EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF CEMENT WITH FLY ASH AND RICEHUSK ASH

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ABSTRACT - The detailed experimental investigation was done to study the effect of partial replacement of cement by Fly Ash (FA) and Rice Husk Ash (RHA) in combine proportion started from 30% FA and 0% RHA mix together in concrete by replacement of cement with the gradual increase of RHA by 2.5% and simultaneously gradual decrease of FA by 2.5%. Last proportion was taken 15%FA and 15% RHA.

The tests on hardened concrete were destructive in nature which includes compressive test on cube for size (150 x 150 x 150 mm) at 7,14and 28 days of curing as per IS: 516 1959

The work presented in this paper reports the effects on the behavior of concrete produced from cement with combination of FA and RHA at different proportions on the mechanical properties of concrete such as compressive strength.

Investigation reported that compressive strength increases by 30.15% in compared with targeted strength and reduces by 8.73% compared with control concrete at 28 days, were obtained at combination of 22.5% FA and 7.5% RHA. Partial replacement of FA and RHA reduces the environmental effects, produces economical and eco-friendly concrete.

INTRODUCTION

Concrete as is well known is a heterogeneous mix of cement, water and aggregates. The admixtures may be added in concrete in order to enhance some of the properties desired specially. In its simplest form, concrete is a mixture of paste and aggregates. Various materials are added such as fly ash, rice husk, and admixture to obtain concrete of desired property. The character of the concrete is determined by quality of the paste. The key to achieving a strong, durable concrete rests in the careful proportioning, mixing and compacting of the ingredients. In the ancient period, construction work was mostly carried out with help of mudstone from industry.

Fly ash is a byproduct of burned coal from power station and rice husk ash is the by product of burned rice husk at higher temperature from paper plant artificial fibers are commonly used nowadays in order to improve the mechanical properties of concrete. Considerable efforts are being taken worldwide to utilise natural waste and bye product as supplementary cementing materials to improve the properties of cement concrete. Rice husk ash (RHA) and Fly ash (FA) with using Steel fiber is such materials. RHA is bye-product of paddy industry.

Rice husk ash is a highly reactive pozzolanic material produced by controlled burning of rice husk. FA is finely divided produced by coal-fired power station. Fly ash possesses pozzolonic properties similar to naturally occurring pozzolonicmaterial. Over the past years, there has been an increasing number of papers on the use and utilization of industrial, agricultural and thermoelectric plants residue in the production of concrete. Different materials with pozzolanic properties such as fly ash, condensed silica fume, blast-furnace slag and rice husk ash have played an important part in the production of high performance concrete. During the late 20th century, there has been an increase in the consumption of mineral admixture by the cement and concrete is met by partial cement replacement. Substantial energy and cost savings can result when industrial by-products are used as a partial replacement for the energy intensive Portland cement. Among the different existing residues and by products, the possibility of using rice husk ash in the production of structural concrete is veryimportant for India. India is the second largest rice paddy cultivating country in the world. Both the technical advantages offered by structural concrete containing rice husk ash and the social benefits related to the decrease in number of problems of ash disposal in the environment have simulated the development of research into the potentialities of this material. A large amount of agricultural waste was disposed in most of tropical countries especially in Asia for countries like India, Thailand, Philippine and Malaysia. If the waste cannot be disposed properly it will lead to social and environmental problem. Recycling of the disposed material is one method of treating the agricultural waste. The used of rice husk ash material in the formation of a composite material that can be used for construction. Rice husk ash is hazardous to environment if not dispose properly. This research paper deals with the study of effects on the behavior of concrete produced from partial replacement of cement with combination of FA and RHA at different proportions.

OBJECTIVE

The main objective of this work is to study the suitability of the rice husk ash and fly ash as a pozzolanic material for cement replacement in concrete.

However it is expected that the use of rice husk ash and fly ash in concrete improve the strength properties of concrete.

Also it is an attempt made to develop the concrete using rice husk ash and fly ash as a source material for partial replacement of cement, which satisfies the various structural properties of concrete like compressive concrete like compressive strength.

1. Effect of Rice Husk Ash and fly ash on workability.

2. Effect on Compressive strength of concrete.

3. Comparison of result of different tests with varying proportion of RHA and FLY **LITERATURE REVIEW**

Makarand Suresh Kulkarni (2014) in this investigation optimized RHA, by controlled burn and or grinding, has been used as a pozzolanic material in cement and concrete. Using it provides several advantages, such as improved strength and durability properties, and environmental benefits related to the disposal of waste materials and to reduced carbon dioxide emissions. Up to now, little research has been done to investigate the use of RHA as supplementary material in cement and concrete production in Vietnam. The main objective of this work is to study the suitability of the rice husk ash as a pozzolanic material for cement replacement in concrete. However it is expected that the use of rice husk ash in concrete improve the strength properties of concrete. Also it is an attempt made to develop the concrete using rice husk ash as a source material for partial replacement of cement, which satisfies the various structural properties of concrete like compressive strength. His findings from the entire experimental work & studies concluded that mix M2 (M0+20%RHA) is the best combination among all mixes, which gives max, tensile, flexure & compression strength over normal concrete.

Kulkarni et al. (2014) carried out due to addition of rice husk ash, concrete becomes cohesive and more plastic and thus permits easier placing and finishing of concrete. Adding 20% RHA gives maximum, compression strength over normal concrete.

Deepa G Nair (2013) investigated on high strength and high performance concrete which are being widely used all over the world. Most of the applications of high strength concrete have been found in high rise buildings, long span bridges etc. The potential of rice husk ash as a cement replacement material is well established. Earlier researches showed an improvement in mechanical properties of high strength concrete with finely ground RHA as a partial cement replacement material. A review 22 of literature urges the need for optimizing the replacement level of cement with RHA for improved mechanical properties at optimum water binder ratio. His findings discusses the mechanical properties of RHA-High strength concrete at optimized conditions.

Harunur&Keramat (2011) investigated the ―durability of cement mortar in presence of Rice Husk Ash (RHA)‖. The strength and durability of mortar with different replacement level (0%, 15%, 20%, and 30%) of Ordinary Portland Cement (OPC) by RHA is investigated .It is concluded from the paper that the mortar incorporating rice husk ash is more durable than OPC mortar up to 20% replacement level.

Maurice &Godwin (2011) investigated the effects of partially replacing OPC with RHA. It is concluded that Adding RHA to concrete resulted in increased water demand, increase in workability and enhanced strength compared to the control sample. This results show that an addition of RHA from 5-10% will increase the strength.

Kartini& Mahmud (2011) reported on the ―Improvement on Mechanical Properties of Rice Husk Ash Concrete with Super plasticizer‖. Without super plasticizer RHA concrete attained lower compressive strength than that of the control due to the higher amount of water for similar workability. RHA concrete improves the durability of concrete. It is concluded from the paper that by adding super plasticizer to the RHA mixes, higher replacement levels are possible. Concrete containing up to 30%RHA can attain strength of 30 N/mm2 at 28 days.

Ramadhansyah Putra Jaya (2011) studied the compressive concrete strength and the gas permeability properties over varying fineness of the rice husk ash were experimentally investigated. Their relationships among them were analyzed. In his study eight samples were made from the rice husk ashes with a different grain size were used, i:e: coarse original rice husk ash 17.96 μm (RHA0), 10.93 μm (RHA1) 9.74 μm (RHA2), 9.52 μm (RHA3), 9.34 μm (RHA4), 8.70 μm (RHA5), 6.85 μm (RHA6) and 6.65 μm (RHA7). The ordinary Portland cement was partially replaced with the rice husk ash (15 wt%). His findings showed that the RHA3 produced the concrete with good strength and low porosity. Additionally the strength of the concrete was improved due to the partial replacement of RHA3 material in comparison with normal coarse rice husk ash RHA0. On the other hand the influence 21 of OPC and RHA materials on the concrete permeability was affected by the grinding time and age (i:e:, curing time). The permeability coefficient decreased with the increasing of curing time. The relationships between compressive strength and permeability coefficient are greatly affected by curing times and are sensitive to the grinding cementitious systems.

Ramasamy (2011) investigated on Rice Husk Ash (RHA) concrete to evaluate the compressive strength and to study its durability properties. In his experimental work of rice husk concrete, cement was replaced at various percentage levels such as 5%, 10%, 15%, 20% and control concrete was also prepared for comparison purpose. Two grades of concrete, namely M30 and M60, were prepared. His findings shows that strength of the concrete increased with the levels of percentage of replacement of 10% at which the increase in strength was 7.07% at 90 days compared to normal concrete. In the case of M60 grade concrete the compressive strength increases with the addition of super plasticizer. In general, Saturated Water Absorption (SWA) 19 increased in the case of RHA Concrete up to 10% replacement level, but the same diminished with addition of super plasticizer. His findings also shows that porosity of RHA Concrete decreased from 4.70% to 3.45% when the replacement level increased from 5% to 20%. There is a further decrease with the addition of super plasticizer. The chloride ion permeability value of RHA Concrete was very low between 100-1000 coulomles, as compared to normal concrete. It was observed from tests that RHA concrete was more resistant to HCl solution than that of control concrete. The percentage of resistance against alkaline attack of M30 grade RHA concrete varied from 25 to 67 and the corresponding value for M60 grade was from 35 to 70 for replacement levels varying from 5% to 20%. There was a higher resistance against sulphate attack for both continuous soaking and cyclic at addition of 20% RHA.

LITERATURE ONFLY ASH

The present study aims to study the effect of fly ash on concrete by partial replacement of cement with 0%, 15%, 20% and 30% of fly ash. Various research works have already been conducted to study the effect of fly ash on various properties of concrete at different ages and for different grades of concrete. Some research works were reviewed and are presented in this paper.

Rishab Joshi an effort as been made to determine the effect on compressive strength of concrete by partial replacement of cement with 0%,10%,20% and 30% of fly ash for M20 grade of concrete.Test results indicate that workability and durability of concrete increases with increase in fly ash in content, there is reduction in compressive strength of concrete. The optimum replacement of cement with fly ash is 30%.

C. Marthong studied the effect of fly ash additive on concrete properties and found that the normal consistency increases with increase in the grade of cement and fly ash content. It was also concluded that the use of fly ash improves the workability of concrete. Moreover, it was also observed that the compressive strength of concrete increases with the grade of cement. As the fly ash content increases in all grades of OPC there is reduction in the strength of concrete. The reduction is more at earlier ages as compared to later ages. Fly ash concrete was also found to be more durable as compared to normal OPC concrete.

S.A.K. Reddy studied the effect of fly ash on strength and durability parameters of concrete and found that consistency increases greatly with increase in percentage of fly ash. The optimum 7 and 28 day compressive strength was obtained in the range of 20% fly ash replacement level. It also led to the increase in split tensile strength of concrete.

Tarun Sama studied the effect of strength of concrete by partial replacement of cement with fly ash and addition of steel fibres. The grade of concrete used was M40 with mix proportion of 1:1.62:2.83 and w/c ratio of 0.45. It was observed that the optimum percentage of adding fly ash and steel fibres was determined to be 40% and 2% which showed the maximum improvement in tensile and flexural strength.

Shantmurti Upadhyaya studied the effects of fly ash on compressive strength of M20 mix design concrete and found that till the addition of fly ash upto 10%, there is negligible change in the strength of concrete. It was also observed that at the replacement till 30%, fly ash blocks have shown very low compressive strength in comparison to concrete containing no fly ash. Blocks containing fly ash were lighter in weight than the concrete block containg no fly ash.

P.R. Wankhede studied the effect of fly ash on properties on concrete and found that slump loss of concrete increases with increase in w/c ratio of concrete and increase in quantity of fly ash. It was also concluded that concrete with 10% and 20% replacement of cement with fly ash shows good compressive strength for 28 days than normal concrete, but in case of 30% replacement of cement with fly ash ultimate compressive strength of concrete decreases.

Rahul Bansal studied the effect on compressive strength with partial replacement of fly ash and found that by 10% replacement of cement by fly ash, 20% and 50% decrease in compressive strength was observed at the age of 7 and 28 days respectively. At 20% replacement, 7% and 11% increase in compressive strength was observed at the age of 7 and 28 days respectively. In 30% replacement, 23%and 25% increase in compressive strength was observed at the age of 7 and 28 days respectively. It was also observed that with the increase in age the compressive strength also increased for fly ash replaced concrete.

METHODOLOGY AND MATERIALS REQUIRED

METHODOLOGY

1. Preliminary Tests: These were performed on the fine aggregates, coarse aggregates and cement to confirm their suitability for concrete making.

2. Mix Design: As 20N/mm^2 was target strength. Nominal mix design of 1(cement):1.5(fine aggregate):3(coarse aggregate) was adopted.

3. Batching: The materials were weigh batched using electronic weighing machine.

4. Mixing: Mixing was done in aconcrete mixer. The mixing was done as per the standard for min 3 min.

5. Preparation of moulds: Before casting the specimens, all cube were cleaned, screwed tightly and oil was applied to all surfaces to prevent adhesion of concrete during casting.

6. Compaction: Placing of concrete in oiled mould was done in three layers for cubical mould and five layers for cylindrical mould, each layer tamped 25 times with the tamping rod.

7. Curing: After 24 hours, all the casted specimen were demolded from the moulds and marked (To identify the casting batch) and immediately put into the curing tank for a period of 7, 14 and 28 days for different specimens. The specimens were not allowed to become dry during the curing period.

8. Testing: Specimen was taken out from the curing tank after 7, 14 and 28 days to perform various test. Three numbers of specimens in each sample were tested and average value was calculated for cubes. Specimen were tested in a compression testing machine

MATERIALS USED

CEMENT

The history of cementing material is as old as the history of engineering constructions. In 1824, Joseph Aspin of England discovered has a mixture of lime and clay, heated to a high temperature could produce a binding material which would harden in the presence of water. Since this new material on setting, resembled to a stone quarried near Portland in England it was named as Portland cement.

SAND

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles.As the term is used by geologists, sand particles range in diameter from 0.0625mm to 2mm. An individual particle in this range size is termed a **sand grain.** The next smaller size class in geology is silt: particles smaller than 0.0625mm down to 0.004mm in dia. The next larger size class above sand is gravel, with particles ranging from 2mm to 64mm

COARSE AGGREGATES

Coarse aggregates are paricles are greater than 4.75mm in size. They can either be from primary, secondary or recyle sources. Primary or 'Virgin', aggregates are either land or marine won. Gravel is a course marine won aggregate; land won course aggregates include gravel and crushed rock gravels constute the majority of course aggregate used in concrete with crushed stone making up most of the remainder.

RICE HUSK ASH

(a).DEFINITION:

1. Rice husk can be burnt into ash that fulfils the physical characteristics and chemical compositionof mineral admixtures.
2. Pozzolonic activity of RHA depends in
3. Silica content
4. Silica crystallization phase

FLY ASH

Fly ash is a fine powder that is a by-product of burning pulverized coal in electric generation power plants. Fly ash is a pozzolan, a substance containing aluminous and siliceous material that forms cement in the presence of water. When mixed with lime and water, fly ash forms a compound similar to Portland cement. This makes fly ash suitable as a prime material in blended cement, mosaic tiles, and hollow blocks, among other building materials. When used in concrete mixes, fly ash improves the strength and segregation of the concrete and makes it easier to pump.

MIX DESIGN OF CONCRETE

MIX DESIGN OF CONCRETE FOR RICE HUSK ASH AND FLY ASH

FACTORS TO BE CONSIDERED FOR MIX DESIGN

The grade designation giving the characteristic strength requirement of concrete. The type of cement influences the rate of development of compressive strength of concrete. Maximum nominal size of aggregates to be used in concrete may be as large as possible within the limits prescribed by IS 456:2000. The cement content is to be limited from shrinkage, cracking and creep.

Grade of concrete – M20

Type of cement – OPC 43 grade

Type of material admixture -Rice Husk Ash (RHA)

Maximum nominal size of aggregate – 20mm

Minimum cement content – 320kg/m3

Maximum water cement ratio – 0.55

Workability – 100mm (slump)

Exposure condition – Severe

Degree of supervision –Good

Types of aggregate – Crushed angular aggregate

Maximum cement – 450 kg/m3

Specific gravity of Cement - 3.064

Specific gravity of RHA –1.25

Specific gravity of fine aggregate-2.76

Specific gravity of coarse aggregate-2.7

MIX PROPORTION DESIGNATIONS: The common method of expressing the proportions of ingredients of a concrete mix is in the terms of parts or ratios of cement, fine and coarse aggregates. For e.g., a concrete mix of proportions 1:1.5:3 means that cement, fine and coarse aggregate are in the ratio 1:1.5:3 or the mix contains one part of cement, two parts of fine aggregate and four parts of coarse aggregate. The proportions are either by volume or by mass. The water-cement ratio is usually expressed in mass.

MIXEDDESIGN CALCULATION FOR M20 GRADE (1:1.5:3)

Volume of mould=0.15*0.15*0.15=0.003375m^3

For 9 blocks =0.003375*9=0.03037m^3 Dry volume =wet volume*1.57=.03037*1.57 =0.0476m^3

We know that

Mix proportion for M20 grade concrete is 1:1.5:3

Volume of cement=1/5.5 *0.0476=0.00865m3

Weight of cement=0.00865*1440 =12.456

=13kg

1. Weight of fine aggregate =1.5*13 =19.5kg
2. Weight of course aggregate =3*13 =39kg
3. Water cement ratio =0.5

Water content=0.5*13

Type equation here.=6.5Lt

For 0% replacement of cement with fly ash (OR) RHA

Cement=1.4kg

FA=2.1kg

CA=4.2kg

Fly ash (OR) RHA=0kg

Water=0.7Lt

For 15% replacement of cement with fly ash (OR) RHA

Cement=1.173kg

FA=2.070kg

CA=4.140kg

Fly ash (OR) RHA=0.207kg

Water=0.7Lt

For 20% replacement of cement with fly ash (OR) RHA

Cement=1.104kg

FA =2.070kg

CA =4.140kg

Fly ash (OR) RHA=0.276kg

Water=0.7Lt

For 30% replacement of cement with fly ash(OR) RHA

Cement=0.966kg

FA=2.070kg

CA=4.140kg

Fly ash (OR) RHA=0.414kg

Water=0.7Lt

TOTAL ESTIMATED QUANTITY FOR 9 BLOCKS FOR 28 DAYS

1. CEMENT : 13kg
2. FA : 19.5kg
3. CA :39kg
4. FLY ASH :2.691kg
5. RHA :2691kg
6. WATER : 6.3Lt

PREPARE OF MOULDS: (AS PER IS: 516-1959)

CUBE MOULDS

The mould shall be of metal, preferably steel or cast iron, and stout enough to prevent distortion. It shall be constructed in such a manner as to facilitate the removal of the moulded specimen without damage, and shall be so machined that, when it is assembled ready for use, the dimensions and internal faces shall be accurate within the fallowing limits:

The height of the mould shall be either 15.0 + 0.005cm and the corresponding internal width of the mould shall be 15.0 + 0.005cm respectively. The angle between the interior faces and the top bottom planes of the mould shall be 90^0+ 0.05^0. The internal surfaces of the mould shall be plane surface with a permissible variation of 0.02 mm in 15.0 cm and 0.1 mm overall. The base plate shall be such dimensions as to support the mould during the filling without leakage and it shall be preferably attached to the mould by spring or screws.

The parts of the mould when assembled shall be positively and rigidly held together, and suitable methods of ensuring this, both during the filling and on subsequent handling of the filled mould, shall be provided. In assembling the mould for use, the joints between the sections of mould shall be thinly coated with mould oil and a similar coating of mould oil shall be applied between the contact surface of the bottom of the mould and the base plate in order to ensure that no water escapes during the filling. The interior surfaces of the assembled mould shall be thinly coated with mould oil to prevent adhesion of the mortar.

6.1.2 CASTING OF TEST SPECIMENS:(AS PER IS: 516-1959)

PREPARATION OF MATERIALS

All materials shall be brought to room temperature, preferably $27^o \pm 3^0$ c before commencing the experiments. The cement samples, on arrival at the laboratory, shall be thoroughly mixed dry either by hand or in a suitable mixer in such a manner as to ensure the greatest possible blending and uniformity in the material, care is being taken to avoid the intrusion of foreign matter. The cement shall taken be stored in a dry place, preferably in air tight metal containers. Samples of aggregates for each batch of concrete shall be of the desired grading and shall be in an air-dried condition.

PROPORTIONING

The proportions of the materials, including water, in Concrete mixes for determining the suitability of the materials available, shall be similar in all respects to those to be employed in the work. Where the proportions of the ingredients of the mortar as used on the site are to be specified by volume, they shall be calculated from the proportions by weight used in the test cubes and the unit weights of the materials.

WEIGHING

The quantities of cement, each size of aggregate, some %age of coconut shell and water for each batch shall be determined by weight, to an accuracy of 0.1 percent of the total weight of the batch.

MIXING CONCRETE

The concrete shall be mixed by hand or preferably in a laboratory batch mixer, in such a manner as to avoid loss of water or other materials. Each batch of concrete shall be of such a size as to leave about 10 percent excess after moldings the desired number of test specimens.

HAND MIXING

The concrete batch shall be mixed on a water-tight, non absorbent platform with a shovel, trowel or similar suitable implement, using the fallowing procedure:

1. The cement and fine aggregate and coarse aggregate shall be mixed dry until the mixture is thoroughly blended and is uniform in colour.
2. The aggregates shall then be added and mixed with the cement until it is uniformly distributed throughout the batch.
3. The water shall then be added and the entire batch mixed added to the copper slag until the concrete appears to be homogenous and has the desired consistency. If repeated mixing is necessary, because of the addition of water increments while adjusting the consistency, the batch shall be discarded and a fresh batch made without interrupting the mixing to make trial consistency tests.

COMPACTION:

COMPACTION BY HAND

When compacting by hand, the standard tamping bar shall be used and the strokes of the bar shall be distributed in a uniform manner over the cross section of the mould. The number of strokes per layer required is 12. The strokes shall penetrate into the underlying layer and the bottom layer shall be tamped throughout its depth. Where voids are left by tamping bar, the sides of the mould shall be tapped to close the voids. After the top layer has been compacted, the surface of the concrete shall be finished level with the top of the mould, using a trowel, and covered with a glass or metal plate to prevent evaporation.

WORKABILITY OF CONCRETE

Workability is defined as the amount of useful internal work necessary to achieve full compaction. It is also defined as the ease with which concrete can be placed and degree to which it resist segregation. It is also given new definition which includes all the essential properties of concrete in plastic condition i.e. mixing ability, transportability, modeliability and ease compaction.

6.1.3 CURING OF TEST SPECIMENS: (AS PER IS: 516-1959):

The test specimens shall be stored on the site at a place free from vibration, under damp matting, sacks or other similar material for 24 hours +1/2 hour from the time of adding the water to the other ingredients. The temperature of the place of storage shall be within the range of 22^0 to 32^0C. After period of 24 hours, they shall be marked for later identification, removed from the moulds and, unless required for testing within 24 hours, stored in clean water at a temperature of 24^0 to 30^0C until they are transported to the testing laboratory. They shall be sent to the testing laboratory well packed in damp sand, damp sacks, or other suitable material so as to arrive there in a damp condition not less than 24 hours before the time of test. On arrival at the testing laboratory, the specimens shall be stored in water at a temperature of 27^0 + 2^0C until the time of test. Records of the daily maximum and minimum temperature shall be kept both during the period of the specimens remain on the site and in the laboratory.

COMPRESSIVE STRENGTH DETERMINATION:

GENERAL:

Compressive strength test is carried out as per Indian Standard code IS 516: 1959 on plain concrete and concrete with copper slag and results are tabulated and conclusions are drawn.

SPECIMEN PREPARATION:

Fresh concrete is made by mixing the proper amounts of cement, water and aggregate as indicated by the mix design calculations, which is then placed in moulds. TS 500 and DIN designate 15x15x15 cm cubic moulds. Three specimens should be prepared. Cubes are filled in two equal portions. All possible measures should be taken during placing so that the specimen is prepared in a similar way to the actual placing condition in the site.

The specimens are left in moulds for two days and then cured in a moist environment such as curing room, water or a wet blanked. At the end of 7,14 and 28 days, the cubic specimens are ready for the compression test. Cubes provide this with us capping.

WEIGHING OF MATERIALS:

Concrete is prepared for M_{20}mix, designed for plain concrete and concrete with copper slag. Materials such as cement, fine aggregate, coarse aggregate and copper slag are weighed to accuracy.

MIXING OF MATERIALS:

Concrete is mixed in a non absorbent clean platform i.e., in a mixing tray with a trowel. Initially coarse aggregate is put into the platform following fine aggregates and cement for plain concrete. For concrete with copper slag, initially coarse aggregate is put into the mixing tray followed by mixture of fine aggregates and copper slag and mixed properly. Now cement is poured to the tray and mixed properly in the dry state. At last required quantity of water as per water-cement ratio is added and mixed well within 2 minutes.

MOULD PREPARATION:

Mould is cleaned properly and greased with mould oil. Concrete is placed in the mould of dimension 150mm x 150mm x 150mm in 3 layers each layer of height approximately after the placement of first layer of concrete it is compacted by a tamping rod of 16mm diameter, 0.6m long and bullet pointed at the lower end. The strokes of the bar are uniformly distributed over the cross section of the mould. Each layer is compacted with 25 strokes and copper slag are sprinkled uniformly on each layer, next scoop of concrete is placed followed by same manner of compaction and top layer is finished.

CURING OF SPECIMENS:

The test specimens are stored in place free from vibration, in moist air of at least 90% relative humidity and at a temperature of $27^{o}+ 2^{o}$ C for 24 hours from the time of addition of water to the dry ingredients. After this period, the specimens are marked and removed from the moulds and immediately submerged in clean fresh water and kept there until taken out just prior to test. The water in which the specimens are submerged, are renewed every seven days and maintained at a temperature of $27^{o}+ 2^{o}$ C. The specimens are not allowed to become dry at any time until they have been tested.

METHOD OF TESTING IN CTM:

Specimens are tested at the ages of 7,14&28days. The specimens to be tested are taken out from water and wiped to remove excess water and grit present on the surface. 3 specimens are tested for each type of mix at specific age. Dimensions of the specimens are measured with an accuracy of 0.1mm and tabulated. Cubes are placed on the compression testing machine of 100 tons capacity such that the marked face faces the observer and load is applied on the specimen and increased at the rate of 140kg/sq cm/min until the resistance of the specimen to the increasing load breaks down and no greater load can be sustained. Maximum load applied to the specimen was recorded and compressive strength of the concrete is found out using the relation,

$$\text{compressive strength} = \frac{P}{B \times D}\,(N/mm^2)$$

P=load in N.

B=breadth of cube in mm.

D=depth of cube in mm.

COMPRESSION TEST

AIM: To determine the compression strength for 7,14 and 28 days of curing. Various cubes were made with various percentage of rice husk ash by weight of cement and tested. Five concrete cube specimens for the test is made for each M-20 with 15%, 20%&30%Flyash And Rice Husk Ash composition. Compressive strength test is conducted on hardened concrete as it is an easy test to perform and also most of the suitable characteristic property of concrete. Sometimes, the compressive strength of concrete is checked using the parts of beam tested in flexure. The cube specimen is of size 150×150×150mm.

COMPRESSIONTEST RESULTS

TABLE: 7 DAYS CURING

%replacement	Fly ash		Rice husk ash		mix	
	Mass (kg)	`Strength (N/mm^2)	Mass (kg)	Strength (N/mm^2)	Mass (kg)	Strength (N/mm^2)
0	8.450	29.648	8.450	29.648	8.450	29.648
15	8.250	24.280	7.650	7.412	7.700	10.020
20	8.200	23.100	7.800	6.104	7.850	10.090
30	8.100	20.000	7.350	4.360	7.800	9.156

TABLE: 14 DAYS CURING

%replacement	Fly ash		Rice husk ash		Mix	
	Mass(kg)	`Strength	Mass(kg)	Strength	Mass(kg)	Strength
0	8.400	33.570	8.400	33.570	8.400	33.570
15	8.300	31.21	7.700	11.772	7.750	16.130
20	8.250	28.950	7.900	14.039	7.900	14.126
30	8.000	24.590	7.400	7.150	7.700	15.170

TABLE: 28 DAYS CURING

Age in days	%0f replacement	Fly ash N/mm2	Rice husk ash N/mm2	mix N/mm2
7	15	24.280	7.650	7.850
14	20	31.210	14.039	16.130
28	30	34.880	20.140	26.592

TABLE: HIGHEST COMPRESSIVE TEST

Age in days	%0f replacement	Fly ash N/mm2	Rice husk ash N/mm2	mix N/mm2
7	15	24.280	7.650	7.850
14	20	31.210	14.039	16.130
28	30	34.880	20.140	26.592

CONCLUSIONS

CONCLUSION ON RICE HUSK ASH

1. At all the cement replacement levels of Rice husk ash; there is gradual increase in compressive strength from 7 days to 14 days. However there is significant increase in compressive strength from14 days to 28 days followed by gradual increase from 28 days.
2. By using this rice husk ash in concrete replacement the emission of greenhouse gases can be decreased to a greater extent.as a result there is a greater possibility to gain more number of carbon credits
3. RHA based sand cement block can significantly reduce room temperature. Hence air conditioner operationis reduced resulting in electric energy saving.
4. 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.
5. 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.
6. The pozzolonic activity of rice husk ash is not only effective in enhance the concrete strength, but also in improving the impermeability characteristics of concrete
7. As the Rice Husk Ash is waste material, it reduces the cost of construction.
8. Samples with 15%, 20%, 30% content of RHA replacing the cement have been tested. Till 20% of replacement of cement content with RHA gives safe and economic results.

CONCLUSION ON FLYASH

From the experimental work carried out for M20 grade of concrete by partial replacement of cement with 15%, 20% and 30% of fly ash, the following conclusion were drawn.

1. Slump loss of concrete increases with increase in w/c ratio of concrete
2. For w/c ratio 0.35 without any admixtures, initial slump cannot be measured by slump cone test as it is very less.
3. Ultimate compressive strength of concrete decreasing with increase in w/c ratio of concrete.
4. Slump loss of concrete goes on increasing with increase og quantity of flyash.
5. The 15% and 20% replacement of cement with fly ash shows good compressive strength for 28 days.
6. The 30% replacement of cement with fly ash ultimate compressive strength of concrete decreases.

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