International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 6 Issue 7, November-December 2022 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Study the Improvement of the Strength of Conventional Concrete using Coconut Shell Ash and Glass Powder

Akshay Kumar Patel, R. S. Parihar, Abhay Kumar Jha

Department of Civil Engineering, Lakshmi Narain College of Technology, Bhopal, Madhya Pradesh, India

ABSTRACT

The compressive strength of CSA and GP mixed concrete has been evaluated at 7 and 28 days after curing, respectively, and workability has been tested right away after the concrete has been prepared. The strength of concrete is increased by the addition of waste CSA and GP up to a degree after which it decreases. When 10% of the cement in CSA and GP mixed concrete is replaced, the compressive strength increases to 28.79 N/mm2 and 28.4 N/mm2, respectively. The replacement of cement in CSA and GP mixed concrete with amounts of 3.7 N/mm2, 3.8 N/mm2, and 9.18 N/mm2, and 9.22 N/mm2 respectively, enhances Split Tensile Strength and Flexural Strength by up to 7.5%. In this present investigation, CSA and GP may be substituted for cement up to a maximum of 7.5% for split tensile and flexural strength and 10% for compressive strength.

KEYWORDS: *CSA and GP, Initial setting, final setting time, Compressive strength, split tensile strength*

How to cite this paper: Akshay Kumar Patel | R. S. Parihar | Abhay Kumar Jha "Study the Improvement of the Strength of Conventional Concrete using Coconut Shell Ash and Glass Powder" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-6 | Issue-7, December 2022, pp.1181-1186, URL: www.ijtsrd.com/papers/ijtsrd52569.pdf

IJTSRD52569

I. INTRODUCTION

This work is based on utilization of waste material like coconut shell and glass powder used in concrete construction industry for their valuable application. Use of such waste material not only reduction in land fill cost, saving in energy and protecting environment from possible pollution effect but also getting them utilized in cement and other construction material. It also used as reduction cost of cement manufacturing and concrete construction. (Tajamul et al. (2016))Popoola et al (2019) investigate the use of coconut waste ash in the construction industry reduces the time cost and improve the maximum dry density (MDD), Unconfined Compressive Strength (UCS), Optimum Moisture Content (OMC) and CBR value of soil.(Garba et al. (2020)). Different effort made by many researchers in using coconut shell ash, coconut shell, coconut husk ash as replacement material for cement, coarse aggregate an cement respectively. This research set out the effect of coconut shell ash.

II. Literature review

Sakale et al. (2016) Our urban and rural communities in India have a serious problem with the storage and proper disposal of garbage and smashed glass. Reusing used glass eliminates or consumes this issue everywhere. This experimental endeavour examines the results of substituting some of the concrete with glass powder. Waste glass powder is used in place of cement in concrete in increments of 10%, 20%, 30%, and 40%, respectively. The effects of this substitution on compressive strength, split tensile strength, workability, and flexural strength are then assessed. It has been discovered that as the amount of cement replaced by glass powder grows, the compressive, flexural, and split tensile strengths of concrete increase first, peaking at 20%, and then begin to decline. As more glass powder is used to replace cement, the workability of concrete decreases monotonically. Glass powder can substitute cement to the extent of 20% without reducing the compressive strength.

Harish et al. (2016) In the twenty-first century, non-biodegradable wastes have become a significant problem since an increasing amount of them are being dumped in landfills without being recycled. It takes a very long time for these wastes to degrade. Research has been done to fully utilise these wastes as the finished goods for construction materials like concrete as a result of this issue. Concrete now contains a variety of cement substitutes due to the growing emphasis on using environmentally friendly materials in construction. Given the significant volume of glass present in the solid waste stream of any major metropolis, glass powder is one such substance with untapped potential. The mechanical and durability characteristics of cementitious systems incorporating a fine glass powder are reviewed in this research. This research demonstrates how concrete mixtures can be metered to produce compressive strengths that are comparable to or greater. Increased use of a non-standard cement replacement material, like glass powder, may result from a greater understanding of that material's performance, which would ultimately promote sustainability.

Magrey et al. (2016), explained about the concrete is the premier civil engineering material. Concrete manufacturing involves consumption of ingredients like cement, aggregates, water & admixtures. Among all the ingredients, aggregates form the major part. More than 50000 billion tons of aggregate are produced each year in the world. Use of natural aggregates in such a rate leads to a question about the preservation of natural aggregate sources. In addition, operation associated with aggregates extraction and processing is the principal causes for environmental concern. The most widely used fine aggregate for the making of concrete is the natural sand mined from the riverbeds. However, the availability of river sand for the preparation of concrete is becoming scarce due to the excessive non-scientific methods of mining from the riverbeds, lowering of water table, sinking of the bridge piers, etc. are becoming common. The present scenario demands identification of substitute materials for the river sand for making concrete. Recently in the environmental issues, restrictions of local and natural access or sources and disposal of waste material are gaining great importance. Today, it becomes more difficult to find a natural resource. Use of the waste materials not only helps in getting them utilized in cement, concrete and other construction materials, but also has numerous indirect benefits such as reduction in land fill cost, saving in energy, and protecting environment from possible pollution effect. It also helps in reducing the cost of concrete manufacturing. In light of this in the contemporary civil engineering construction, using alternative materials in place of natural aggregate in concrete production makes concrete as sustainable and environmentally friendly construction material. In this research, the effect of coconut shell as partial replacement of coarse aggregate and waste glass as partial replacement of fine aggregate on the properties of concrete were studied. The characteristic properties of concrete such as compressive strength, flexural strength, and water absorption of various mixes were reviewed in this work.

Gautam et al. (2016), described the literature of use of glass powder as a replacement of cement to assess the pozzolanic activity of fine glass powder in concrete and compare its performance with other pozzolanic materials like silica fume and fly ash. Nowadays glass is used in many forms in day-to-day life. It has limited life span and after use it is either stock piled or sent to landfills. Since glass is non-biodegradable, landfills do not provide an environment friendly solution. Hence there is strong need to utilize waste glasses. Many efforts have been made to use waste glass in concrete industry as a replacement of coarse aggregate, fine aggregate and cement. Its performance as a coarse aggregate replacement has been found to be non-satisfactory because of strength regression and expansion due to alkali-silica reaction.

Sravika et al. (2017), explained collection of materials required and the data required for mix design are obtained by sieve analysis and specific gravity test. Sieve analysis is carried out from various fine aggregates (FA) and coarse aggregates (CA) samples and the sample which suits the requirement is selected. Specific gravity tests are carried out for fine and coarse aggregate. In this project Fine aggregate is replaced by Quarry dust of 30 % along with the partial replacement of coarse aggregate with coconut shell. The coarse aggregate is replaced with 10 %, 20%, 30% and 40 % by coconut shell. The design Mix used for the project is M20 grade (1:1.5:3) with W/C Ratio 0.5. The Conventional concrete and Coconut shell with quarry dust concrete specimens were casted and tested for compressive strength and split tensile strength for 7 and 28 days The compressive strength of the CS10%+QD30% and CS20%+QD30% was 24.35N/mm2 and 24.98 N/mm2, Split tensile strength is 3.454N/mm2 and 3.499N/mm2.

Islam and Rahman (2017), explained the use of milled (ground) waste glass in concrete as partial replacement of cement could be an important step toward development of sustainable (environmentally friendly, energy-efficient and economical) infrastructure systems. When waste glass is milled down to micro size particles, it is expected to undergo

pozzolanic reactions with cement hydrates, forming secondary Calcium Silicate Hydrate (C–S–H). In this research chemical properties of both clear and colored glass were evaluated. Chemical analysis of glass and cement samples was determined using Xray fluorescence (XRF) technique and found minor differences in composition between clear and colored glasses. Flow and compressive strength tests on mortar and concrete were carried out by adding 0–25% ground glass in which water to binder (cement + glass) ratio is kept the same for all replacement levels. With increase in glass addition mortar flow was slightly increased while a minor effect on concrete workability was noted. To evaluate the packing and pozzolanic effects, further tests were also conducted with same mix details and 1% super plasticizing admixture dose (by weight of cement) and generally found an increase in compressive strength of mortars with admixture. As with mortar, concrete cube samples were prepared and tested for strength (until 1 year curing). The compressive strength test results indicated that recycled glass mortar and concrete gave better strength compared to control samples. A 20% replacement of cement with waste glass was found convincing considering cost and the environment.

Kumar et al. (2017), this study investigated the use of Egg Shell Powder and Coconut Shell Ash as replacement for cement in M-30 Grade concrete. The both materials used to partially replace the cement from 5%- 25%. Compressive strength, split tensile strength and Flexural strength are evaluate at 7, 14, 21 and 28 days. The reduction in cost up to 10% can be achieved for every cubic meter of concrete production with use of materials. In the last decades, the use of residue in civil construction, especially in addition to concrete, has been subject of many researches due to besides to reduce the environmental polluter's factors, it may lead several improvements of the concrete properties. The world Coconut Shell Ash is estimated in 500 million tons per year, and India is the second producer. This project evaluates how different contents of Egg Shell Powder (ESP) and Coconut Shell Ash (CSA) added to concrete may influence its physical and mechanical properties. Due to its high pozzolanic activity, both strength and durability of concrete are enriched. This may increase the strength of concrete against cracking. Previously, investigation on the corrosion performance of Coconut shell ash and Egg shell powder blended concrete is very limited.

Umamaheswari and kumar (2018), this experimental study investigated the strength performance of concrete using Ordinary Portland Cement and Coconut Shell Ash and Silica Fume. Initially, coconut shell ash and silica fume samples were collected and its properties were investigated. Normal consistency and setting time of the pastes containing ordinary Portland cement and coconut shell ash at 5%, 10% & 15% and silica fume at 5% and 10% replacement were investigated. Compressive strength, flexural strength, split tensile strength, durability test and density of M50 concrete containing ordinary Portland cement with coconut shell ash at 5%, 10% & 15% and silica fume at 5% & 10% replacements were also investigated at water cement ratio 0.35. The mix design used for making the concrete specimens was based on previous research work from literature.

Gopinath et al. (2018), described the high cost of conventional construction material affects economy of structure. With increasing concern over the excessive exploitation of Natural aggregates, lightweight aggregate produced from waste is a viable new source of structural aggregate material. In this work we have partially replaced coarse aggregate with coconut shell and ordinary Portland cement with rice husk ash. The percentage of replacement are 0%, 18%, 20%, 22%, 24% with coconut shell and 0%, 5%, 8%, 10%, 12% with rice husk ash. The characteristic properties of concrete such as compressive strength, split tensile strength using the mix made by partial replacement of coarse aggregate with crushed coconut shell aggregate and ordinary Portland cement with rice husk ash were reviewed in the present work. The results show that high strength is attained at replacement of 18% with coconut shell and 8% with rice husk ash.

III. Material used

Fine aggregates

In fine aggregate (sand) particle size passing through 4.75 mm BIS sieve BIS:383-1970. In the nature (ATM) sand is naturally occurring with action of weathering seasoning and rock spelled in river. Due to weathering action rock convert in small size of stone that stones moved by river water and it concert in another small size stone and finally convert into sand particle. After that it collected from various placed and also screening it by performed sieve analysis for sand as well as aggregate.

According to the Bureau of Indian Standard BIS:383-1970 fine aggregate (sand) divided into 4 Zones (I, II, III&IV) When we go with zone I to zone IV aggregate become finer. After studying I choose II zone fine aggregate sand. After that I determine SP, FM and water absorption before used in the mixed.

Figure 1 Fine aggregates

Waste Glass (Glass Powder)

Glass is the hard, brittle, transparent amorphous solid, such as that used for windows, door, vehicle window, many bottle etc. Glass also used in scientific field and in the industry by the physical and optical properties of glass container glass, flat glass, optic and optoelectronics material, laboratory equipment, thermal insulation (Wood Glass), R/F fiber (Glass Reinforced plastic), glass fiber reinforced concrete etc. without changing chemical properties glass is a unique material due many times recycled. Waste glass can be crushed into small particles and after melted it convert into new glass without changing it chemical properties not all glass can be recycled into new glass. In my study we used recyclable glass in crushed glass (Powder Form).

Figure 2 Uncrushed Glass Sample (b) Crushed Glass (Powder) Sample

Coconut Shell Ash (Powder)

In construction the increased cost of various ingredients of concrete is a main factor. Coconut shell ash used in the concrete production, it reduced and preventing environmental pollution as well as managing the waste generated by these shells. It also decreasing potential use of natural resource hence conserving sources.

In Civil Engineering construction industry of cement concrete is the vital material due to it has in build properties like workability, economical, durability and easy to construction for that reason recent years some commercial and agricultural waste become popular to use in construction. Coconut shell is the outer cover of the coconut. Coconut shell can be used as reinforced material, aggregate or in powder form when their size is between 20mm to 600 micron and the density near about 1.6gm/cm3. Coconut shell has higher modulus of rigidity for that it is capable to enhance the concrete properties.

Figure 3. Uncrushed Coconut Shell Sample (b) Crushed Coconut Shell (Ash Form) Sample

The quality of water is very important as it can influence the setting time of fresh concrete and the strength of hardened glass powder and coconut shell ash. On the other hand, water is required for the heat of hydration process of cement and molding and placing of cement concrete in the required shape and location.

IV. CONCLUSION

Based on the above study following conclusions can be made:

- The gradual increase seen in the Split Tensile Strength of Coconut Shell Ash and Glass Powder mixed concrete at 7 days and 28 days curing with 7.5% addition of CSA and GP in the amount of 0.381 N/mm2 and 0.390 N/mm2 respectively but after that it starts reducing the Split Tensile Strength with increase of CSA and GP addition.
- We also find that the Flexural Strength of Coconut Shell Ash & Glass Powder mixed concrete at 7 days and 28 days curing with 7.5% addition of CSA and GP in the amount of 0.920 N/mm2 and 0.922 N/mm2 respectively but after that it starts reducing the Flexural Strength with increase of CSA and GP addition.
- The mix which was prepared with the addition of 10% CSA & GP with 0.55 W/C ratio possess the maximum compressive strength. Therefore, this mix is recommended for maximum strength.

REFERENCES

[1] Dr. R. Umamaheswari, M. Vigneshkumar "Experimental study on partial replacement of cement with coconut shell ash and silica fume in concrete" International Journal of Scientific & Engineering Research (IJSER), vol. 5, no. 7, pp. 2175-2179, 2018.

[2] G. M. Sadiqul Islam, M. H. Rahman, Nayem Kazi "Waste glass powder as partial replacement of cement for sustainable concrete practice" International Journal of Sustainable Built Environment (IJSBE), vol. 6, no. 1, pp. 37-44, 2017.

[3] Gopal Charan Behera, Ranjan Kumar Behera "Effect of coconut shell aggregate on natural strength concrete running title: coconut shell as coarse aggregate" International Journal of Engineering Research & Technology (IJERT), vol. 2, no. 6, pp. 2405-2415, 2013.

[4] Gopu Ganesh Naidu, Nettikoppula Ramesh Babu, Pappula Ravi Kumar "Strength characteristics of concrete by partial replacement of coarse aggregate with coconut shell & cement with glass powder" International Conference on Trends in Material Science and Inventive Materials (ICTMIM), page 1-9, 2021.

[5] Gunalaan Vasudevan, Seri Ganis Kanapathy pillay (2013) Performance of Using Waste Glass Powder In Concrete As Replacement Of Cement American Journal of Engineering Research (AJER) e-ISSN : 2320-0847 p-ISSN : 2320-0936 Volume-02, Issue-12, pp-175-181 www.ajer.org

[6] Harish B A, Hanumesh B M, Siddesh T M, Siddhalingesh B K (2016) An Experimental Investigation on Partial Replacement of Cement by Glass Powder in Concrete International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 03 Issue: 10 | Oct-2016 p-ISSN: 2395-0072 www.irjet.net.

[7] ISO: 9383:1995/ AMD 1:2004, "Products in fiber R/F cement short corrugated or

[8] ISO:7884-6:1987, "Glass viscosity and viscometrical fixed points Part 6 Determine of softening point"

[9] Jagriti Gupta, A.S. Jethoo, P.V. Ramana (2022) Evaluating long term properties of concrete using waste beverage glass materialtoday proceedings Volume 61, Part 2, 2022, Pages 297-306 https://doi.org/10.1016/j.matpr.2021.09.446

[10] K. I. M. Ibrahim "Recycled waste glass powder as a partial replacement of cement in concrete containing Silica Fume and Fly Ash" Case studies in construction material (CSCM), vol. 15, pp. 1-10, 2021.

[11] M. Arivazhagan, T. Balakrishna, A. Deepak, M. Hariskumar (2019) "Experimental study on partial replacement of cement by groundnut shell ash in concrete" International Journal of Current Engineering and Scientific Research (IJCESR), vol. 6, no. 3, pp. 144-160, 2019.

[12] M. J. Garba, A.S.J. Smith, E. N. Ogork, A. Aboshio "Effect of coconut shell ash (CSA) an admixture on the properties of cement paste and concrete "British Journal of Educational Technology (BJET), vol. 15, no. 02, pp. 22-29, 2020.

[13] M. Nabil, Al Akhras, Ayman Ababnesh "Effect of glass powder on the mechanical properties of mortar" An Najah National University (ANNU), vol. 4, no. 3, Page 1-66, 2009.

[14] Mayur B. Vanjare, Shriram H. Mahure (2012) Experimental Investigation on Self Compacting Concrete Using Glass Powder International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 http://www.ijera.comVol. 2, Issue 3, May-Jun 2012, pp.1488-1492.

[15] Murthi palanisamy, Poongodi koloandasamy, Paul Awoyera, Ravindra Gobinath "Permeability properties of light weight self-consolidating concrete made with coconut shell aggregate" Journal of Materials Research and Technology (JMR&T), vol. 9, no. 3, pp. 3547-3557, 2018.

[16] N. Gupta, A. Gupta, R. Shukla, S. Goyal Kumar "Utilization of recycled aggregate plastic glass waste and coconut shell in concrete a review" International Symposium on Fusion of Science and Technology (ISFT), vol. 03, no. 02, pp.1-8, 2020.

[17] Nitin S. Taksande, G. O. Dhawale, S. G. Makrande, M. R. Nikhar "A comparative study on behavior of concrete to partial replacement of cement by rice husk ash and glass powder" International Advanced Research Journal in Science, Engineering and Technology (IARJSET), vol. 6, no. 4, pp. 30-36, 2019.

[18] P. Mehta, J. Paulo, M. Monteiro (2005) "Concrete microstructure properties and material" Hc Graw Hill Professional Edition, Page 659, Book