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EFFECT OF REPLACEMENT OF FLYASH AND RICEHUSK ASH ON STRENGTH STUDIES OF M25 GRADE CONCRETE

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ABSTRACT

In the ancient period, construction work was mostly carried out with help of mudstone from industry. Fly ash is a by-product of burned coal from power station and rice husk ash is the by –product of burned rice husk at higher temperature from paper plant. Considerable efforts are being taken worldwide to utilize natural waste and bye –product as supplementary cementing materials to improve the properties of cement concrete. Rice husk ash (RHA) and Fly ash (FA) 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 pozzolonic material. The detailed experimental investigation done to study the effect of partial replacement of cement with FLY ASH and RICE HUSK ASH on concrete. In this paper I started proportion form 10%(FA+RICE HUSK ASH) such as 5% FA and 5% RHA mix together in concrete by replacement of cement ,last proportion was taken 15% FA and 15%RHA, with gradual increase of fly ash and rice husk ash by 10%, 20%, 30% of partial replacement of cement . 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, 28, days of curing as per IS: 516 1959, Flexural strength on beam (100 x 100 x500 mm) at 28 days of curing as per IS: 516 1959 and split tensile strength on cylinder (150 mm ø x 300mm) at 28 days of curing as per IS: 5816 1999. It is observed that though the strength of RHA concrete goes on decreasing after the 15% addition of RHA, the composition of 20% FA + 10% RHA gives maximum strength results as well as shows the potential to be used as useful material for different building materials. Partial replacement of FA and RHA reduces the environmental effects, produces economical and eco-friendly concrete

KEYWORDS: FlyAsh, Ricehusk Ash, Flexural Strength, Admixture, Compressive Strength, Split Tensile Strength.

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, 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.

LITERATURE REVIEW

Hwang Chao-Lung, Bui Le Anh-Tuan, Chen Chun-Tsun, (2011): In this, they have founded that compression strength and electrical resistance of rice husk concrete. In this project, they added different proportions of ground rice husk ash such as 10%, 20%, and 30% by the replacement of cement. The compressive strength of concretes with up to 20% ground RHA added attain values equivalent to that control concrete after 28 days. finally they found two this project, compressive strength of RHA concrete and electrical resistance of RHA concrete After 91 days of curing, the electrical resistance of all RHA concrete becomes higher than 20 k X-cm. Similarly, for all RHA concrete samples, the UPV are all higher 3660 m/s after 91 days of curing. The strength efficiency of cement in ground RHA concrete is much higher than that of the control concrete]

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Satish D. Kene1, Pravin V. Domke2, Sandesh D. Deshmukh3, R.S.Deotale (2011): In this, they have studied on the strength studies of concrete with partial replacement of cement by fly ash and rice husk ash with different proportions. The detailed experimental investigation done to study the effect of partial replacement of cement with RHA and FA on concrete. In this paper I started proportion form 30% FA and 0% RHA mix together in concrete by replacement of cement, last proportion taken 0% FA and30% RHA, with gradual increase of RHA by 1% and simultaneously gradual decrease of FA by 1%. They prepared cubes, cylinders, prisms. Finally they found compressive strength, spilt tensile strength, and flexural strength of fly ash and rice husk of concrete. It is observed that though the strength of RHA concrete goes on decreasing after the 15% addition of RHA, the composition of 10% RHA + 20% FA gives maximum strength results as well as shows the potential to be used as useful material for different building materials.]

MATERIALS AND THEIR PROPERTIES

CEMENT: Ordinary Portland cement (OPC) is the most common type of binder used for concrete production and hence, OPC 43 Grade conforming to Indian Standard IS 12269:1987 was used as a binder. The local brand name of the OPC cement is used. Specific gravity of the cement is found to be 3.15 in the laboratory.

FINE AGGREGRATE: River sand was used throughout the investigation as the fine aggregate conforming to grading zone II as per IS 383:1970. The density of the fine aggregate is found to be 2671 kg/m3, specific gravity is found to be 2.65 Fine aggregate of the same grading but with a difference of 1% voids content may result in a remarkable difference in water demand. The optimum gradation of fine aggregate for concrete is determined more by its effect on water requirement than on physical packing.. Fine aggregate with a fineness modulus in the range of 2.5 to 3.2 are preferable.

COARSE AGGREGATE: Crushed granite stone aggregate 3-12 mm sizes were used for CC for comparison. The bulk density, specific gravity, water absorption, aggregate impact value (AIV), aggregate crushing value (ACV), aggregate abrasion value, and particle size distribution were determined. A 20-25mm nominal maximum size aggregate is common for producing concrete strengths up to 60MPa and 10-12 mm above 60MPa. In general, the smallest size aggregates produces the highest strength for a given water cement ratio.

FLY ASH: In the past, fly ash was generally released into the atmosphere via the smoke stack, but pollution control equipment mandated in recent decades now. Depending upon the source and makeup of the coal being burned, the components of the fly ash produced vary considerably, but all fly ash includes substantial amounts of silica (silicon dioxide, SiO_2) (both amorphous and crystalline) and lime (calcium oxide, (CaO)). Fly ash is commonly used to supplement Portland cement in concrete production, where it can bring both technological and economic benefits, and is increasingly finding use in synthesis of geo polymers and zeolites.

RICE HUSK ASH:. Chemical compositions of RHA are affected due to burning process and temperature. Silica content in the ash increases with higher the burning temperature. As per study RHA produced by burning rice husk between 600 and 700°C temperatures for 2 hours, contains 90-95% SiO_2, 1-3% K_2O and < 5% un burnt carbon. Under controlled burning condition in industrial furnace, Studies have shown that RHA resulting from the burning of rice husks at control temperatures have physical and chemical properties that meet ASTM (American Society for Testing and Materials).Standard C 618-94a. Studies have shown that to obtain the required particle size, the RHA needs to be grown to size 45 µm – 10 µm.

WATER: Water is an essential component of concrete for mixing and curing. It should be free from harmful impurities. The pH value of water shall not be less than 6. If the water is drinkable, it is considered to be suitable for concrete making. Hence, potable tap water was used in this study for mixing and curing.

MATERIAL PROPERTIES

CEMENT: In the present study OPC 43 grade local brand was used. The specific gravity of cement is given in Table

Specific gravity of cement

Sl. No.	Observations	Trail 1	Trail 2	Trail 3
1.	Weight of the specific gravity bottle W1, g	35.8	35.8	35.8

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2.	Weight of the specific gravity bottle + 1/3rd filled cement W2, g	53.8	53.6	53.8
3.	Weight of the specific gravity bottle + 1/3rd filled cement + kerosene W3, g	89.4	89.3	89.4
4.	Weight of the specific gravity bottle W1 + kerosene W4, g	76.2	76.2	76.2
5.	Specific gravity	3.11	3.10	3.11

Average specific gravity of cement = 3.11

FINE AGGREGATE: Locally available river sand conforming to grading zone-II as per IS: 383 – 1970 was used. The screened at site to remove deleterious materials. Sieve analysis and specific gravity test results of sand were given.

sieve analysis of fine aggregate

Sieve size, mm	Weight retained, gms	Cumulative weight retained, gms	Cumulative % retained (%)	Percentage passing (%)
4.75	0	0	0	100
2.36	11	11	2.2	97.8
1.18	52.7	63.7	12.74	87.26
0.6	138.3	202	40.4	58.6
0.3	249.5	451.5	90.3	9.7
0.15	42.1	493.6	98.72	1.28
<0.15	6.4	500	100	0

Fineness modulus of sand = 2.45

Specific Gravity of Fine Aggregate=2.65

COARSE AGGREGATE: In the present study a locally available coarse aggregate (MSA,20mm) from quarry was used.

Sieve Analysis of Coarse Aggregate

Sieve size (mm)	Weight Retained(g)	Cumulative Weight retained(g)	Cumulative % retained	% Passing
40	0	0	0	100
26.5	0	0	0	100
20	675	13.5	13.5	86.5
12.5	3525	70.5	84	16
10	260	5.2	89.4	10.6
4.75	420	8.4	97.6	2.4
<4.75	120	2.4	100	0

Fineness modulus of coarse aggregate = 3.75

Specific Gravity of Coarse Aggregate=2.72

FLY ASH: Fly Ash is a pozzolan. A pozzolan is a siliceous or alumina siliceous material that, in finely divided form and in the presence of moisture, chemically reacts with the calcium hydroxide released by the hydration of Portland cement to form additional calcium silicate hydrate and other cementitious compounds. The hydration reactions are similar to the reactions occurring during the hydration of Portland cement. Thus, concrete containing Fly Ash pozzolan becomes denser, stronger and generally more durable long term as compared to straight Portland cement concrete mixtures.

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FLY ASH plant at NTPC(Visakhapatnam)

RICE HUSK ASH AND ITS PROPERTIES: Rice husk, basically an agricultural residue, is obtained from rice processing of mills of the developing countries. Only a small amount of husk is used as fuel in rice mill and electricity generating power plant. After burning rice husk, the RHA is produced as a by-product, about 20% of its original weight. The unburnt rice husk contains about 50% cellulose 25-30% of lignin and 15-20% of silica; burning the former two components leaves behind silica ash. When rice husk is burnt at temperatures lower than 700°C, it shows a cellular microstructure which is highly reactive RHA is a highly pozzolonic material; it contains non-crystalline silica and high specific surface area that are accountable for its high pozzolonic reactivity.

RICE HUSK ASH

CURING

FRESHLY CASTED CONCRETE PROPERTIES

Workability Test: A concrete mix must be made of the right amount of cement, aggregates and water to make the concrete workable enough for easy compaction and placing and strong enough for good performance in resist in stresses after hardening. If the mix is too dry, then its compaction will be too difficult and if it is too wet, then the concrete is likely to be weak. During mixing, the mix might vary without the change very noticeable at first. For instance, a load of aggregate may be wetter or drier than what is expected or there may be variations in the amount of water added to the mix. These all necessitate a check on the workability and strength of concrete after producing. Slump test is the simplest test for workability and are most widely used on construction sites. In the slump test, the distance that a cone full of concrete slumps down is measured when the cone is lifted from around the concrete. The slump can vary from nil on dry mixes to complete collapse on very wet ones. One drawback with the test is that it is not helpful for very dry mixes. The slump test carried out was done using the apparatus shown in Figure below.

Slump cone test

MECHANICAL PROPERTIES: Compressive Strength test: To calculate the compressive strength of concrete cubes the universal testing machine (UTM) having capacity of 300tonnewas used. In this test the strength obtained in tone. The measured compressive strength of the specimen shall be calculated by dividing the maximum load applied to the specimen during the test by the cross sectional area calculated from mean dimensions of the section and shall be expressed to the nearest N/mm2.Out of many test applied to the concrete, this is the utmost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not. For cube test two types of specimens either cubes of 15 cm X 15 cm X 15 cm or 10cm X 10mm X 10 cm depending upon the size of aggregate are used. For most of the works cubical moulds of size 15 cm x 15cm x 15 cm are commonly used. These specimens are tested by compression testing machine after 7 days curing, 14 days curing, 28 days curing and 56 days curing. Load should be applied gradually at the rate of 140 kg/cm2 per minute till the Specimens fails. Load at the failure divided by area of specimen gives the compressive strength of concrete.

$$F_c = P/A$$

Where,

F_c - Compressive strength of concrete
P - Maximum Compressive load
A - Cross sectional area

Concrete cube specimens testing for compressive strength

Flexural Strength Test: For this test the beams of dimension100mmX100mmX500mm were casted. Flexural strength, also known as modulus of rupture, bend strength, or fracture strength,[dubious – discuss] a mechanical parameter for brittle material, is defined as a material's ability to resist deformation under load. The transverse bending test is most frequently employed, in which a rod specimen having either a circular or rectangular cross-section is bent until fracture using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture. The beam tests are found to be dependable to measure flexural strength. The value of the modulus of rupture depends on the dimensions of the beam and manner of loading. In this investigation, to find the flexural strength by using third point loading. In symmetrical two points loading the critical crack may appear at any section not strong enough to resist the stress with in the middle third, where the banding moment is maximum. Flexural modulus of rupture is about 10 to 20 percent of compressive strength depending on the type, size and volume of coarse aggregate used. The flexural strength of the specimens was calculated

Modulus of rupture, $fb= (P L) / (b d^2)$,
$=(3P x a)/ (bd^2)$.

Where P = Maximum load applied, N
L = Supported length of the specimen, mm
b = Measured width of the specimen, mm
d = Measured depth of the specimen at the point of failure, mm

Concrete specimens testing for flexural strength split tensile strength

Split Tensile Strength Test: As we know that the concrete is weak in tension. Tensile strength is one of the basic and important properties of the concrete. The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However, the determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack. The cracking is a form of tension failure. The usefulness of the splitting cube test for assessing the tensile strength of concrete in the laboratory is widely accepted and the usefulness of the above test for control purposes in the field is under investigation. The standard has been prepared with a view to unifying the testing procedure for this type of test for tensile strength of concrete. The load at which splitting of specimens takes place shall then be recorded. The universal testing machine (UTM) having capacity of 150tonne was used for the splitting tensile strength of the concrete cylinders.

fsp= 2P / (DL)

Where, P = maximum load applied to the specimen, N

D = cross sectional diameter of the specimen, mm and

L = length of the specimen, mm

CONCRETE MIX DESIGN FOR M25 GRADE

Finalized Mix proportion:

Finalized Mix	Cement (Kg/m^3)	Fine Aggregate (Kg/m^3)	Coarse Aggregate (kg/m^3)	Water (l/m^3)
Proportion	1	2.12	2.81	0.5
CCM (M25) (IS:10262-2009)	372	790	1048	186

RESULTS AND DISCUSSIONS

COMPARISION OF COMPRESSIVE STRENGTH: Compression test according to IS: 516(1959) was carried out on the 150 x 150 x150 mm cubes were tested for the compressive strengths of concrete specimens were determined after 7 and 28 days of standard curing.

COMPARISION OF SPILT TENSILE STRENGTH: Spilt tensile strength test according to IS: 516(1959) was carried out on the 150 x300 mm cylinders were tested for the spilt strengths of concrete specimens were determined after 28 days of standard curing.

COMPARISION OF FLEXURAL STRENGTH: Flexural strength test according to IS: 516(1959) was carried out on the 100x 100x500 mm prisms were tested for the flexural strengths of concrete specimens were determined

MIX	FLY ASH	RICE HUSK ASH	COMPRESSIVE STRENGTH AT 28 DAYS in MPa	SPLIT TENSILE STRENGTH AT 28 DAYS in MPa	FLEXURAL STRENGTH AT 28 DAYS in Mpa
Normal	0%	0%	36.12	4.2	5.75
10% of FA and RHA	10%	0%	33.15	3.65	5.25
	0%	10%	29.15	2.65	4.1
	5%	5%	31.62	3.15	5.12
20% of FA and RHA	15%	5%	34.36	3.85	5.23
	5%	15%	30.15	2.65	4.25
	10%	10%	32.78	3.15	4.82
	20%	10%	35.42	4.05	5.62

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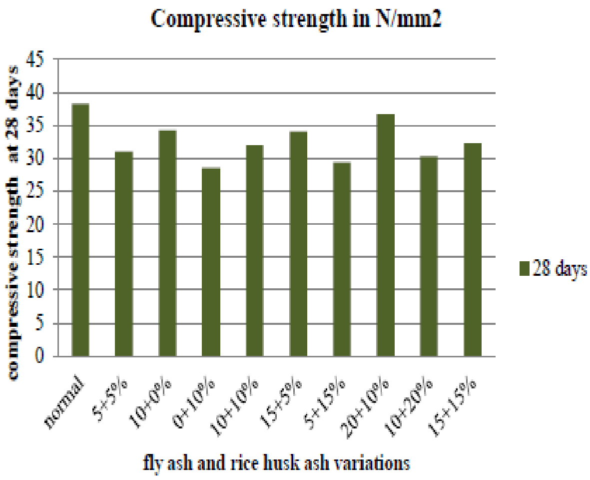
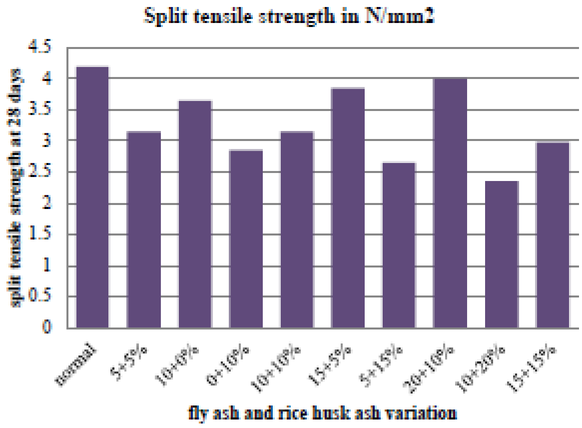
30% of FA and RHA	10%	20%	31.52	2.35	3.95
	15%	15%	32.58	3.12	4.55





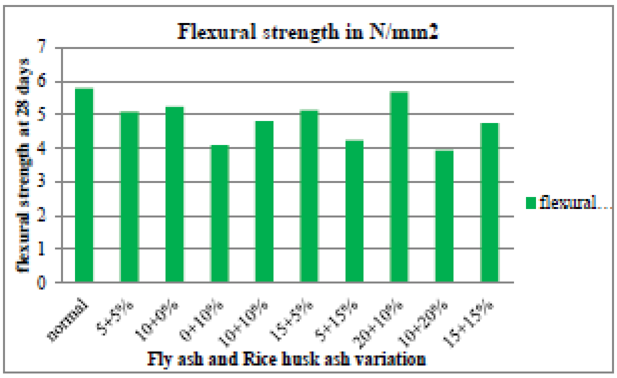


Fig 5.4 Flexural strength-Comparison of ncc and fly ash and rice husk ash concrete.

CONCLUSION

Based on the experimental investigations carried out, the following conclusions are drawn

1) Compressive strength increases with the increase in the percentage of Fly ash and Rice Husk Ash up to replacement (20%FA and 10% RHA) of Cement in Concrete for different mix proportions.
2) The maximum 28 days split tensile strength was obtained with 20% fly ash 10% rice husk ash mix.
3) The maximum 28 days flexural strength was obtained again with 20% fly ash and 10% rice husk ash mix.
4) Concrete requires approximate increase in water cement ratio due to increase in percentage of RHA. Because RHA is highly porous material.
5) The workability of RHA concrete has been found to decrease with increase in RHA replacement.
6) It was found that rice husk when burned produced amount of silica (more than 80%).For this reason it provides excellent thermal insulation
7) The workability of RHA concrete has been found to decrease but FA increases the workability of concrete so RHA and FA mix together in concrete to improve the workability of concrete.
8) Rice Husk Ash can be used with admixtures, plasticizers, and super plasticizers, for increasing the strength of concrete with partial replacement of cement.
9) The transition zone gets improved and densified with the use of ternary mix concretes containing rice husk ash and fly ash.
10) The mechanical properties in terms of flexural and tensile strength have been significantly improved with the addition of RHA.

FUTURE SCOPE

- Effect of addition of fly ash and rice husk ash on durability studies of concrete
- has to be investigated

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