reheating a sample of the ash in an oven. The difference in mass of the sample before and after heating is referred to as the 'Loss on Ignition' (LOI). The LOI value is normally the same as the carbon content of the ash. The carbon content of RHA varies according to the combustion process. RHA analyses from a literature search and from analyses performed on RHA material for this study indicate carbon (or LOI) values ranging from 1% to 35%. Typically, commercial RHA combustion appears to result in RHA with 5-7% maximum carbon.

3.5. REVIEW OF INFLUENCE OF COMBUSTION METHOD ON PROPERTIES OF RHA

The main factors in the various combustion and gasification processes that determine the type of ash produced are time, temperature and turbulence. These effect all chemical changes that occur in the combustion process including the way the ash morphology is altered. A broad explanation of combustion techniques was given in Section 5.2. Specific chemical and physical properties of ash, taken from literature accounts, are described below. Appendix A compiles the chemical analyses of rice husk ash from the literature review, going back several decades. It also includes the analyses of two samples of RHA (one bottom ash and one fly ash sample) obtained specifically for this study.

3.6. FIXED GRATE BOILERS

None of the reports in the literature made specific reference to conventional grate (fixed- or moving-grate) technology, and although reference to "normal" or "conventional" boilers may well be a reference to a grated boiler we cannot assume this in terms of the reported ash properties. However, a sample of ash ("Patum") from a fixed grate boiler in Thailand was analyzed.

A significant difference between this and other ash samples is the large grain size, with 50% of the sample larger than 0.425mmsq/hole sieve. Compared with the circulating fluidized bed RHA (see "Fortnum" ash analysis below) the Patum RHA showed a higher LOI (4.1% versus 2.2%), a higher total carbon content (3% versus 0.5%) and higher crystalline silica content as one would expect comparing the two technologies. The coarseness of the ash samples has market significance, because for the majority of marketable purposes (steel, cement, absorbent etc) a fine material is preferred, and the grinding of husks before combustion or RHA after combustion adds a significant cost to the process.

3.7. POTENTIAL TO EARN CARBON CREDITS

The Kyoto Protocol is part of the UN's Framework Convention on Climate Change and has set an agenda for reducing global greenhouse gas emissions. If CO2 emissions can be shown and verified to be reduced due to different practices, then Certified Emission Reductions (CERs) can be generated. If RHA is used in concrete manufacture as a cement substitute then there is the potential to earn CERs.

3.8. ROLE OF RHA IN REDUCING GHG EMISSIONS

The cement industry is reducing its CO2 emissions by improving manufacturing processes, concentrating more production in the most efficient plants and using wastes productively as alternative fuels in the cement kiln. Despite this, for every tonne of cement produced, roughly 0.75 tonnes of CO2 (greenhouse gas) is released by the burning fuel, and an additional 0.5 tonnes of CO2 is released in the chemical reaction that changes raw material to clinker (calcinations).

4. TECHNICAL REVIEW ON USE OF RICE HUSK ASH

4.1. CEMENT

Cement used in the experimental work is Ordinary Portland cement conforming to IS: 12269-1987. The physical properties of the cement obtained on conducting appropriate tests and the requirements as per IS: 12269-1987 is given in Table.1

Table.1: Chemical Properties of Ordinary Portland Cement

S.no	Particulars	Test results	Requirements of Is: 12269-1987
1	Loss on Ignition	4	5.0Max
2	Magnesia	6	6.0 Max
3	Sulphuric anhydride	1.55	3.0 Max
4	Insoluble Material	2	27.5 Max
5	Chloride(%)	0.011	0.1 Max

Table.2: Specifications of Rice Husk Ash

S.no	Materials	Percentages
1	Silica	90% minimum
2	Humidity	2% maximum
3	Mean Particle Size	25 microns
4	Colour	Grey
5	Loss on ignition at 8000 C	4% maximum

4.2. SUPER PLASTICIZER

Super plasticizers are usually highly distinctive in their nature, and they make possible the production of concrete which, in its fresh or hardened state, is substantially different from concrete made using water-reducing admixtures.

4.3. MIX DESIGN FOR M25- GRADE OF CONCRETE

Characteristic Compressive Strength required at the end of 28 days: 316 N/mm2

Maximum size of Aggregate : 20mm (Angular)

Type of Exposure : Moderate

Degree of Workability : 0.90 (compacting factor)

Degree of Quality Control : Good

Table.3: Specifications of Mix Design

S.no	Grade Designation	M25
1	Type of Cement	OPC 53 Grade
2	Maximum Nominal size of Aggregate –mm	20 mm
3	Minimum content of Cement – Kg/m^3	384 Kg/m3
4	Maximum Water Cement ratio	0.5
5	Specific Gravity of Cement	3.15
6	Specific Gravity of Coarse Aggregate	2.6
7	Specific Gravity of Fine Aggregate	2.62

5. TESTING OF SPECIMENS

This section describes the test methods that are used for testing fresh mortar and HRC properties, hardened, drying shrinkage and micro level properties of HRC

5.1. SPLITTING TENILE STRENGTH TEST

Splitting tensile strength (STS) test was conducted on the specimens for all the mixes at different curing periods as per IS 5816 (1999). Three cylindrical specimens of size 150 mm x 300 mm were cast and tested for each age and each mix. The load was applied gradually till the failure of the specimen occurs. The maximum load applied was then noted. Length and cross-section of the specimen was measured. The splitting tensile strength (*fct*) was calculated as follows:

$fct = 2P/ (\Pi\, l\, d)$

Where, *fct* = Splitting tensile strength of concrete (N/mm2)

P = Maximum load applied to the specimen (in Newton)

l = Length of the specimen (in mm)

d = cross-sectional diameter of the specimen (in mm).

5.2. FLEXURAL STRENGTH TEST

Flexural strength test was conducted on the specimens for all the mixes at different curing periods as per IS 516 (1991). Three concrete beam specimens of size 100 mm x 100 mm x 500 mm were cast and tested for each age and each mix. The load was applied gradually till the failure of the specimen occurs. The maximum load applied was then noted. The distance between the line of fracture and the near support '*a*' was measured. The flexural strength (*fcr*) was calculated as follows:

When '*a*' is greater than 13.3 cm for 10 cm specimen, *fcr* is

$fcr = (P \times l) / (b \times d2)$

When '*a*' is less than 13.3 cm but greater than 11.0 cm for 10 cm specimen, *fcr* is

$fcr = (3 \times P \times a) / (b \times d2)$

Where, *fcr* = Flexural strength of concrete (N/mm2)

P = Maximum load applied to the specimen (in Newton)

b = measured width of the specimen (in mm)

d = measured depth of the specimen at the point of failure (in mm)

l = Length of the specimen on which the specimen was supported (in mm)

Fig -5: Flexural Strength Testing Machine

5.3. BOND STRENGTH TEST

Bond strength test was conducted on the cylindrical specimens for all the mixes at different curing periods by means of pull-out test as per IS 2770 (1967). The test specimen contains cylindrical specimen of size 150 mm x 300 mm with an embedded single reinforcing bar of 12 mm diameter. This reinforcing bar was embedded to a depth of 150 mm into the cylinder vertically along a central axis and projected upwards 500 mm from the top surface of the cylinder to perform the pull-out test.

The maximum load applied was then noted. The bond strength (*fb*) was calculated as follows:

$fb = P / (\Pi \, d \, l)$

Where, *fb* = Bond strength of concrete (N/mm2)

P = Maximum load applied to the specimen (in Newton)

d = cross-sectional diameter of the specimen (in mm)

l = Length of the specimen (in mm)

6. RESULTS AND DISCUSSIONS

The present investigation is based on the IS method for Control concrete. For Rice husk ash (RHA) concrete, replacement method is considered. Trial mix proportions have been obtained for M25 grade Control concrete from the mix design. By conducting trail mixes, an optimized proportion for the mix is obtained for M25 grade Control concrete.

Compressive strength behaviour of RHA concrete designed by the replacement method are studied, where in the effect of age and percentage replacement of cement with RHA on Compressive strength is studied in comparison with that of M25 grade Control concrete. In addition Flexural strength studies are also carried out.

6.1. MIX PROPORTIONING OF CONTROL CONCRETE

According to IS method of mix design, the proportions of Control concrete were first obtained; trial mixes were carried out to determine the strength at 3, 7 and 28 days. Where in the compressive strength obtained for M25 grade trial mixes are represented against age.

As the cube compressive strength at 28 days obtained was higher than the target mean strength as shown in figure, the trials were conducted based on reduced cement content. The compressive strength at different ages of M25 grade concrete under trial mix and final mix

The slump was measured to know the range of workability, which was desired to be between 50 to 100 mm. But the slump obtained was 0 mm in the trial mix; hence super plasticizer was used to obtain the required slump.

Different mixes were tested for slump and optimum dosage, which gave the required slump, was noted and same was used in the final mix. Comparison of compressive strength at 28 days of trial and final mix .where in the target mean strength required is also indicated. It can be seen how closely the compressive strength of the final mix at 28 days correlates with the target mean strength for the M25 grade concrete.

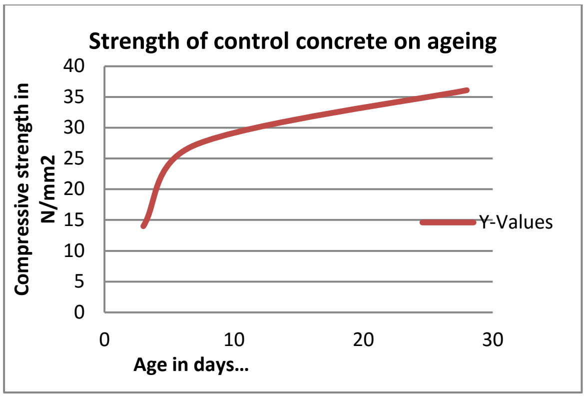

Fig -6: Compressive strength Vs Age of Control Concrete

6.2. MIX PROPORTIONING OF RICE HUSK ASH CONCRETE

In this method, three replacements of cement i.e., 5%, 10%, and 15% with Rice husk ash (RHA) are done, whereas the total binder content remains the same.

The mix proportions considered for each replacement by replacement method with RHA are presented in tables.

Table.4: Mix Proportion of Rice Husk Ash Concrete for 5% Replacemenet

Grade Of Concrete	Cement in Kgs	Rice Husk Ash In Kgs	Fine Aggregate in Kgs	Coarse Aggregate in Kgs	Water in Ltrs
M25	1.235	0.065	2.43	3.58	0.52
IN CUM	364.8	19.2	720.56	1063.3	202

Table.5: Mix Proportion of Rice Husk Ash Concrete for 10%

Grade Of Concrete	Cement in Kgs	Rice Husk Ash In Kgs	Fine Aggregate in Kgs	Coarse Aggregate in Kgs	Water in Ltrs
M25	1.17	0.13	2.43	3.58	0.52
IN CUM	345.6	38.4	720.56	1063.3	202

Table.6: Mix Proportion of Rice Husk Ash Concrete for 15%

Grade Of Concrete	Cement in Kgs	Rice Husk Ash In Kgs	Fine Aggregate in Kgs	Coarse Aggregate in Kgs	Water in Ltrs
M25	1.105	0.195	2.43	3.58	0.52
IN CUM	326.4	57.6	720.56	1063.3	202

6.3. COMPRESSIVE STRENGTH

Most concrete structures are designed assuming that concrete processes sufficient compressive strength but not the tensile strength. The compressive strength is the main criterion for the purpose of structural design. To study the strength development of Rice husk ash (RHA) concrete in comparison to Control concrete, compressive strength tests were conducted at the ages of 3, 7 and 28. The tests results are reported in table for control concrete are in table for RHA concrete respectively.

Table.6: Compressive Strength of control Concrete in N/mm^2

Grade Of Concrete	3 days	7 days	28 days
M25	14	27.2	36.1

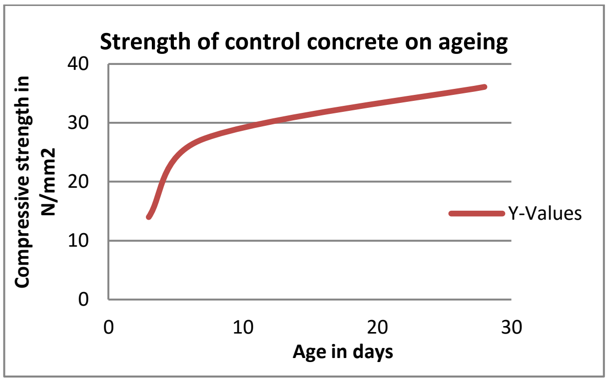

Fig -7: Strength of control concrete at different ages

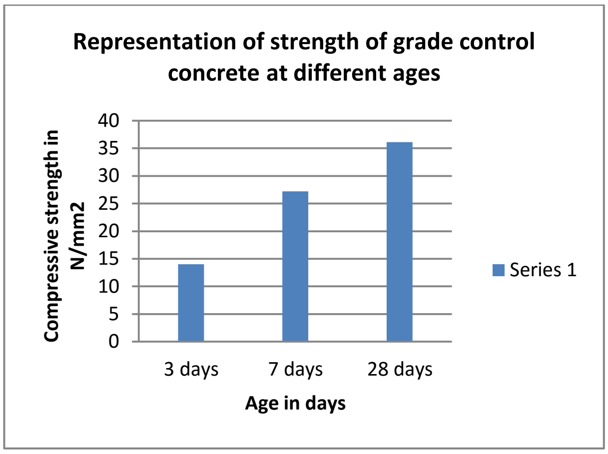

Fig -8: Compressive strength of M25 Grade Control Concrete at different ages

Strength achieved by M25 grade control concrete at different ages as a ration of strength at 28 days is reported in table 12. From the table, it can be seen that 3 days strength is found to be 0.38 times that of 28 days strength, for 7 days, the strength is found to be 0.73 times that of 28 days strength.

Table.7: Compressive Strength for 28days at different ages of control concrete

Grade of concrete	3 days	7 days	28 days
M25	0.39	0.75	1

In each of these variations, it can be clearly seen that, as the age advances, the compressive strength also increases. The highest strength obtained at a particular age for different replacement levels with RHA is reported in table 13 for the ages of 3 days, 7 days, 28 days.

Table.8: Compressive Strength for 28days at different ages of control concrete

CRL	% increase between 3 days - 7 days	% increase between 7 days - 28 days
0%	94.2	32.72
5%	96.96	35.38
10%	98.4	33.87
15%	95.2	40

From the above table it can be clearly seen that, the strength is higher for control concrete (i.e. 0% replacement) for initial period up to between 3-7 days up to 10% replacement with Rice husk ash, and for 15% replacement with RHA, the strength is very much higher when compared to that of control concrete. The rate of strength development between 7-28 days is maximum when cement is replaced with 5% RHA. Thus from the above table it is clear that the rate of strength development is maximum up to the age of 28 days at all the replacement levels with RHA. The rate of strength development gradually decreases at all the replacement levels.

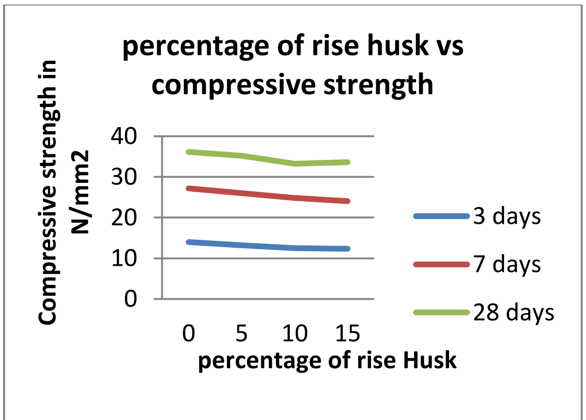

Fig -9: Compressive strength Vs % Replacement of rice husk ash

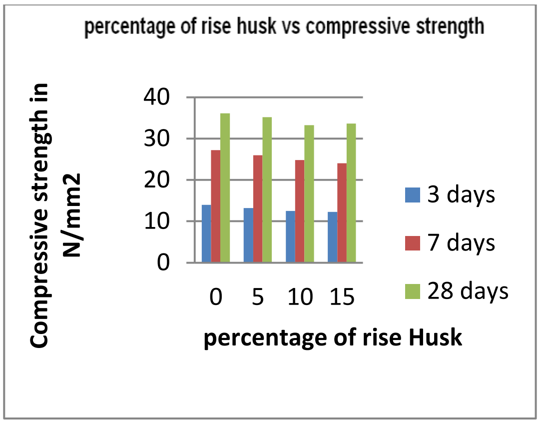

Fig -10: Effect of Rice Husk ash percentage on Compressive strength of concrete

7. CONCLUSION

Based on the limited study carried out on the strength behaviour of Rice Husk ash, the following conclusions are drawn:

At all the cement replacement levels of Rice husk ash; there is gradual increase in compressive strength from 3 days to 7 days. However there is significant increase in compressive strength from 7 days to 28 days followed by gradual increase from 28 days to 56 days.

At the initial ages, with the increase in the percentage replacement of both Rice husk ash, the flexural strength of Rice husk ash concrete is found to be decrease gradually till 7.5% replacement. However as the age advances, there is a significant decrease in the flexural strength of Rice Husk ash concrete.

By using this Rice husk ash in concrete as replacement the emission of greenhouse gases can be decreased to a greater extent. As a result there is greater possibility to gain more number of carbon credits.

The technical and economic advantages of incorporating Rice Husk Ash in concrete should be exploited by the construction and rice industries, more so for the rice growing nations of Asia.

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