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Partial Replacement of Cement with Rice Husk Ash & Jaggery in Cement Concrete

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Abstract: *Concrete is one of the significant materials of the construction industry. These days because of expansion in a population, the demand of infrastructure is expanding day by day. This prompts the increment in production of cement. In the present scenario the overall cement production is about 4.1 billion metric tons worldwide. This huge amount of production prompts utilization of natural resources and it is very unsafe for environment. Enormous amount of waste by-products is delivered from the manufacturing enterprises, for example, mineral slag, fly ash, silica fumes, rice husk ash and so on. the rice husk ash is an agricultural byproduct which is obtained from the rice mills, the husk which is obtained from mill is of no use i.e., it is not even be used for animals to eat. Hence it is used as a fuel in various big industries the burning temperature is very high hence, they are obtained from that. the RHA is very lightweight. The research work here deals with the partial replacement of cement with RHA in concrete at various percentage such as 0%,5%,10%,15%,20% and25% by mass of cement. Various experimental investigations are carried out to find out the compressive strength, split tensile strength and of concrete samples cured for period of 7 and 28 days. the results obtained from the experiments with satisfactory replacement of cement with rice husk ash are presented in this research paper.*

Keywords: *Concrete, rice husk ash, compressive strength, split tensile strength, flexural, workability, shear strength, flexural strength, jaggery*

I. INTRODUCTION

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Quality of concrete is influenced by the proportion of ingredients and method of preparation in concrete production. A unique word which is used on concrete is inevitable in human life due to its properties and applications. From the ancient days lime and jiggery are used as binding materials. This review paper expressed the significance of jaggery on strength behavior of a new concrete composition. Experimentation carried out for determining strength properties of a new concrete for M25 grade nominal concrete using jaggery as admixture. Based on previous study, jaggery is an unrefined sugar product and it is easily available market; the main function of jaggery is to increase the initial setting time of concrete and it also influencing the properties of concrete. Preferably this type of admixture is used in different construction sites like deep foundations, piers and long piles. Four different percentages of admixture were chosen into the experimentation at 0, 0.25, 0.50 and 0.75% by weight of cement, finally it is accomplished that the workability of concrete is being superior with jiggery as admixture but flexural strength and shear strength of this new concrete decreased as compared with convectional M25 concrete.

Concrete is a most broadly utilized construction material. It is, all in all, a mixture of cement (binding material), aggregate (filler materials), admixture and water. It very well may be formed in any necessary shape, simple to deal with and has a wide range of design strength. It is therefore utilized in approximately all benevolent construction work. Cement is the main element of concrete as to act as a binding material. Be that as it may, the production of concrete causes so numerous natural risks, like cement dust, air contamination, solid waste pollution, noise pollution, ground vibrations and resource depletion because of crude material extraction. The primary components of the gases produced from cement enterprises are CO2, N2, O2, SO2, water vapors and micro components for example CO and NOx.

The cement industry is one of the two biggest producers of carbon dioxide (CO2), making up to 8% of overall man-made emanation of this gas, of which half is from chemical process and 40% from consuming fuel. The CO2 produced from structural concrete is assessed at 410 kg/m3. Around 900 kg of CO2 are discharged for the creation of every 1 ton of concrete.

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The CO2 is major greenhouse gas. In this way cement assembling contributes greenhouse gases both straightforwardly through the decay of calcium carbonate and furthermore through utilization of energy, especially from the combustion of fossil fuel. Thus, we are expected to discover other discretionary material for concrete instead of cement. In the event that we ready to supplant few percent of cement from concrete, it will supportive to lessen CO2 emission. From different exploration works, some mechanical squanders are discovered which can diminish the measure of concrete in cement without bargaining its essential properties (like strength). Granulated blast furnace slag, silica fume, rice husk ash, chemosphere and fly ash are some industrial wastes that can be utilized as strengthening cementitious materials. Rich husk ash is an agricultural by product which is obtained from rice mill and then burned and very high temperature as fuel. which gives some extra advantages when utilized in cement. Before additional conversation about RHA let us quickly examine about concrete.

Rice husk may be a rural deposit that represents 20% of the 649.7 million a lot of rice created each year-round the world. The delivered somewhat blazed husk from the process plants once used as a fuel likewise adds to contamination and endeavors are being created to defeat this natural issue by using this material as a supplementary establishing material2. The artificial arrangement of rice husk is found to vary beginning with one specimen then onto successive attributable to the distinctions within the reasonably paddy, harvest year, atmosphere and geologic conditions.

Smoldering the husk beneath controlled temperature beneath 800 °C will deliver fiery remains with silica primarily in shapeless structure. As of late, Nair et al. reportable an examination on the pozzolanic movement of RHA by utilizing completely different systems as an area of request to examine the impact of combustion temperature and smoldering length. He expressed that the specimens blazed at 500 or 700 °C and smoldered for over 12 hours delivered fiery junk with high reactivity with no noteworthy

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measure of crystalline material. The short blazing spans (15 - 360 minutes) caused high carbon content for the created RHA even with high burning temperatures of 500 to 700 °C. A best in class report on rice husk fiery debris (RHA) was distributed by Mehta in 1992, and contains a survey of physical and compound properties of RHA, the impact of combustion conditions on the pozzolanic qualities of the clinker, and a rundown of the exploration discoveries from a number of nations on the use of RHA as a supplementary establishing pozzolanic material.

Concrete is one of the important construction materials used in all engineering works including the infrastructure development at all stages. It has been used in construction sector for a long time and proved that, its ingredients are widely available in natural world. Due to wide spread usage and fast infrastructure development in all over the world, there is shortage of natural and quality aggregates. Due to this reason quality of concrete is being reduced, in order to satisfy certain conditions, retarders (Admixtures) are used in concrete composition to improve the setting time with different type of natural, mineral and chemical admixtures. From the ancient period also natural admixtures like jaggery were preferred to use in masonry works and structural elements for enhancement of concrete properties.

II. LITERATURE SURVEY

The diversity of compressive strength between conventional concrete and concrete with 0.1% sugar as admixture in concrete was 12.0%, for jaggery, its variation was 15.11% after 28 days, among these two admixtures, raw jaggery was given better results than sugar, hence jiggery is suitable admixture into concrete composition.

It was accomplished that replacement ratio of jaggery increases; workability and setting time was increased. Compressive strength of this new concrete was increased by 8.93% at 15% optimum replacement of sugar cane ash as admixture. There was no much more increase of compressive strength with sugar cane ash replacement after 28 days.

Based on experimental results for M30 and M60 grade of concretes and they prepared with molasses treated with waste water, revealed as slight increase in compressive, flexural, splitting tensile strengths at all ages.

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Strength of Concrete with Jaggery as admixture was Shown high strength values than the sugar. Segregation and bleeding was very less due to this admixture and it acts as a thin layer over a cement and slows down the hydration process, formation of calcium ions increases the solubility and discouraging the formation of Calcium Hydroxide. Setting time of the concrete increased as the percentage of dosage was increased.

It was proficient that the strength achieved more than 100% at 30% replacement and 90% of compressive strength was achieved at 40% and 50% replacement. Bonding property of the concrete is increased with the use of jaggery in concrete. bleeding was very less due to this admixture and it acts as a thin layer over a cement and slows down the hydration process, formation of calcium ions increases the solubility and discouraging the formation of Calcium Hydroxide.

It was concluded that the workability increments with the expansion in the rates of Jiggery, compressive strength increased at 0.1% and 0.2% of jiggery as admixture and reduced at dosage of 0.3% and 0.4% jiggery as admixture. Similar trends were observed in flexural strength and tensile strength.

It was concluded that molasses used as admixture into the concrete, increased the workability condition. Molasses enhances the compressive strength, initial and final setting time. Bleeding and Segregation in concrete was reduced by using molasses as an admixture.

Concrete made by using jaggery as an admixture gives better workability than concrete made by using Sugar as an admixture and conventional concrete. Percentage of admixture improved, compressive strength and workability was increased. Setting time of samples was increased and difficult to demolds after 24 hrs., due to this difficulty of demolding, so, specimens were demolded after 48 hrs.

Setting time, workability and compressive strength of the concrete composition was increased with increase of sugar percentage as admixture. The setting time of concrete increased 30 to 85 min by increase of sugar percentage from 0 to 0.08 and similarly compressive strength was improved from 24.44 MPa to 29.46 MPa.

Workability of concrete increases when the dosage of admixture was increased. All explored Jaggery blends had high slump

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values and worthy workability. Segregation and bleeding was a smaller amount due to the usage of these admixtures. Compressive Strength at the age of 7, 14, 28 and 50 days were higher than with the use as admixture at 0.1 and 0.2% of Composition and lower than 0.3 and 0.4% of jaggery contrast with other organization cube examples for M20 grade of concrete. Compressive strength of this new concrete was increased by 8.93% at 15% optimum replacement of sugar cane ash as admixture. There was no much more increase of compressive strength with sugar cane ash replacement after 28 days.

V.Ganesan (2015) has learned about exploratory investigations on strength of concrete by somewhat supplant cement with sugarcane stick bagasse fiery debris. The examination program incorporated the incomplete replacement of cement by bagasse powder by 10%, 15% and 20% and found that expansion in compressive strength and flexural strength of RC concrete for 15 % replacement of cement with bagasse slag. Yogesh. R. Suryawanshi (2015) has inspected about on impact of sugar powder on Strength of cement. Sugar powder content is 0, 0.05, 0.075, 0.1, 0.15, and 0.2 % by weight of cement. Every one of the examples was water cured and testing is improved the situation 3 days, 7 days and 28 days.

The measure of sugar powder 0.1% of the aggregate weight of cement gives expanded introductory and last setting time. The measure of sugar powder 0.1% of the aggregate weight of cement gives enhanced outcomes in compressive strength. The compressive strength of cement and concrete is expanded up to 15 - 20%. A. V. Pavan Kumar (2015) has perform about effect of Sugar, Jaggery and Sugar Cane Ash on Properties of Concrete. The admixtures (sugar and jaggery) are incorporated into concrete at the estimation levels of 0, 0.025, 0.05, 0.1% with 5.10,15, 20, 25% Ash is and cement up to 15% to improve the distinctive properties of concrete. Collapse To slump was seen in both the admixtures at a measurements of 0.1%. Workability increments when the measurement of admixture was increased. Compressive strength of concrete improves when dose of admixture is expanded.

III. MATERIAL USED

CEMENT:

For this research work, PCC cement of Ultratech cement company is used, that is

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available in our nearest construction material shop. While adding cement in concrete mix, it is ensured that cement is moisture free and no lumps are found in the cement bag.

Rice husk ash (RHA):

RHA is the result of burning of rice husk. A large portion of the evaporable parts of rice husk are gradually lost during consuming and the essential deposits are the silicates. The attributes of the debris are subject to (1) arrangement of the rice husks, (2) consuming temperature, and consuming time.

Each 100 kg of husks consumed in a heater for instance will yield around 25 kg of RHA. For this experimental work the rice husk ash is taken from a potter man at our village.

FINE AGGREGATES:

Fine aggregates are the material going through an IS sieve 4.75 mm and hold on to 150µm gauge. Locally accessible sand is utilized as fine aggregates in this a\experimental investigation.

COARSE AGGREGATE:

The aggregates which may infiltrate 75mm IS strainer and held on 4.75mm IS sieve is called coarse aggregate. Size of coarse aggregate may change from 10mm to 40mm. Locally accessible coarse aggregate is utilized for test, that accessible on closer construction material shop.

ADMIXTURE:

The useful purpose of this study is to influence of jaggery available in market was used as admixture in concrete composition and it was used at different percentages at 0, 0.25, 0.50 and 0.75%. After crushing and make the powder form which passes through one mm sieve was used as admixture in concrete preparation.

WATER:

Generally, water having pH value 6.0 to 8.0 is used, it is potable water i.e., not containing any type of alkalinity and salinity.

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Fig.1 Concrete Mix

MIX PROPORTION

Nominal mix of M25 grade concrete of 1:1:2 (W: C: C.A: F.A) by weight was chosen for the concrete mix of M25 grade as per IS: 10262-1982. Graded aggregates were used in preparation of samples at 60% of 20mm and 40% of 12.5mm. Zone 2 Fine aggregate was used in composition.

Fig.2 Jaggery

IV. METHODOLOGY

Proportioning

The standard proportion according to IS:456-2000, for M25 grade concrete is 1:1:2. Here extent is embraced. Which is determined by mix design method. Concrete is supplanted with RHA at different rates for example 0%, 5%, 10%, 15%, 20% and 25%.

The measure of every fixing utilized per cubic meter is as follow: - Concrete = 363.498 kg; Fine total = 683.812 kg; Coarse total = 1329.614 kg

Casting Of Samples

Total 12 samples are casted out cubes, cylinders and beams are prepared. Concrete mix is filled in molds in three layers. Each layer is compacted by tampering rod with 25 number of blows. samples are casted out cubes, cylinders and beams are prepared. Concrete mix is filled in molds in three layers. Each layer is compacted by tampering rod with 25 number of blows.

Curing

The sample specimens are set apart inside 2 to 3 hours of casting and are kept in vibration free place, in almost 90% relative damp air and at temperature of 270 ± 20 C for 24 ± ½ hours. After this period, the specimens are put in submerged condition in fresh water in a tank and are kept there only before to test. The duration of curing of sample is according to their schedule of testing.

Testing Of Samples

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Compressive strength test

The IS code followed for testing IS: 516 – 1959. The concrete cubes are casted of size 150mm ×150mm × 150mm. These samples are tested in UTM (Universal Testing Machine) of capacity 2000KN. at pace of 140 kg/cm2/min. The compressive strength test is performed at 7 days and 28 days.

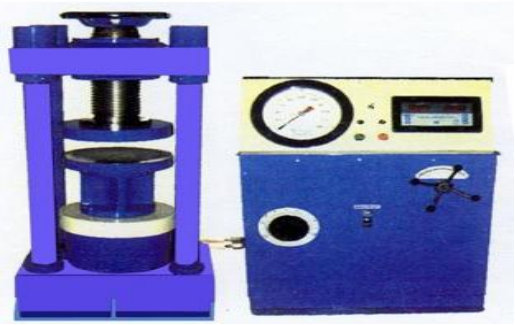

Fig.3 Compressive Strength Machine

Split tensile test

This test is an indirect method for finding tensile strength of concrete. The cylinder of diameter 150mm and height 300mm is casted and afterward tested at 7 days and 28 days. The loading rate is kept 1.2 MPa.

Fig.4 Compressive Strength Machine

Flexural strength

The beams of size 100mm × 100mm × 500mm were casted for this test and one point loading method is adopted for testing. Tests are performed per the ASTM C 293. The tests are performed at 7 and 28 days.

Fig.5 Flexural Strength Mechine

Test procedure of Workability:

Workability of concrete has been determined by conducting slump cone and compaction tests. Mix the all-concrete ingredients on water tight platform (on finished concrete floor) and measure the

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slump and compaction factor values. During the experimentation work, it was clearly observed that true slump for 0% and collapse slump when admixture added at dosages of 0.75

Fig. 6: True slump for Admixture 0%

Test procedure of flexural strength:

This test has been performed under symmetrical third point loading system. It is determined from the moment at failure. Flexural strength of the beam specimen is determined according to IS516-1959 with

fb = 3 P a / bd2 ----------(1)

Where "a" is less than 20 cm but more than 17 cm for 150x150x700 cm specimen.

Fig. 7: Concrete block Cube mould

V. RESULTS AND DISCUSSION

Table-1: average compression test results of cube specimens

Percentage of RHA	7 days compressive strength	28 days compressive strength
0	15.85	28.51
5	16.95	31.02
10	18.26	32.72
15	19.75	33.89
20	18.89	33.00
25	17.10	28.80

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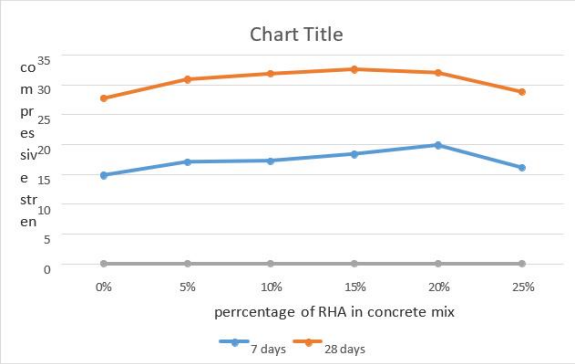

Fig. 8 compression test analysis

Tensile strength of cylindrical specimens:

Table 2: average split tensile strength of cylindrical specimens

Percentage of RHA	7 days compressive strength	28 days compressive strength
0	1.193	1.535
5	1.251	1.656
10	1.281	1.671
15	1.382	1.692
20	0.954	0.963
25	0.81	0.783

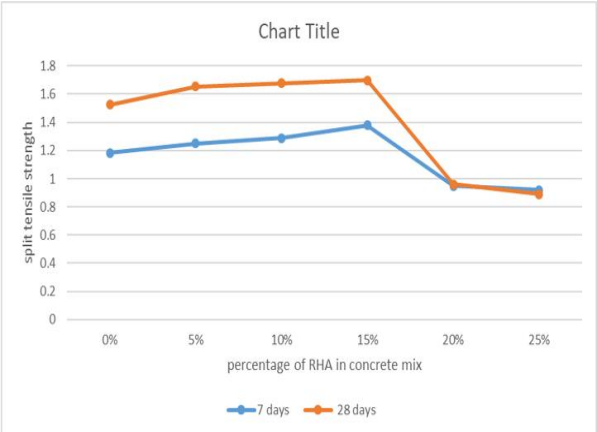

Fig.9 : split tensile strength analysis

VI. CONCLUSION

The compressive strength of conventional concrete at 28 days is 27.75MPa and 15% rice husk ash concrete is 32.78 MPa, it shows the 15.34 % improvement from conventional concrete. For other percentages of RHA (rice husk ash) the strength is below 20MPa, thus, optimum percentage of RHA is 15%. Finally, from the experimental analysis we have found that 15 % replacement of rice husk ash with cement in cement concrete is beneficial replacement. And we go beyond this for further replacement in percentage of cement we will see decrease in strength of concrete. Based on the test results, following conclusions are drawn; · The slump and compaction factor values being increased with increase in percentage of jaggery. Addition of jaggery into the concrete composition is acts as a thin layer over a cement and slows down the hydration process, formation of calcium ions increases the solubility and discouraging the formation of Calcium Hydroxide. Hence the setting time of concrete increased. Adding of jaggery in concrete composition slows down the hydration process; hence jaggery is a better

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retarder and it can be used in deep foundations. The split tensile strength of conventional concrete for 28 days is found to be 1.526MPa and that for 15% rice husk ash concrete is 1.697MPa. it shows the 24.41% improvement from conventional concrete. The optimum use of rice husk ash is 15%. Finally, from the experimental analysis we have found that 15 % replacement of rice husk ash with cement in cement concrete is beneficial replacement. And we go beyond this for further replacement in percentage of cement we will see decrease in strength of concrete.

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