International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 01 | January - 2024 SJIF Rating: 8.176 ISSN: 2582-3930

REVIEW OF EFFECT OF GLASS POWDER AND RICE HUSK ASH ON CONCRETE PROPERTIES

PANKAJ YADAV *1, RAHUL SHARMA*2

*1M Tech Student, Prashanti Institute of Technology & Science Ujjain M P, India.

*2 Professor, Civil Department, Prashanti Institute of Technology & Science, Ujjain M P, India.

*

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.

I. 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

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

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.

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 ^{0}C. 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
- Roofing Shingles

II. PRAPOSED 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.

III. LITERATURE REVIEW

1. Bhaskara Rao Nalli[1] and Prudhviraju Vysyaraju[1] (2022) Utilization of ceramic waste powder and rice husk ash as a partial replacement of cement in concrete Ceramic 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 landfills, reducing the construction cost by replacing costly cement and improvement in performance of concrete etc. due to their mineral composition. 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.

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 to globalization, privatization and liberalization, the erection of important infrastructure projects is increasing for the progress of countries like India. Significant amounts of natural resources are needed for certain construction activities. The building industry's use of natural resources causes them to deplete at a higherace. In view of this, lot of research works are being carried out for exploring the alternate materials for natural materials as ingredients of concrete. Usage of glass dust and rice husk ash for cementitious material is one such economical method. The tests were conducted on concrete in which glass dust and rice husk ash were used as partly substituting cementitious material in amounts of 10, 20 and 30%. The concrete strength was also investigated at the ages of 7, 14 and 28 days. The strength properties of the composite were comparable to those of standard concrete, as well as a material characteristics analysis.

Qiang Su, Jinming Xu (August 2023) Mechanical properties of concrete containing glass sand and rice husk ash The use of glass sand and rice husk ash in concrete production can not only save natural river sand resources and promote the recycling of waste, but also reduce or even eliminate the alkali–silica reaction produced by glass sand and cement slurry through the pozzolanic effect of rice husk ash. The mechanical properties of glass sand concrete and glass sand concrete containing rice husk ash were tested through a series of experiments to study the applicability of adding glass sand/rice husk ash to concrete. The experimental results show that the addition of glass sand reduces the water absorption and compressive strength of ordinary concrete but improves the splitting tensile strength, shear strength, and cyclic compression performance of ordinary concrete. Meanwhile, rice husk ash can greatly enhance the later compressive strength and splitting tensile strength of glass sand concrete. The optimal replacement rate is 15%—replacement rates of 30% and 45% are unsuitable for structural concrete. In addition, although rice husk ash reduces the shear strength and cyclic compression performance of glass sand concrete, rice husk ash can effectively enhance the crack resistance of glass sand concrete. The

results of this study provide a reference of the mechanical properties of rice husk ash glass sand concrete and provide a basis for future research.

Shahid Ali Shaikh Shaikh (JANUARY 2021) The Utilization of Glass Waste as Fine Aggregate Replacement and Rice Husk Ash as Cement Replacement in Concrete: A Review Cement as a binder used in the mixture of concrete is a costly product and it is also harmful to the environment due to the emission of huge amounts of CO_2 and other gases. Like cement the fine aggregate is also the main constituent of the 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-lasting handling of ineffectual solid 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 futile materials in the field of concrete technology.

Memon Shazim Ali et. al.(Aug-2008) presented "Production of low cost self-compacting concrete using rice husk ash" studied focuses on comparison of fresh properties of SCC containing varying amounts of RHA with that containing commercially available viscosity modifying admixture. The comparison is done at different amount of super plasticizer keeping rest ingredient contents constant. Test comes about substantiate the achieve to develop SCC utilizing RHA. Cost comparision showed that the cost of concrete of specific SCC mix is

42.47 percent less than that of control concrete. The utilization of RHA in SCC solves the problem of its disposal thus keeping the environment free from pollution.

Chik Farah Alwani Wan et al.(2011) studied on the effect of gasses incinerating rice husk ash (GIRHA) on properties of concrete block. The compressive strength test , water absorption, moisture movement and modulus of elasticity were performed. Preliminary analysis of the constituent materials of the ordinary Portland cement and Rice Husk Ash concrete blocks were conducted to confirm their suitability for block making. Physical test of the recently prepared mix was also carried out. 390mm x 190mm x 100mm concrete blocks were cast and compacted by a KANGO hammer for 7, 14, 28 and 60 days at 0, 10, 15 and 20 percent replacement levels. They conclude that, the high performance of masonry blocks can be produced using rice husk ash (RHA) as cement replacement material. The compressive strength of the RHA concrete blocks start reducing as the amount of RHA content increases more than optimum. At 15% of replacement of cement with RHA positive result arrived.

Khatib J.M. et. al.(2012) presented "Glass Powder Utilization in Concrete Production" research on the performance of concrete mix glass powder as partial ingredient of cement. Portland cement (PC) was partially replaced with varying percentage from 0 to 40% of glass powder. Testing included ultrasonic pulse velocity, compressive strength and absorption. Specimens were cured in water at 20°C. The results indicate that the optimum strength of concrete occurs at approximately 10% glass powder. The slump of seems to increase with the increase in glass powder in the concrete mix. As we increase percentage of Glass powder more than 10% it start declined and that's less than control concrete.

Kawahata Celso Yoji et. al. (June-2012) presented "Rice husk derived waste materials as partial cement replacement in light weight concrete" They were studied that, rice husk ash (RHA) and broiler bed ash from rice husk (BBA), two agricultural waste materials, have been assessed for use as partial cement replacement materials for application in lightweight concrete. Properties of concrete investigated were compressive and flexural strength at different ages, absorption by capillarity, resistivity and resistance to

chloride ion penetration (CTH method) and accelerated carbonation. Test results obtained for 10% cement replacement level in lightweight concrete indicate that although the addition of BBA conducted to lower performance in terms of the degradation indicative tests, RHA led to the enhancement of mechanical properties, especially early strength and also fast ageing related results, further contributing to sustainable construction with energy saver lightweight concrete.

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.

Patil Dhanaraj Mohan et. al. (2013) presented "Experimental investigation of waste glass powder as partial replacement of cement in concrete" They studied, waste glass powders have been used as replacements to the concrete ingredient like cement and the mechanical properties like compressive strength are measured. Also they were studied the size effect of glass powder on strength of concrete. For checking strength effect of replacement of cement by glass powder, the cement is replaced at 10%, 20% and 30%. For study of size effect of glass powder the powder is divided in to two grades one is glass powder having size less than 90 micron and another is glass powder having particle size ranges from 90 micron to 150 micron. And carried out compressive strength test for 7 days. It is found from study, Initial strength gain is very less due to addition of GP on 7^{th} day but it increases on the 28 day. It is observed that 20% addition of GP gives maximum strength. And also GP size finer than 90 micron is very effective in strength enhancement.

Dr. Kumar G. Vijay et. al. (Feb. 2013) presented "Studies on Glass Powder as Partial Replacement of Cement in Concrete Production" They studied, finely powdered waste glasses are used as a partial replacement of cement in concrete and compared it with conventional concrete. In this work trying to search the possibility to replace cement by Glass powder. Glass powder were partially replaced as 10%, 20%, 30% and 40% and tested for its compressive, Tensile and flexural strength up to 60 days of age and were compared with those of conventional concrete; from the results obtained, it is found that glass powder can be used as cement replacement material up to particle size less than 75µm to prevent alkali silica reaction.

Vandhiyan R. et. al. (May 2013) presented "Experimental study on replacement of cement by glass powder" They studied, aims at utilization of such industrial by product for value added application. In addition the waste can improve the properties of construction materials. The recycled glass has been used in the form of powder. The recycled glass was tested with concrete and mortar. Cement was replaced by the glass powder in the proportion of 5%, 10%, and 15%. The compressive strength, split tensile strength, consistency and flexural strength were conducted for the above replacement. The result showed glass powder improves the mechanical properties. The cube up to a replacement of 10% of cement shows greater compressive strength, considerable improvement in flexural strength and marginal improvement in split tensile strength. The advantages of this project are that the replacement of glass powder is economically cheap as well as a superior concrete can be made.

Akeke Godwin A. et. al. (May-2013) presented "Structural properties of Rice husk ash concrete" That research was experimentally carried out to investigate the effects of introducing Rice Husk Ash (RHA) as a Partial Replacement of OPC on the Structural Properties of Concrete. RHA which is an Agriculture

byproduct having Super Pozzolana properties have been used for mass concrete and it impart compressive strength ranging from 33-38.4N/mm at replacement percentages varying from 10-25% in M-20 (1:1.5:3) concrete. A further study was carried out for the determination of cracking by finding modulii of rupture and tensile strength, the values obtained at 28days are 3, 2.5 and 2.4N/mm while the tensile strength values are 1.94, 1.17 and 0.91N/mm^2 at replacement percentages of 10%, 20% and 25%. This investigation has proved that RHA Concrete can be used as a Structural Concrete at suitable percentage of replacement of cement.

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.

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.

Kartini & Mahmud reported on the ―Improvement on Mechanical Properties of Rice Husk Ash Concrete with Super plasticizer‖. We have to perform this test using super plasticizer otherwise it show less strength than control one because it required extra amount of water for same workability that causes reduction in strength . RHA concrete improves the durability of concrete. It is observed from this research that by adding super plasticizer to the RHA mixes, further replacement at higher percentage can be carried out. Concrete containin up to 30%RHA can attain strength of 30 N/mm2 at 28 days.

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.

Marthong 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.

Shirule et al. studied the ―Partial Replacement of cement with Marble Dust Powder. It can be concluded that for M20 grade concrete The Compressive strength of Cubes are increased with addition of waste marble powder up to 10% replace by weight of cement and further any addition of waste marble powder the compressive strength decreases. The Split Tensile strength of Cylinders increased when cement is replaced by 10% with marble powder and further increase in percentage of waste marble powder the Split Tensile strength decreases.

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.

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.

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.

Kartini showed that ―The RHA is a pozzolanic material‖. The adition of Sp in RHA concrete while maintaining the w/c ratio increased workability and improved the cohesiveness of the concrete. Replacement of OPC with RHA reduced the water permeability of the concrete. The optimum replacement of OPC is 30% for M-30 & M-40 gradeand 20% for M-50 grade for 28days strength. From the study conducted, it was clearly shown that RHA is a pozzolanic material that has the potential to be used as partial cement replacement material and can contribute to the sustainability of the construction material.

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. This can be more beneficial for the areas where rice is an important crop like Asia.

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.

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 thepaper that the mortar incorporating rice husk ash is more durable than OPC mortar up to 20% replacement level.

IV. CONCLUSION

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 .

V. REFERENCES

[1] Coutinho, S. J., 2003 “The combined benefits of CPF and RHA in improving the durability of concrete structures”, Cement and concrete composites: 25(1): 2003, pp. 51– 59.

[2] Memon Shazim Ali, Shaikh Muhammad Ali, Akbar Hassan (2008) “Production of low cost self-compacting concrete using rice husk ash” (ICCIDC–I).

[3] Chik Farah Alwani Wan, Bakar Badorul Hisham Abu, Johari Megat Azmi Megat & Jaya Ramadhansyah Putra, (2011) “Properties of concrete block containing rice husk ash subjected to girha” IJRRAS 8(1).

[4] Khatib J.M., Negim E.M., Sohl H.S. and Chileshe N. (2012) "Glass Powder Utilization in Concrete Production" European journal of applied science 4(ISSN 2079-2077).

[5] Celso Yoji Kawahata, Holmer Savastano Junior, Joana Sousa-Coutinho(2012) "Rice husk derived waste materials as partial cement replacement in light weight concrete" Lavras, volume 36.

[6] Dr. Patagundi B.R., Dr. Prakash K.B. (2012) "Effect of temperature on the properties of concrete containing glass powder as pozzolana" IJERT,ISSN 2278-0181, Volume1 Issue 8.

[7] *7.* Patil Dhanaraj Mohan, Dr. Sangle Keshav K (2013) "Experimental investigation of waste glass powder as partial replacement of cement in concrete" International journal of advanced technology in civil ngineering, ISSN:22311-5721, vol. 2.

[8] *8.* Dr. Kumar G. Vijay, Ms Vishaliny H., Dr. Govindarajulu (2013) "Studies on Glass Powder as Partial Replacement of Cement in Concrete Production" (IJETAE,ISSN2250-2459, vol. 3).

[9] Vandhiyan R., Ramkumar K. and Ramya R. (2013) "Experimental study on replacement of cement by glass powder" (IJERT, ISSN:2278-0181,vol. 2 issue 5.

[10] Godwin A. Akeke, Maurice E. Ephraim, Akobo, I.Z.S. and Joseph O. Ukpata(2013) "Structural properties of Rice husk ash concrete" (IJEAS, ISSN 2305-8269, vol. 3, No.3) Gambhir M L Concrete Technology (fourth edition).

[11] Urhan, S. (1987). "Alkali silica and pozzolanic reactions in concrete" Part 1: interpretation of published results and a hypothesis concerning the mechanism. Cement and Concrete Research, 17(1), 141-152.

[12] Dr. G.Vijayakumar, Ms H. Vishaliny, Dr. D. Govindarajulu."Studies on Glass Powder as Partial Replacement of Cement in Concrete Production", International Journal of Emerging Technology and Advanced Engineering, ISSN 2250-2459, Volume 3, Issue 2, February 2013.

[13] Dr. Shubha Khatri,"Impact Of Admixture And Rice Husk Ash In Concrete Mix Design", IOSR Journal of Mechanical and Civil Engineering E-ISSN: 2278-1684, P-ISSN: 2320-334X, Volume 11, Issue 1 Ver. 4 , Feb 2014, PP 13-17.

[14] Godwin A. Akeke, Maurice E. Ephraim, Akobo, I.Z.S and Joseph O. Ukpata," Structural Properties Of Rice Husk Ash Concrete" International Journal of Engineering and Applied Sciences, ISSN 2305- 8269,Volume 3, No 3, May 2013.

[15] Jayanti Rajput,R.K. Yadav, R. Chandak,"The Effect Of Rice Husk Ash Used As Supplementary Cementing Material On Strength Of Mortar", International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 Vol. 3, Issue 3, May-Jun 2013, PP 133-136.

[16] Jitendra B. Jangid , Prof.A.C.Saoji," Experimental Investigation Of Waste Glass Powder As The Partial Replacement Of Cement In Concrete Production", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, P-ISSN: 2320-334X , PP 55-60.

[17] J.M. Khatib, E.M. Negim, H.S. Sohl and N. Chileshe," Glass Powder Utilisation in Concrete Production", European Journal of Applied Sciences 4 (4): 173-176, ISSN 2079-2077, 2012.

[18] Kartini,Mahmud, Hamidah,"Strength Properties Of Grade 30 Rice Husk Ash Concrete", 31st Conference on Our World In Concrete & Structures: 16 – 17 August 2006, Singapore.

[19] Obilade,"Use Of Rice Husk Ash As Partial Replacement For Cement In Concrete", International Journal of Engineering and Applied Sciences,ISSN 2305-8269, Volume 5, No 4, Sept 2014.

[20] Prema Kumar W, Ananthayya M , Vijay K," Effect Of Partial Replacement Of Cement With Waste Glass Powder On The Properties Of Concrete", ISSN 2319 – 6009 ,Volume 3, No 2, May 2014.

[21] P.Padma Rao, Pradhan Kumar, Bhaskar Singh," A Study on Use of Rice Husk Ash in Concrete",

IJEAR , ISSN: 2348-0033,Volume 4, Issue Spl-2, Jan-June 2014.

[22] Kartini k et al. (2008) ―Improvement on mechanical properties of Rice Husk Ash concrete with Super plasticizer‖ Universiti Teknlogi MARA, MALAYSIA ,international conference on construction and building technology ICCBT 2008 -A - (20) - pp221-230.

[23] Dao V et al. (2008) ―Effect of rice husk ash on properties of high strength concrete‖ The 3rd ACF International Conference- ACF/VCA 2008.

[24] Ramezanianpour A et al. (2009) ―The Effect of Rice Husk Ash on Mechanical Properties and Durability of Sustainable Concretes‖. International Journal of Civil Engineerng. Vol. 7, No. 2, June 2009.

[25] Zemke N and Woods E (2009) ―Rice Husk Ash‖ California Polytechnic State University.

[26] Harunur k et al. (2010) ―Durability of Mortar in Presence of Rice Husk Ash‖ World Academy of Science, Engineering and Technology 43 2010.

[27] Shirule P et al. (2012) ―Partial Replacement of Cement with Marble Dust Powder‖. Department of Civil Engineering ,SSBTs COET ,Bambhori, Jalgoan Maharashtra.

[28] Marthong C (2012) ―Effect of Rice Husk Ash (RHA) as Partial Replacement of Cement on Concrete Properties‖. Civil Engineering Department, Shillong Polytechnic, Shillong, Meghalaya, India, 793008, International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181, Vol. 1 Issue 6, August – 2012.