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Feasibility of Glass Powder and Rice Husk ash as a Partial Replacement of Cement in Concrete Mix

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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.

Key Words: Glass powder ,Rice Husk ash ,Workability ,Strength.

1.INTRODUCTION *(Size 11, Times New roman)*

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.

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.

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

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 slirry 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 0C. The ash obtained has to be powderised in a ball mill for Half an hour and its appearance in colour 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 Commericialise RHA. RHA is a good super-pozzolan. This super-pozzolan can be used in a big way to make special concrete mixes. There is hige demand for fine amorphous silica in the manufactureing 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

2. Methodology

In this study of testing cement ,coarse aggregate fine aggregate will be done. In this study property of fresh concrete and hardened concrete such as workability test ,compresive and flexural strength test to be done. In the mix cement will replace by 5% ,10%, 15%, 20% of Glasspowder and Rise husk ash mix suitable percentage will be carried out by the mix giving maximum compresive and flexural strength after 7 Days and 28 Days . Then Cost analysis will be done between conventional concrete and modified concrete.

3. Literature Review

1.Bhaskara Rao Nalli and Prudhviraju Vysyaraju(2022) Utilization of ceramic waste powder and rice husk ash as a partial replacement of cement in concreteCeramic waste powder (CWP) and rice husk ash (RHA) are one of the highly produced waste materials from tiles industry and rice processing units respectively. Using these materials in concrete as a part replacement for cement offers several advantages like reducing the burden on land fills, reducing the construction cost by replacing costly cement and improvement in performance of concrete etc. Due to the irmineralcomposition. In the current study, an effort was made to partly replace the cement with CWP and RHA. Concrete design mix was carried out by using 0, 5, 10, 15 and 20% CWP and varied proportions of RHA were tried on the optimum CWP for cement replacement (0, 5, 10, 15, 20%). Tests were carried out on the fresh and hardened concrete specimens to study the mechanical properties of concrete. Analysis of the test results indicate that 15% CWP yielded best results and 10-15% RHA in combine proportion was found to be the optimum replacement of cement offering higher strength when assessed to the conventional concrete. Maximum compressive strength achieved at 15% CWP and 15% RHA whereas, the flexural strength and split tensile strength were attained at 15% CWP and 10% RHA dosage.

2.Anusha&S. T. Dhaarini(November 2021) Study on Microstructural Characterization of Concrete by Partial Replacement of Cement with Glass Powder and Rice Husk Ash in Concrete Owing toglobalization,privatizationandliberalization,theerectionofimportantinfrastructureprojectsisincreasingfor the progress of countries like India. Significant amounts of natural resources are needed for certainconstruction activities. The building industry's use of natural resources causes them to deplete at ahigherace. In view of this, lot of research works are being carried out for exploring the alternate materialsfor natural materials as ingredients of concrete. Usage of glass dust and rice husk ash for cementitiousmaterial is one such economical method. The tests were conducted on concrete in which glass dust andrice husk ash were used as partly substituting cementitious material in amounts of 10, 20 and 30%. Theconcrete strength was also investigated at the ages of 7, 14 and 28 days. The strength properties of thecomposite were comparable to those of standard concrete, as well as a material characteristics analysis.

3.Shahid Ali Shaikh Shaikh (JANUARY 2021) The Utilization of Glass Waste as Fine Aggregate Replacement and Rice Husk Ashas Cement Replacement in Concrete: A Review Cement as abinderused in the mixture of concrete is a costly product and it is also harmful to the environment due to the emission ofhugeamounts of$CO_2$and othergases. Likecement thefineaggregateis also themainconstituent ofthe concrete used as inert filler in concrete is also expensive. The researchers are probing towards the new inexpensive and environment friendly materials for the concrete. They have agreed over the point that by utilizing the recycled waste materials could be helpful in achieving the sustainable construction. So in this case a lot of research has been carried out for the utilization of rice husk ash as cement substitution and recycled waste glass as alternative of concrete fine aggregate. The outcome of this research is that these both green materials have enormous potential to contribute in the long-lastinghandling of ineffectualsolid waste, reduction of landfill sites, preserving natural resources and protecting atmosphere from extremely hazardous gases. The purpose of this review work is to summarize the previous research findings on utilization of rice husk ash and recycled waste glass as a substitution to the cement and fine aggregate respectively. This review paper will come up with the remarkable idea and valuable information for the upcoming researchers working for the aim of utilization of renewable and futilematerials in the field of concrete technology.

4.Chabi, Edem, Valéry Doko, Sena Peace Hounkpè, and Edmond C. Adjov et al. (2020) The aim of this study was to evaluate the possibilities of exploiting agricultural waste immediately available, especially rice husks, in construction to meet the requirements of sustainable development. Firstly, the compatibility of the untreated rice husk with CEM II B-LL 32.5 R cement has been proven. Then the mechanical behavior in compression and tensile and the thermal properties of the material was studied. The materials have good mechanical and thermal characteristics, given their use in the building. The study of shear behavior has shown that rice husk composites have good shear performance. The shear strength is up to 27 % of the compressive strength in contrast to normal concrete which has very low shear strength.

5.Bisht, Kunal, and P. V. Ramana et al. (2018) This author study on discarding of waste glass is creating major ecological issues across the globe. In recent years, the rate of disposal of this material has amplified. One conceivable

approach is to employ this rejected material as a substitute of fine aggregate in concrete. Hence, this study examines the behaviour of concrete with waste glass as fine aggregate at various substitution levels (18%, 19%, 20%, 21%, 22%, 23% & 24%). Fresh, hardened and durability properties were evaluated in terms of workability, compressive strength, flexural strength, density and water absorption.

4. Results and Testing

Flexural strength of concrete when RHA is 5% and GP with varying 5%, 10%, 15% and 20% after 7 days and 28 days curing are shown in table 1 and are depicted in Fig. 1

Table -1: Flexural Strength for varying % of GP & for 5% RHA

Material Mixture	Flexural strength of concrete beams(N/mm²)	
	7 days	28 days
RHA05GP05	3.24	3.93
RHA05GP10	3.21	4.09
RHA05GP15	3.27	4.08
RHA05GP20	3.24	3.95

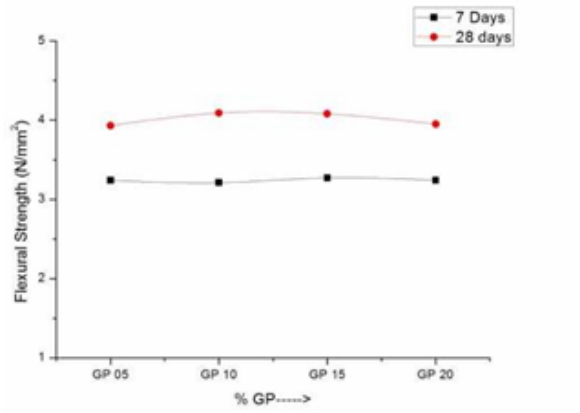

Fig -1: 7 days & 28 days Flexural Strength for 5% RHA and varying Glass Powder

Flexural strength of concrete when RHA is 10% and GP with varying 5%, 10%, 15% and 20% after 7 days and 28 days curing are shown in table 2 and are depicted in Fig. 2

Table -2: Flexural Strength for varying % of GP & for 10% RHA

Material Mixture	Flexural strength of concrete beams(N/mm²)	
	7 days	28 days
RHA10GP05	3.12	3.87
RHA10GP10	3.14	3.93
RHA10GP15	3.38	4.12
RHA10GP20	2.93	3.83

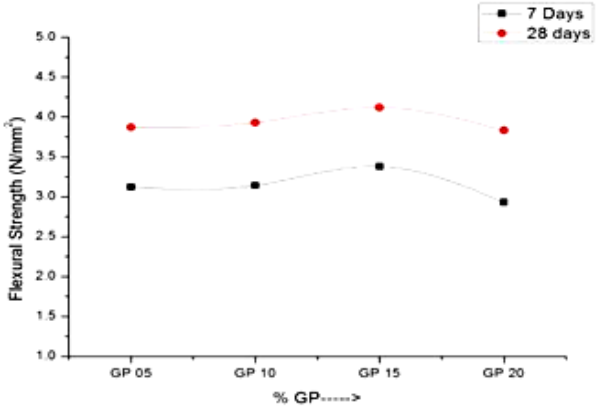

Fig. -2: 7 days & 28 days Flexural Strength for 10% RHA and varying Glass Powder

Flexural strength of concrete when RHA is 15% and GP with varying 5%, 10%, 15% and 20% after 7 days and 28 days curing are shown in table 3 and are depicted in Fig. 3

Table -3: Flexural Strength for varying % of GP & for 15% RHA

Material Mixture	Flexural strength of concrete beams(N/mm²)	
	7 days	28 days
RHA15GP05	2.92	3.85
RHA15GP10	2.78	3.79
RHA15GP15	3.12	4.05
RHA15GP20	2.79	3.62

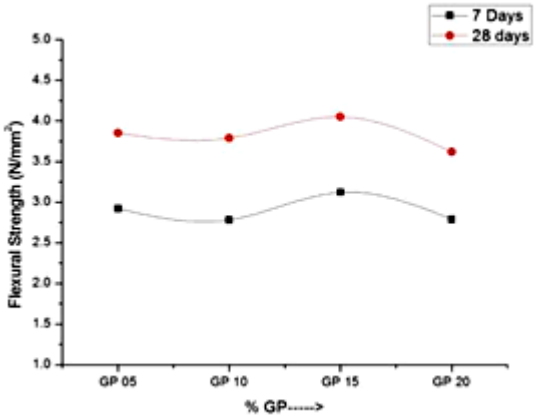

Fig -3: 7 days & 28 days Flexural Strength for 15% RHA and varying Glass Powder

Flexural strength of concrete when RHA is 20% and GP with varying 5%, 10%, 15% and 20% after 7 days and 28 days curing are shown in table 4 and are depicted in Fig. 4

Table – 4: Flexural Strength for varying % of GP & for 20% RHA

Material Mixture	Flexural strength of concrete beams(N/mm²)	
	7 days	28 days
RHA20GP05	2.74	3.79
RHA20GP10	2.55	3.64
RHA20GP15	2.7	3.6
RHA20GP20	2.21	3.05

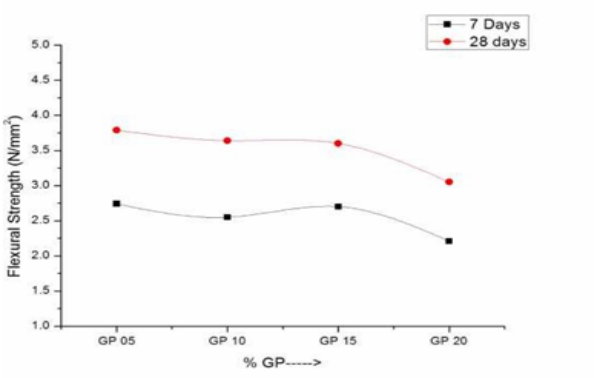

Fig-4: 7 days & 28 days Flexural Strength for 20% RHA and varying Glass Powder

The combined Flexural strength of concrete of various combinations is shown in Fig. 5 and Fig 6. for 7 days and 28 days curing of concrete

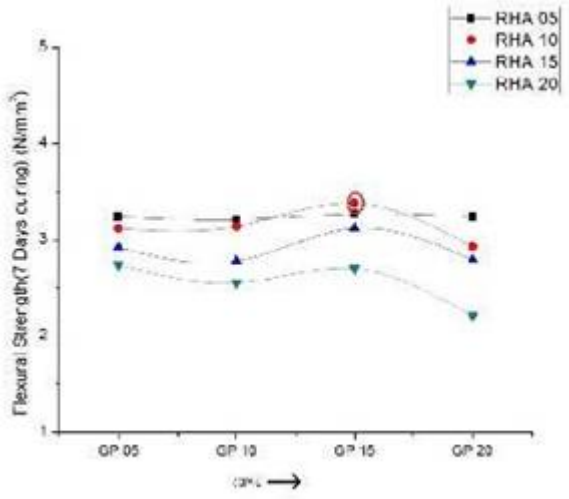

Fig -5: 7 days Flexural Strength of concrete for keeping RHA constant & Glass Powder varying

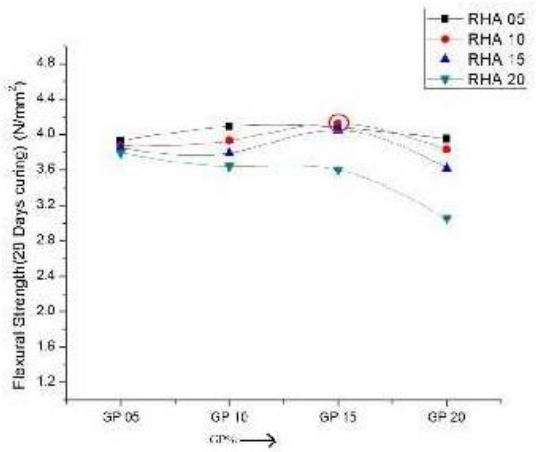

Fig -6: 28 days Flexural Strength of concrete for keeping RHA constant & Glass Powder varying

5. CONCLUSIONS

The Using Glass powder and Rice husk ash in conventional concrete can element the problem of disposal of waste material. By finding optimum percentage used in conventional concrete of the Glass Powder and Rice husk ash can increase Compresive and Flexural strength of concrete . It can improve workability as well. Using this material as replacement of cement can reduce cement consumption and ultimatly reduce per meter cube cost ofconcrete .

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