International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 10 | Oct -2017 www.irjet.net p-ISSN: 2395-0072

Partial Replacement of Fine Aggregate & Coarse Aggregate by Waste Glass Powder & Coconut Shell

Kumar Animesh[1], Jeet Tiwari[2], Kapil Soni[3]

[1]M.tech Scholar, Department of Civil Engineering , Institute of Technology Aisect University, Raisen (M.P.) India
[2]Assistant Professor, Department of Civil Engineering, Institute of Technology Aisect University, Raisen (M.P.) India
[3]HOD, Department of Civil Engineering, Institute of Technology Aisect University, Raisen (M.P.) India

---

Abstract: *Concrete is the mixture of various materials coarse aggregate, fine aggregate, cement & water, each of them is mixed in various proportions to achieve specific strength. Cement being the most important material plays an important role in the manufacturing of concrete. The high cost of conventional construction materials is a dominating factor effecting constructions cost. This is necessity research for some new kind of alternative materials in the constructions field. Waste glass in the form of fine aggregate & coconut shell as coarse aggregate can be used.*

The proportion of the mineral and mixtures is applied in testing cubes for their workability, compression strength and flexural strength

This paper briefly discusses the effects of addition of glass powder & coconut shell on the properties of mortar concrete mix of M25 at 28 days four concrete mix with fibre dosages 0%, 5%, 10% & 20% of the weight concrete mix.. Combination of these glass powder & coconut shell will used as dosages of mix. Cubes of size 15x15x15cm to check the compressive strength. The result of glass powder & coconut shell concrete for 7 days, 28days, curing of concrete. The testing of concrete according to Indian standard specification to identify the effect of workability and mechanical strength properties due to doses glass powder & coconut shell.

Keywords: Concrete, waste glass powder, coconut shell, partial replacement, fine aggregate, coarse aggregate, drying shrinkage, compressive strength, workability test such slump cone test

1. INTRODUCTION

Concrete is the second largest of widely used material; but there are environmental issues related with its use which are needed to be taken under considerations. Due to various factories and industries large volume of waste produced daily .The disposal of the waste generated from industries has become serious issue solid waste management is one of the major environmental concerns in the world. The recycling and reuse of the waste has become the best alternatives as their disposal problem of waste .The reuse of such waste will reduce the environment impact and is more economical the energy required to reuse the recyclable material is less than that of virgin materials. Use of natural aggregates at a great rate leads to a question about the preservation of natural aggregates sources. In addition, operation associated with aggregates extraction and processing is the principal causes environmental concern. 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. Coconut shell being a hard and not easily degrade material if crushed to size of sand can be a potential material to substitute sand. At present, coconut shell has also been burnt to produce charcoal and activated carbon for food and carbonated drink and filtering mineral water use. However, the coconut shell is still under utilized in some places. The chemical composition of the coconut shell is similar to wood.

2. LITERATURE REVIEW

[1]Rakesh Sakale (2015) studied the replacement of fine aggregate by waste glass powder in steps of 10%, 20%, 30% and 40% respectively by volume of cement and its effects on compressive strength, split tensile strength, workability and flexural strength are determined. It is found that the compressive, flexural and split tensile strengths of concrete increase initially as glass powder increases and become maximum at about 20% and later decrease. The workability of concrete reduces monotonically as the replacement percentage increases. The replacement of cement up to about 20% by glass powder can be done without sacrificing the compressive strength.

[2]Chikhalikar S.M. and Tande S.N(2012) There is a need to replace a part of fine aggregate by waste glass powder to reduce the consumption of fine aggregate and the environmental pollution can be checked to some extent. Recently the research has shown that the waste glass can be effectively used in concrete as fine aggregate. Waste glass when grounded to a very fine powder shows some cementitious properties because of silica content. Therefore the glass powder to some extent can replace the cement and fine aggregate, contributes for the strength development and also enhances durability of the concrete.

[3]Naik and Moriconi(2005) Concrete is the 2nd most widely used materials in the world. However, the production of Portland cement, leads to the release of significant amount

of CO2, a greenhouse gas. One ton of Portland cement clinker production is said to create approximately one ton of CO2 and other greenhouse gases (GHGs). Environmental issues are playing an important role in the sustainable development of the cement and concrete industry.

[4]VeenaV. Bhat, N.BhavanishankarRao(2014) Glass is an indeterminate material with high silica content (SiO2) i.e.72% of waste glass when grounded to very fine powder (600 micron) reacts with alkali in cement & cementations product that help to contribute to the strength development.

[5]Idir R(2009) Demand for recycled glass has considerably decreasing in recent years. Glass is cheaper to store than to recycle, as it is expensive for the recycling process. There are several alternatives for the reuse of waste glass. According to previous studies, all the applications, which require pre-conditioning and crushing of waste glass, are more or less limited and unable to absorb all the quantities of waste glass available. In order to provide a sustainable solution to glass storage, a potential and incentive way would be to reuse this type of glass in concrete.

3. MATERIAL USED

3.1 Cement

Cement is a binder, a substance used in construction that sets, hardens and adheres to other materials, binding them together. Cement is seldom used solely, but is used to bind sand and gravel (aggregate) together. Cement is used with fine aggregate to produce mortar for masonry, or with sand and gravel aggregates to produce concrete. Cements used in construction are usually inorganic, often lime or calcium silicate based, and can be characterized as being either hydraulic or non-hydraulic, depending upon the ability of the cement to set in the presence of water. Cement used in construction is characterized as hydraulic or non-hydraulic. Hydraulic cements (e.g., Portland cement) harden because of hydration, chemical reactions that occur independently of the mixture's water content; they can harden even underwater or when constantly exposed to wet weather. Non-hydraulic cement will not set in wet conditions or underwater; rather, it sets as it dries and reacts with carbon dioxide in the air. It is resistant to attack by chemicals after setting.

3.2 Fine Aggregate

Aggregates are inert granular materials such as sand, gravel or crushed stone that are an end product in their own right. They are also the raw materials that are an essential ingredient in concrete. For a good concrete mix, aggregates need to be clean, hard, strong particles free of absorbed chemicals or coatings of clay and other fine materials that could cause the deterioration of concrete. Fine aggregate are basically sands won from the land or the marine environment. Fine aggregates generally consist of natural sand or crushed stone with most particles passing through a 9.5mm sieve. As with coarse aggregates these can be from Primary, Secondary or Recycled sources.

3.3 Coarse Aggregates

Coarse aggregates are particles greater than 4.75mm, but generally range between 9.5mm to 37.5mm in diameter. They can either be from Primary, Secondary or Recycled sources. Primary, or 'virgin', aggregates are either Land- or Marine-Won. Gravel is a coarse marine-won aggregate; land-won coarse aggregates include gravel and crushed rock. Gravels constitute the majority of coarse aggregate used in concrete with crushed stone making up most of the remainder. Secondary aggregates are materials which are the by-products of extractive operations and are derived from a very wide range of materials

Recycled concrete is a viable source of aggregate and has been satisfactorily used in granular sub bases, soil-cement, and in new concrete. Recycled aggregates are classified in one of two ways, as:

- Recycled Aggregate (RA), or as
- Recycled Concrete Aggregate (RCA)

Aggregates, which account for 60 to 75 percent of the total volume of concrete, are divided into several distinct categories, and are either coarse or fine.

3.4 Coconut Shell

A Coconut shell is an item obtained by removing coconut milk from coconut opened with a hammer. It can be used to generate super compost. Coconut shells are one of the by-products from splitting a Coconut. The freshly discarded shells were collected from the local temples and they were well seasoned. The seasoned CS is crushed, which was developed and erected for this purpose. The crushed edges were rough and spiky and the lengths were restricted to a maximum of 12 mm. The surface texture of the shell was fairly smooth on concave and rough on convex faces.

3.5 Waste Glass Powder

Waste glass is not just waste, but a new resource. Generally, beer, wine bottles and other food jars etc., are among the few normal household glass items put into landfills every day. Glass is generally produced from sand, lime and soda and uses about 40 percent more power to produce from raw materials than it does with recycled materials The glass in light bulbs, cook ware and window panes are not recyclable due to some special additives used to the glass. These additives are ceramics and other impurities that generally contaminate the recycling process. The glass that cannot be recycled only plays a small part of the glass that is put into the landfills though. The process of glass recycling is less extensive than the process of making it from raw materials.

Once glass is picked up and taken to the recycle centre it is separated by colour and then broken into small pieces. The broken glass pieces are then crushed and sorted before being cleaned and added to raw materials to make the final glass product. Crushed glass melts at a lower temperature than the raw materials and therefore the more recycled material that is in the mixture the less energy it takes to melt the materials into glass

4. METHODOLOGY

The present thesis work requires preliminary investigations in a methodological manner.

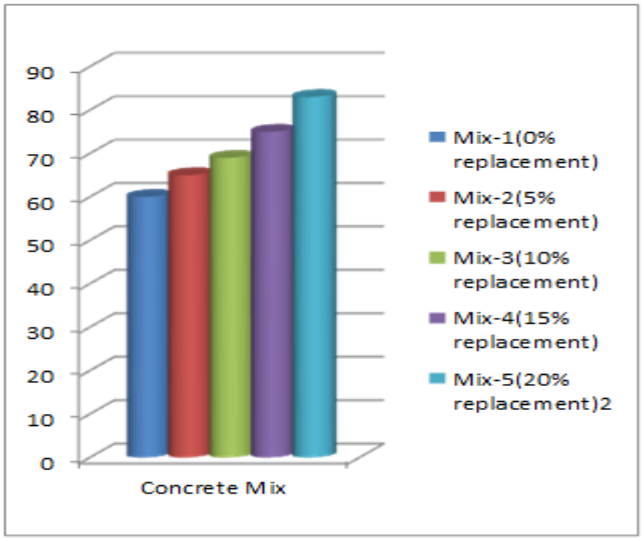
- Selection of type of grade of mix, mix design by an appropriate method, trial mixes, final mix proportions.
- Estimating total quantity of concrete required for the whole project work. Estimating quantity of cement, fine aggregate, coarse aggregate, coconut shells required for the project work.
- Testing of properties of cement, fine aggregate, coarse aggregate, waste glass powder and coconut shells. Production of concrete mixes
- Production of mix (normal concrete of grade M-20) in the laboratory is carried out by IS method of concrete mix design (IS 10262-1982). Glass powder &Coconut shell concrete is produced by adding coconut shells & glass powder in different percentage replacement in concrete.
- Test on ingredients materials: The ingredients of concrete i.e. cement, fine aggregate, coarse aggregate, coconut shells are tested before producing concrete.
- The respective Indian standard codes are followed for conducting various tests on ingredients materials and the concrete.
- Slump cone test, Compression Test & Flexural Test is carried out on the cubes and beam casted by the materials.

3. RESULTS

3.1 SLUMP TEST

TABLE-1: Slump Cone Results

Mix	W/C Ratio	Slump value (MM)	Remark
Mix-1(0%)	0.43	60mm	--
Mix-2 (5%)	0.43	65 mm	Slump>60mm
Mix-3 (10%)	0.43	69 mm	Slump>60mm
Mix-4(15%)	0.43	75 mm	Slump>60mm
Mix-5(20%)	0.43	83 mm	Slump>60mm

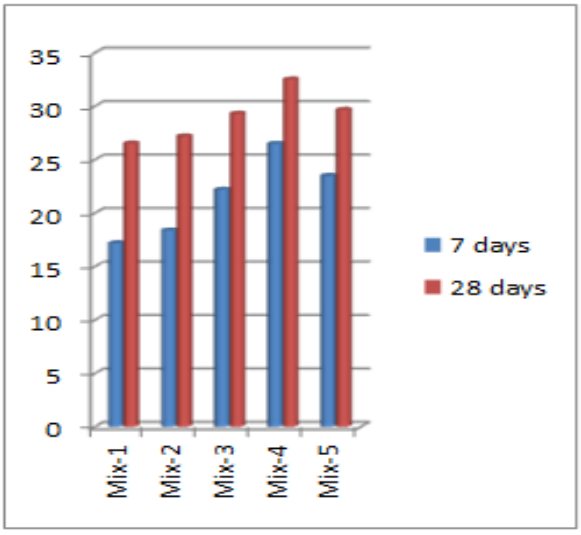


From the table it is observed that the desired slump value is obtained for Mix 5 at water cement ratio = 0.43 is maximum. Hence we fix it as the design ratio. Mix 2 and 3 yielded very low slump values which was very close to Mix-1(conventional) may be either due to inadequate paste available for binding the mix or due to improper mixing procedure.

3.2 COMPRESSIVE STRENGTH TEST

TABLE-2: Compressive Strength Results

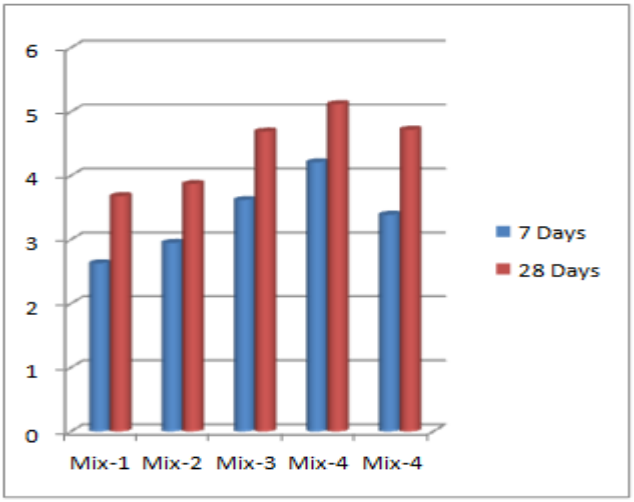
Mix	7 days strength (N/mm²)	28 days strength (N/mm²)
Mix-1(0%)	17.20	26.53
Mix-2 (5%)	18.39	27.19
Mix-3 (10%)	22.21	29.32
Mix-4(15%)	**26.5**	**32.52**
Mix-5(20%)	23.5	29.69



The value obtained for 15% addition of coconut shell and waste Glass powder at a water cement ratio 0.43 yielded highest results for compressive strength in both 7 days and 28 days; beyond which at 20% replacement the value of compression strength decreases. This may be due to the fact when glass powder are added initially the finer sized fine aggregates enter into the surface pores in the concrete. Hence there is an optimum value of mix to, beyond which the compressive strength decreases. Hence 0.43 was taken as the optimum water cement ratio and 15% replacement as optimum mix content was taken.

3.2 FLEXURAL STRENGTH TEST

Mix	7 days strength (N/mm^2)	28 days strength (N/mm^2)
Mix-1(0%)	2.63	3.68
Mix-2 (5%)	2.95	3.87
Mix-3 (10%)	3.62	4.69
Mix-4(15%)	**4.21**	**5.12**
Mix-5(20%)	3.39	4.72



In the chart it is seen that when Glass powder & Coconut shell content is increased there is an increase in flexural strength will be increased with a maximum at 15%. However when the Glass powder & Coconut shell content is increased beyond this value (20%) a downward slope observed. This must be due to cluster of Waste Glass Powder which can crust the binding and strength formation in concrete.

4. CONCLUSIONS

Waste Glass Powder, Coconut Shell and Cement bag is available in a at the test site, which is material in concrete. Further, it acts as a source of waste disposal for both Waste Glass Powder& Coconut Shell due to is use in construction industry. In addition to that Waste Glass Powder& Coconut Shell mix will reduce the demand for additional waste disposal infrastructure and decrease the load on existing landfills and incinerators. Coconut Shell being natural in origin is ecologically sustainable and cements bags uses is eco-friendly can bring down the global carbon footprint quite effectively.

5.1 Experimental Conclusion

1. The desired slump value is obtained for Mix 5 at water cement ratio = 0.43 is maximum. Hence we fix it as the design ratio. Mix 2 and 3 yielded very low slump values which was very close to Mix-1(conventional) may be either due to inadequate paste available for binding the mix or due to improper mixing procedure.
2. The value obtained for 15% addition of coconut shell and waste Glass powder at a water cement ratio 0.43 yielded highest results for compressive strength in both 7 days and 28 days; beyond which at 20% replacement the value of compression strength decreases. This may be due to the fact when glass powder are added initially the finer sized fine aggregates enter into the surface pores in the concrete. Hence there is an optimum value of mix to, beyond which the compressive strength decreases. Hence 0.43 was taken as the optimum water cement ratio and 15% replacement as optimum mix content was taken.
3. When Glass powder & Coconut shell content is increased there is an increase in flexural strength will be increased with a maximum at 15%. However when the Glass powder & Coconut shell content is increased beyond this value (20%) a downward slope observed. This must be due to cluster of Waste Glass Powder which can crust the binding and strength formation in concrete.
4. The presence of dust and other impurities on the surface of shells is also another reason for this reduction in strength which may interfere with the bonding of mix and subsequent strength formation.
5. It was also found that the addition of CS increases workability of concrete. The amount of cement content may be more when coconut shell are used as an aggregate in the production of concrete compared to conventional aggregate concrete.

Since higher strength is attained at a lower design mix. It can be used to manufacture building blocks at relatively lower costs in comparison to plain concrete blocks thus making it suitable for rural residential buildings up to 10m height or as protection walls around buildings

ACKNOWLEDGEMENT

I express my sincere gratitude and respect to HOD and all the faculty members of Department of Civil Engineering, Institute of Technology Aisect University for their valuable suggestions, timely support and encouragement. I thank

them for numerous useful suggestions apart from valuable guidance to me. I would like to convey my sincere gratitude to my friends, colleagues for their support and encouragement. The meaning of work is incomplete without paying regards to my respected parents and family whose blessings and continuous encouragement have shown me the path to achieve my goals.

REFERENCES

[1] Rakesh Sakale, Sourabh Jain and Seema Singh, "Experimental Investigation on Strength of Glass Powder Replacement by Fine Aggregate in Concrete with Different Dosages", International Journal of Advanced Research in Computer Science and Software Engineering, Vol.5, Issue 12, December 2015, pp. 386390, ISSN: 2277-128X.

[2] Chikhalikar S.M. and Tande S.N. (2012) "An Experimental Investigation On Characteristics Properties of Fibre Reinforced Concrete Containing Waste Glass Powder as Pozzolona" 37th Conference on Our World in Concrete and Structures, Singapore, August.

[3] BhatVeena V, Rao N. Bhavanishankar "Influence of Glass Powder On The Properties Of Concrete" International Journal of Engineering Trends andTechnology (IJETT), ISSN: 2319 –8753, Volume16, Number-5, October 2016.

[4] Idir R., Cyr M., and Tagnit-Hamou A. (2009) "Use of Waste Glass as Powder and Aggregate in Cement-Based Materials" SBEIDCO – 1st International Conference on Sustainable Built Environement Infrastructures in Developing Countries ENSET Oran (Algeria).

[5] Vandhiyan R., Ramkumar K. and Ramya R.(2013)"Experimental Study On Replacement Of Fine Aggregate By Glass Powder" International Journal ofEngineering Research and Technology (IJERT) Vol. 2 Issue 5, May, ISSN: 2278-0181.

[6] VasudevanGunalaan and Pillay Seri GanisKanapathy "Performance of Using Waste Glass Powder In Concrete As Replacement Of Fine Aggregate" American Journal of Engineering Research (AJER) e-ISSN : 2320-0847 p-ISSN : 2320-0936 Volume-02, Issue-12.

[7] Dali J.S. and Tande S.N. (2012) "Performance of Concrete Containing Mineral Admixtures Subjected to High Temperature" 37th Conference on Our World in Concrete and Structures, Singapore, August.

[8] Nwaubani Sunny O. and Poutos Konstantinos I.(2013) "The Influence of Waste Glass Powder Fineness on the Properties of Cement Mortars" International Journal of Application or Innovation in Engineering and Management (IJAIEM) Volume 2, Issue 2, ISSN 2319 – 4847.

[9] .J. P. Ries, J. Speck, (2015), "Experimental Study on Strength Characteristics of M25 Concrete with Partial Replacement of coarse aggregate with coconut shell and cement with Fly Ash", International Journal of Innovative Research in Science, Engineering and Technology.

[10] Vishwas P. Kulkarni, Sanjay kumar B. Gaikwad, "Comparative study on coconut shell aggregate with conventional concrete", IJIET, Volume 2, Issue 12, June 2013, pp 67-70.

[11] Kulkarni V.P, Kumar .S, (2013), "Comparative study on coconut shell aggregate with conventional concrete", Vol.2, Issue 12, pp 67-70.

[12] Parag S. Kambli[1], Sandhya R. Mathapati[2], (2014), Application of Coconut Shell as Coarse Aggregate in Concrete: A Technical Review. Engineering Research and Applications www.ijera.com ISSN: 2248-9622, Vol. 4, Issue 3(Version 1).

[13] Damre Shraddha, Sustainable Concrete by Partially Replacing Coarse Aggregate Using Coconut Shell, Journal on Today's Ideas Tomorrow's Technologies,Vol. 2, No. 1, June 2014, pp. 1–14

[14] Daniel Yaw Osei, "Experimental assessment on coconut shells as aggregate in concrete", International Journal of Engineering Science Invention; ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726 Volume 2 Issue 5 ‖ May. 2013 ‖ PP.07-11

BIOGRAPHIES

Kumar Animesh
M.tech (CTM) Scholar
Institute of Technology Aisect University, Raisen (M.P.) India

Jeet Tiwari
Assistant Professor
Department of Civil Engineering
Institute of Technology Aisect University, Raisen (M.P.) India

Kapil Soni
Head of Department
Department of Civil Engineering
Institute of Technology Aisect University, Raisen (M.P.) India