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Performance of Concrete by partially replacement of Cement with Glass powder and Rice husk ash

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Abstract **-** Concrete is a basic construction material. Being at the core of construction conventional concrete attracts many researchers toward itself. The main objective of researchers now a day is to increase the strength of conventional concrete and decrease the cost of conventional concrete by replacing cement with various industrial waste materials such as waste glass powder ,fly ash ,ceramic waste , blast furnace slag , Polymers and rice husk ash etc .This study is mainly concentrated on the use of Glass waste and Rice husk ash in concrete and observe effect of it. The purpose of using the Glass powder to reduce cost and rice husk ash to increase binding property because its an pozzolanic material.

Keywords **-** Glass powder ,Rice Husk ash ,Workability ,Strength

1. INTRODUCTION

As we know now a day developing as well as developed countries facing of lack availability of land and methodology for efficient disposal of waste .We need efficient alternative methods to dispose off this waste conveniently or Regenerating and reusing this waste for beneficial purpose. In this research, considering the used of post consume waste glass, there is effort to recover and use waste glass or otherwise its end up at disposal landfill as well as the rice husk ash that's generated as by product from the furnace . Currently most of recovered waste glass is used by glass manufactured company in the production of new glasses used to manufacture many objects . But only a limited amount of waste glass is used for making new glass. These is because, manufactures only can use waste glass that's has been pre-sorted by color and type and this is exclude waste glass that mixed with color were it is very expensive to produce new glass and even all the black and green glass bottles, car windshield, glass for cathode-ray tubes, glass for liquid crystal panels, glass building materials such as windowpane, and the like other than the colorless and brown bottles have come to be increasingly recycled, but are mostly discarded now and this wastes color mixed glass still it end up at landfill site.On other hand Rice husk is used as full for furnace but after burning the by product ash is useless and have to dispose of as ground filling .Glass powder has approximately same chemical composition as the cement :

Composition	Clear Glass	Brown Glass	Green Glass
SiO2	72.42	72.21	72.38
Al2O3	1.44	1.37	1.49
TiO2	0.035	0.041	0.04
Cr2O3	0.002	0.026	0.130
Fe2O3	0.07	0.26	0.29
CaO	11.50	11.57	11.26
MgO	0.32	0.46	0.54
Na2O	13.64	13.75	13.52
K2O	0.35	0.20	0.27
SO3	0.21	0.10	0.07

Table : Chemical composition of various coloured glass

Glass powder

Glass powder collected from post-consumer source in Indore city. The main sources of waste glasses are waste crockery, broken glass window glasses, window screen, medicinal bottles, liquor bottles, Tube light and bulbs, electronic equipment's etc. Only pre sorted by color and type waste glass can be used in recycling. The waste glass when powderised to a very fine powder shows some pozzolanic properties. Therefore, the glass powder can be ingredient that can mix with the cement and contribute to development of strength. The typical glass contains 70% silica approximately. Past study shows pozzoloonic properties of glass are noticeable on particle sizes below approximately 100µm. Size of glass powder less than 75µm possessed cementitious capability and improves compressive strength, resistance to sulphate attack and chloride ion penetration. The presents of alkali in glass may cause alkali-silica reaction and change the volume but it has been found that finely ground glass does not contribute to alkali-silica reaction. Less than 90-micron size of glass powder was use in this study.

Application of glass powder –

- Glass powder use in paint and lining in chemical plants, marine construction & harbor facilities and petroleum tanks.
- Glass powder use in pollution control facilities, plating metal industries, boiler & water tanks, food industries, transportation concerns and

fishery concerns.
- Glass can be used as blasting media as dry of slurry form mixed with water.
- It has excellent anticorrosion characteristics in the fields of paint and lining.

Rice husk ash

Rice husk is a byproduct of agriculture, which is produced annually worldwide around 300 million metric tons . Approximately, 10 Kg of rice husk are obtained from 50 Kg of rice. Rice husks contain natural substances and 20% of inorganic material. Rice husk powder (RHA) is gotten by the ignition of rice husk. The burning temperature must be within the range of 600 to 800 ^{0}C. The ash obtained has to be powdered in a ball mill for Half an hour and its appearance in color will be grey. The property of RHA that causes pozzolanic activity is the amorphous phase content. RHA contains a high amount of silicon dioxide, and its reactivity related to lime depends on a combination of two factors, namely the non-crystalline silica content and its specific surface.

Application of Rich Husk Ash -

RHA is a carbon neutral green product. There are a lots of ways are under consideration of Commercialize RHA. RHA is a good super-pozzolan. This super-pozzolan can be used in a big way to make special concrete mixes. There is high demand for fine amorphous silica in the manufacturing of special cement and concrete mixes, high performance concrete, high strength, low permeability concrete, for use in bridges, marine environments, nuclear power plants etc. Some other uses of RHA are given below :

- Green Concrete
- High performance of concrete
- Refractory
- Ceramic glaze&Insulator
- Water proofing chemicals&Roofing Shingles

2. LITTERATURE REVIEW

1. **Dr. Patagundi B.R. et. al. (oct-2012)** presented "Effect of temperature on the properties of concrete containing glass powder as pozzolana" studied an attempt were made to find out the effect of temperature on the properties of concrete containing waste glass powder as pozzolana. The cement is replaced by glass powder in different percentages like 0%, 5%, 10%, 15%,20%, 25%, 30%, 35% and 40%. And carried out physical test like compressive strength, flexural strength, split tensile strength and impact test when cement is replaced by glass powder in different proportion and when subjected to high temperature of 200°C and 500°C for 12 hrs. 20% replacement of cement by glass powder is found to be beneficial when concrete is subjected to temperature.

2. **Patel et al. (2014)** investigated the properties of pervious concrete by replacing the cement content with 20% of fly ash and 10% of silica fume. He can used A/C ratio 4:1 and various W/C ratio 0.30, 0.35 and 0.40. He investigated that when W/C ratio is increased from 0.30 to 0.40 the compressive strength, flexural strength and split tensile strength is increased, but permeability is decrease for both pervious concrete, which contain 20% fly ash and 10% silica fume.

3. **Yukari et al. (2009)** investigate the properties of pervious concrete by replacing the cement with 20% and 50% of fly ash. He concluded that compressive strength decreases with increase of the fly ash content. When fly ash content is increased up to 20% in concrete permeability is decreasing, but after that when fly ash content reach to 50% in concrete permeability is increased which is nearly similar to no fly ash pervious concrete.

4. **DaoVan&PhamDuy** presented several key properties of high strength concrete using RHA. RHAs obtained from two sources: India and Vietnam. RHA sample from India was much better than that of Vietnam. The optimum content is 10% to replace for cement with RHA to get maximum strength. Investigations in manufacturing high quality RHA in Vietnam is necessary.

5. **Marthongn** investigated the ―Effect of Rice Husk Ash (RHA) as Partial Replacement of Cement on Concrete Properties‖. Three grades of ordinary Portland cement (OPC) namely; 33, 43 and 53 are used. Percentage replacement of OPC with RHA was 0, 10, 20, 30 and 40% respectively. When test conducted on all grade of OPC it has been observe that setting time increase on addition of RHA. It is concluded from the paper that, Workability decreased upon the inclusion of RHA. Shrinkage of RHA concrete is similar to the pure cement concrete in all grades of OPC. Inclusion of RHA as partial replacement of cement slightly improves the durability.

6. **Maurice & Godwin** investigated the effects of partially replacing OPC with RHA . It is observed that replacement of cement with RHA in concrete resulted in increased demand of water , increase in workability and improve strength compared to the control concrete. This results show that an addition of RHA from 5-10% will increase the strength.

7. **Abhilash&Arbind** evaluated one type of

commercially available RHA as supplementary cementitious material for cement. There was a significant improvement in Compressive strength of the Concrete with RHA content of 10% for M30 and M60 at 7 days and 28 days i.e. 4.23% to 10.93%. It is observed that using 10% RHA in cement can be beneficial without any ill effect.

8. **Malleswara&Patnaikuni** studied the ―Performance of RHA concrete exposed to sea water‖. It can be concluded that for Mix of grade 20 ; RHA concrete subjected to seawater exposure for 28 days & 90 days. Better result observed on replacement by 7.5%. Seawater exposure to 90 days is shown better compressive strength than normal concrete.

9. **zemke& woods** recommended to use rice husk ash substitution for Ordinary Portland Cement up to 30%. This will decrease the weight of the finished project, decrease the cost, and dispose of the rice husk ash waste product.

10. **Ramezanianpour&khani** investigated ―The effect of rice husk ash on mechanical properties and durability of sustainable concretes‖. RHA replaced with cement by weight are 7%, 10% and 15%. Results conclude that concrete mixed prepare be replaced cement by RHA had higher compressive, splitting tensile strength and elastic modulii at various ages compared with that of the control concrete. In addition, results show that RHA as an artificial pozzolanic material has enhanced the durability of RHA concretes and reduced the chloride diffusion.

11. **Harunur&Keramat** investigated the durability Rice husk ash mortar (RHA)‖. The strength and durability of mortar with different replacement level (0%, 10%, 15%, 20%, 25% and 30%) of Ordinary Portland Cement (OPC) by RHA is investigated. In durability test all sample passed till 20 % replacement. It is concluded from the paper that the mortar incorporating rice husk ash is more durable than OPC mortar up to 20% replacement level.

3. METHODOLOGY

3.1 Concrete Mix Design

The concrete mix design is done by systematic analysis and knowledge to choose and proportion the ingredient used in a concrete mix produce economical concrete which will have the desired properties both when fresh and when hardened. The variables which can be controlled are water cement ratio, maximum aggregate size, aggregate grading, and use of admixtures. Interactions between the effects of variables complicate mix design and successive adjustments following trial mixes are usually necessary. Experiences built up by ready mix concrete producers should enable them to produce suitable mix design more quickly than this

3.2 DETAIL OF SAMPLES

In this research, the concrete will mixed using concrete mixer and for each mixes, total of six of 150x150x150mm cubes will cast. The sample will be cured until the day of testing. The cubes will be tested at ages of 7 day and 28 day to study the development of the compressive strength.

3.3TEST RESULTS

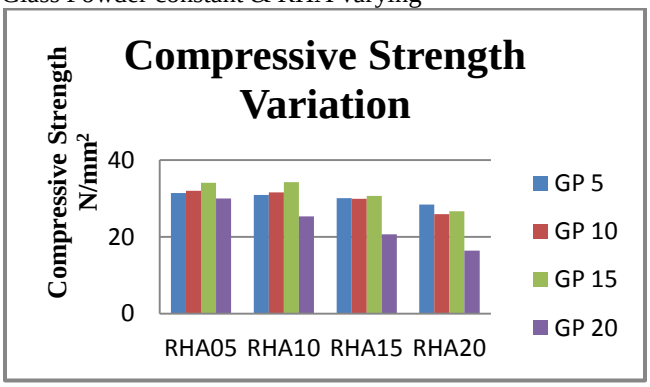
After Prepare cubes of various proportion combination and test after 7days and 28 days following results observed .

Material Mixture	Nature of Concrete M-30	Compressive Strength of Concrete Cube (N/mm^2)	
		7 Days	28 Days
GP00RHA00	Conventional Concrete	22.63	33.06
GP05RHA05	5% cement replaced by glass powder and 5%cement replaced by Rice Husk ash	21.60	31.06
GP05RHA10	5% cement replaced by glass powder and 10%cement replaced by Rice Husk ash	19.51	31.45
GP05RHA15	5% cement replaced by glass powder and 15%cement replaced by Rice Husk ash	17.11	30.11
GP05RHA20	5% cement replaced by glass powder and 20%cement replaced by Rice Husk ash	14.46	28.69
GP10RHA05	10% cement replaced by glass powder and 5%cement replaced by Rice Husk ash	21.15	32.04
GP10RHA10	10% cement replaced by glass powder and 10%cement replaced by Rice Husk ash	18.35	31.67
GP10RHA15	10% cement replaced by glass powder and 15%cement replaced by	16.60	29.97

	Rice Husk ash		
GP10RHA20	10 % cement replaced by glass powder and 20%cement replaced by Rice Husk ash	16.59	26.00
GP15RHA05	15% cement replaced by glass powder and 5%cement replaced by Rice Husk ash	20.81	34.14
GP15RHA10	15% cement replaced by glass powder and 10 %cement replaced by Rice Husk ash	20.93	34.76
GP15RHA15	15% cement replaced by glass powder and 15%cement replaced by Rice Husk ash	19.54	30.48
GP15RHA20	15% cement replaced by glass powder and 20 %cement replaced by Rice Husk ash	16.96	26.85
GP20RHA05	20 % cement replaced by glass powder and 5%cement replaced by Rice Husk ash	20.25	30.58
GP20RHA10	20 % cement replaced by glass powder and 10 %cement replaced by Rice Husk ash	17.65	25.70
GP20RHA15	20 % cement replaced by glass powder and 15%cement replaced by Rice Husk ash	15.57	20.12
GP20RHA20	20 % cement replaced by glass powder and 20 %cement replaced by Rice Husk ash	12.42	16.82

The combined compressive strength of concrete of various combinations is shown in bar chart for 7 days and 28 days curing of concrete

Fig. -7 days Compressive Strength of concrete for keeping Glass Powder constant & RHA varying



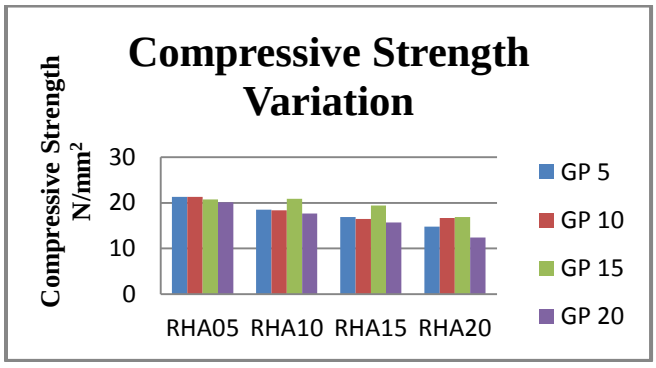


Fig.- 28 days Compressive Strength of concrete for keeping Glass Powder constant & RHA varying

COST ANALYSIS

This study found GP15RHA10 combination is shows good strength as compared to other combination and conventional concrete mix. Cement quantity was reduced by using the other pozzolonic material in this study so cost is decrease. Table shows cost analysis for 1cubic meter concrete .

Study shows that replacement of cement with Glass powder and Rice husk ash decrease in cast about 16% .

Cost Analysis for 1 m³ Concrete

	Conventional Concrete			modified concrete		
Ingredient	Quantity (KG)	Rate (Rs)	Cost (Rs)	Quantity (KG)	Rate (Rs)	Cost (Rs)
Cement	390	6	2340	253.5	6	1521
Rice husk ash	0	0	0	58.5	2.5	117
Glass Powder	0	0	0	39	4	156
Sand	507	0.43	218.1	507	0.43	218.1
Aggregate	1014	0.45	456.3	1014	0.45	456.3
water	148.2	0.3	44.46	148.2	0.3	44.46
Admix.	2.64	115	303.6	2.68	115	308.2
Total	Rs.=		3362.3	Rs.=		2820.9

CONCLUSION

1. Addition of Glass Powder and Rice husk ash in cement concrete for replacement of cement solve the problem of disposal of waste material.
2. When 25 % of cement is replaced by 15% Glass Powder and 10% Rice husk ash compressive strength of modified concrete is more than the conventional concrete.
3. On addition of Glass powder and Rice husk ash initially the rate of gain of strength is slightly low but at 28 days it meets required design strength.
4. Use of the modified concrete will reduce the cement consumption hence saving of energy will take place.
5. Till date research on effect of cement replacement with rice husk ash and glass powder is carried out separately but in this result when combination of those is used .
6. If we replace cement by rice husk ash and glass powder in concrete it help in saving of cost by 16% .
7. The modified concrete is eco-friendly as cement consumption is low.

FUTURE SCOPE OF STUDY

1. To check the durability and permeability of modified concrete.
2. To study the properties of modified reinforce concrete.

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