A Review Study To Analysis Of Partial Replacement Of Glass Powder And Fly Ash With Different-Different Percentages Of Cement To Improve The Compressive And Flexural Strength Of Concrete

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Abstract- *The ordinary material for construction is concrete in India and its production causes some environmental effects during the production. There are many countries seeing deficiency of human dumping wastes or it's becoming very serious day by day for each nation. In order to deal with atmospheric impact related with cement manufacturing and so there is a requirement to produce an alternative binding material for preparing concrete. The development of concrete could reducing the utilization of naturally occurring sources or lesser the load of pollutants on atmosphere. In current scenario, no. of researchers have recognized the uses of additional cementing materials like silica fumes, fly ash, glass powder, rice husk ash, blast furnace slag etc. Glass is an amorphous material which having high % of silica content. This property makes it probable pozzolanic property when its particles sizes is less than 75 mm. An important anxiety related to the uses of glass powder in concrete mix is that is chemical reaction happen among the alkali in pore solution and silica rich glass particle, which is called Alkali-Silicate. Reactions could be more harmful for the stability parameters of concrete, for this proper safety measure should be taken to reduce its effects. The addition of fly ash in glass concrete reducing the alkalies, silica reaction and improves the workability and durability of concrete. Unwanted glass powder is using for preparing concrete which leads environmental ecofriendly.*

Keywords- Silica fumes, Blast furnace, Rice husk, Glass powder, Fly ash, Compressive strengthening, Flexure strengthening

I. INTRODUCTION

Million tonnes of glass cullet are used for land filled throughout the world in every year. In 2005, around 12.8 millions tonne of glass cullet was used in land filled in United States. When unwanted glass is collecting and various colour glasses is frequently added. Then Mixed colour glasses couldn't be recycled since of mixing colouring agent result in an changeable and uncontrollable colour in the new glass. Large glass pieces can be effectively sorted by colour using optical sensors; however, sorting small glass pieces is not cost effective, and much of this non-recyclable glass cullet is land filled. In the United Kingdom for example, 1.65 million tonnes of unwanted glasses are discarded per year due to their inability to be recycled. As far as the economic and environmental effects of landfills are concerned. One of the possible ways of reusing millions of tonnes of glass cullet each year as aggregate or supplementary cementitious material is in the concrete industry. The majority of crushed glass research has concentrated on its use as fine aggregates in concrete. However, the use of glass as a fine aggregate substitute in concrete has been restricted due to concerns about alkali-silica reaction (ASR). Several studies shows that if ground finely enough, glass acts pozzolanically with a surface area of more than 300 m2/kg [4-9]. The pozzolanic reaction occurs when amorphous silica in the SCM reacts with calcium hydroxide (CH), which is produced as a by-product of the cement reaction, and water to form more calcium silicate hydrate. The majority of research on the impact of glass cullet on cementitious mixtures as SCM based on mechanical and chemical properties. Increases Long-term compressive strength, flexural strength, resistance to ASR and sulphate attack, and a reduction in water sorptivity of concrete containing finely ground glass powder have all been observed in concrete containing finely ground glass powder. Furthermore, some research found that finely ground glass powder had mechanical properties comparable to or slightly better than fly ash and slag at later ages, but much less than silica fume.

II. MATERIALS

The materials used in concrete mix projects are cement, fine aggregate, coarse aggregate, Fly ash, Glass Powder as described in detail below:

1. Concrete Composition: The most important purpose of this research is to calculate the effect on the mechanical properties of concrete when OPC is partially replaced by 10%, 20%, 30% and 40% of glass powder, fly-ash and their combinations. Different material and experimental tests are performed to check the quality of concrete. The materials should be appropriate for future use in concrete or doesn't hold harmful ingredients in some amounts that can damage the quality or durability of the concrete.

2. Cement: its one of the main imprtant component of concrete, since the binding medium for the distinct ingredients is created. Produced from naturally occurring raw materials and then mixing with toxic waste or underground. For the analysis, OPC 53 grades of Ordinary Portland Cement (OPC) conforming to IS12269-1987 were used. The mix configuration is made with ordinary Portland cement of grade 43. Concrete's most essential component is cement. The ability of cement to create improved microstructure in concrete is one of the most important criteria for cement selection. The hard Cement of Grade 43 was used in this analysis. Since it is an essential ingredient of concrete, mortar, stucco, and most non-specialty grout, Portland cement (often referred to as OPC, from ordinary Portland cement) is the most common form of cement in general use around the world.

3. Fine Aggregate: Aggregates that cover almost 70 to 75 % concrete volume are often used in more than one way as inert ingredients. This is well known now a day, however, that the (i) physical (ii) chemical (iii) thermal properties of aggregates drastically affect the property of 23 mm and concrete results. To extract all pebbles, fine aggregates (sand) use as fresh dry sand sewn in a 4.75 mm sieve. Clean river sand of maximum size 4.75 mm used such as fine aggregate.

4. Coarse Aggregate: For making concrete, coarse aggregate is used. They are generally in form of irregular broken stone, or gravel that naturally occurs. Coarse aggregates are called material that is wide to be held at 4.75 mm sieve size. Up to 20 mm may be its maximum span. And angular aggregate of size between 4.75mm to 20 mm is used as coarse aggregate.

5. Water: water plays an important role as it engages in a heat of hydration with cement. In concreting water is present in the form of gel which help to increase the concrete's strength. For mixing, portable water is usually considered satisfactory. The pH value of water shall not be lower than the maximum allowable values expressed in the following concentrations.

a) Limits of acidity: Not more than 5 ml of 0.02 NaOH should be needed to neutralize a 100 ml solution of water using phenolphthalein as an indicator. The test details are as stated in IS 3025.

b) Limits of alkalinity: Using a mixed indicator, neutralizing a 100 ml solution of water does not need more than 25 ml of 0.02 natural H2SO4. The specifics of the tests are as stated in IS 3025.

c) Percentage of solids: When measured in compliance with IS 3025, the maximum allowable limits of solids are as set out in IS 3025.

a) The chemical and physical properties of groundwater shall be tested in conjunction with the soil investigation and if there is no water found to comply with the necessities of IS 456-2000, it shall be clearly specified in the tender documents that contractor has to organize for the construction of good quality water indicating the source.
b) Water is to be found satisfactory for mixing as well as curing. For curing water shall not, however, create on the surface any undesirable stain or unsightly deposit.
c) For mixing or curing, sea water must not be used.
d) Water available for every source is to be tested before start any construction work and every three months thereafter until the end of work. In case of groundwater, different test can also be performed for a separate drawdown point.

6. Fly ash: Fly ash is finely divided residue consequential from the combustion of pulverized coal and transported by the flue gases of boilers by pulverized coal. It was obtained from thermal power station, dried and used. In this experiment fly ash having particle sizes not more than 90 μ is used. Mineral admixtures like fly ash are generally adding in much more quantity in concrete to improve the workability of freshen concrete and also improving fire resistance in concrete by which thermal cracking doesn't occur, alkali-aggregate expansion, and sulphate attack; or to permit a reduction in cement content. F class fly ah is the highest classification. In this analysis, fly ash was obtained from the Century pulp and paper mill in Lalkuan, Uttarakhand. The specific gravity and fineness modulus of the fly ash were both poor, at 1.975 and 1.195, respectively.. Fly ash, otherwise called flue-ash, it may be noticeable among the residues created under combustion, and comprises those fine particles that rise with flue gases. Ash that doesn't rise is called bottom ash. In mechanical context, fly ash typically alludes with burning of coal. Fly ash is obtained by electrostatic precipitators and suction pumps before the gasses goes through coal-fired power plant's chimneys. Since, its depending on the source of the coal burning continuously and the contents for fly ash particles.

7. Glass Powder: Locally available glass is collected and converted into powder form. This material replace the cement in different % . Before adding glass powder in the concrete, it has to be powdered to required size. In this experiment glass powder particle sizes not more than 90 μ is used. Glass being transparent material produced by melting a mixture of silica, soda ash, and CaCO3 at temperature emulated by cooling during which hardening happens without crystallization. Glass products are normally used in our daily fabricated items. Since the increase of waste glass leads over the recent years and these waste glass pieces have been dumped and occasionally not in use. The waste glass fill areas are not in use since glass is less eco-friendly and is not biodegradable. The glass powder which is used in this analysis was purchased from a market in Kolkata. In the mix, this substance takes the place of cement. Glass is a completely recyclable material in theory; it can be recycled without losing its consistency. There are numerous examples of waste glass being successfully recycled: as cullet in glass making, as a raw material for the manufacture of abrasives, and so on, in sandblasting, as a pozzolanic additive, in road beds, pavement, and parking lots, as raw materials for making glass pellets or beads for highway reflective paint, to make fibre glass, and as fractionators for lighting matches and shooting ammunition

Glass is an amorphous (non-crystalline) substance that is essentially a supercooled liquid rather than a solid.

- Glass can be manufactured in a range of shapes and sizes, from small fibres to meter-sized parts, with excellent homogeneity.
- Glass is primarily composed of sand, soda ash, limestone, and other additives (Iron, Chromium, Alumina, Lead and Cobalt).
- Glass has been used as an aggregate in road, house, and masonry construction.

Source of Glass–

- Sand is circulated into three different size screens of various sizes.
- The best sand produces the best glass. The toughest glass is made from the largest sand.
- Glass is made by melting sand in a crucible.

Sources of waste glass

- Glass food and beverage containers are a common source of waste glass, as are window repair shops.
    - Decorative glass pieces
    - Electric bulbs and old tube lights
    - Glass polishing and manufacturing shop for glass windows and doors
- Application and properties of glass
    - Glass is a uniform amorphous solid material that forms when a viscous molten material cools rapidly below its glass transition temperature without allowing enough time for a normal crystal attice to form.
    - The most common type of glass is silica-based glass, which is used for windows, containers, and decorative items.
- Glass falls in the category of biologically inactive material that can be formed with very smooth and impervious surfaces.

III. OBJECTIVES

Comparison of different property like compressive strength, density of modified concrete, with partial replacement of standard concrete with Fly ash & waste glass powder.

- To analyze the effect on the strengthening of Fly ash & glass powder waste materials in concrete.
- Analysis the property of fresh concrete prepared by Fly ash & waste glass powder particle material replacement
- Using knowledge of the various parameters to work out the best result and secure concrete output.
- To safeguard the optimization natural resource, prices.

IV. LITERATURE SURVEY

Literature paper are based on the theme of strength parameter is to be adopted by the author and their literature.

M.D.A. Thomas, M.H. Shehata et al. have discovered that cementations blending of Portland cement, silica fume, and fly ash provide major benefits over binary cementitious blends, and even greater benefits than pure Portland cement.

Sandor Popovics et al. have investigated the Portland cement-fly ash-silica fumes system in concreting and over that adding silica fumes to fly ash cement mortar has many beneficial effects in conditions of strengthening, workability, and ultrasonic velocity test performance.

Jan Bijen et al. have investigated the benefits of adding copper slag or fly ash to OPC concrete in provisions of alkali-silica reaction and sulphate attack.

L. Lam, Y.L. Wong, and C.S. Poon et al. concluded in their study various Effects of fly ash and silica fumes on compressive and rupture behaviours of concrete that adding different percentages of fly ash and silica fumes to improving strength properties of concrete.

Tahir Gonen and Salih Yazicioglu et al. The impact of primary and secondary minerals admixture on small and large term performance of concrete was investigated, and lots of enhanced concreting property in freshen and hardened state were discovered.

Mateusz Radlinski, Jan Olek and Tommy Nantung. The causes of various proportions of ingredient in primary blending of mixing on scaling resistance of concrete in very least temperature was discovered in this investigational work and allowed causes of mix components and initial curing situation on the scaling resistance of primary concrete**..**

S.A. Barbhuiya, J.K. Gbagbo, M.I. Russeli, P.A.M. Basheer The properties of fly ash concrete customized with hydrated lime and silica fume were investigated, and it was discovered that adding some quantity of lime and silica fume improving concrete's early compressive strength as well as its long-term strength growth and durability.

Susan Bernal, Ruby De Gutierrez, Silvio Delvasto, Erich Rodriguez Research based on performance of an alkali-activated slag concrete reinforced with steel fibres was carried out. The established AASC has high compressive strengthening than Ordinary Portland cement concretes, according to their findings. The addition of fibres increases the splitting tensile strengthening of both OPCC and AASC concretes after 28th days of curing period.

Hisham Qasrawi , Faisal Shalabi, Ibrahim Asi Done research on the use of unprocessed steel slag with a low CaO content as a fine aggregate in concrete. Their final result is that steel slag is most beneficial for lower strength concretes in condition of compressive and tensile strengthening.

M. Maslehuddin, Alfarabi M. Sharif, M. Shameem, M. Ibrahim and.S M Barry Done investigational work comparing the properties of steel slag and crushed limestone aggregate concretes, and came to the conclusion that the steel slag cement concrete had greater toughness characteristics than the crushed limestone aggregate concrete. Any of the physical property of concrete were superior than the crushed lime stones.

J. G. Cabrera and P. A. Claisse Experiments on oxygen and water vapours transfer to the paste were carried out, and it was concluded that although oxygen flow is defined by the Darcy equation, water vapour flow is not. Because of the various mechanisms of transport, oxygen transmission rates are much more variable than water vapour transmission rates, with some SF samples nearly impermeable to oxygen.

O. Boukendakdji, S. Kenai, E.H. Kadri, F. Rouis Effects of copper slag on the rheology of freshen self-compacted concrete was the subject of research. Slag, they conclude, will generate strong self-compacting concrete.

Tahir Gonen,Salih Yazicioglu carried The impact of different admixtures on small and large term performance of concrete was investigated, and this was establish that silica fume contributing to both small and large term properties of concrete, while fly ash have beneficial effect over a longer period of time. In terms of compressive strength, the addition of both silica fume and fly ash improved compressive strength significantly, but contributed more to the development of concrete's transport properties.

Houssam A. Toutanji and Tahar El-Korchi when increasing the compressive strengthening of cement mortar 6 contains silica fumes as half substitution for cement significantly contributing the strength of bonds among the cement paste or aggregate, according to investigational work on oxygen and water vapour transfer in cement pastes.. It was also discovered that combining a superplasticizer with silica fume is more efficient in mortar mixes than in paste mixes. It could be credited to most effective use of super plasticizer in mortar mix suitable to improved silica fume dispersion.

Jigar p. patel Done investigational work on the wider use of steel slag aggregate in concrete, and thus concluded that the main aim of this research was to determine the toughness of steel slag aggregates concrete in a freeze-thaw setting, as there was a perception that steel slag aggregates have expansive properties and would cause cracking in concrete.

R. D. Padhye et al (2016) Their findings revealed that fly ash may be replacing up to 40% of the time, and that replacements greater than 40% might not be safe for various concrete mixes. The compressive strengthening of concreting mix decreases as the quantity of fly ash in the mix increases.

Veena V. Bhat et al (2014) This study, they rendered concrete with different percentages of unwanted glass powder replacing cement, such as 5%, 10%, 15%, and 20%, and compared the freshen or hardened property of concrete to traditional concrete. When 20% of the cement in concrete is

substituted with glass powder or water/cement ratio is kept stable, then strengthening of concrete increasing by 27%. Even with 20% substitution, the slump was 70 to 72mm. Glass powder wills substitution of cement up to 20% of the time, depending on the strength requirements.

Dr. G.Vijayakumar et al (2013) Experiments on concrete prepared by partially replacing cement with unwanted glass powder by 10%, 20%, 30%, and 40% of the binder were carried out as part of their study. The compressive strengthening of cement is increased by 19.6%, 25.3 percent, and 33.7 percent, respectively, when glass powder is replaced by 20%, 30%, and 40%. The split tensile strengthening of cement is increased by 4.4 percent when glass powder is replaced by 40%. The flexural strengthening of cement is increased by 83.07 percent, 99.07 percent, and 100 percent, respectively, when glass powder is replaced by 20%, 30%, and 40%.

Y. S. Tai et. al. [2016] they mechanical examined the actions of high working steel fiber rounded in UHPC at different pullout speeds the experiment variables were steel fiber style matrix ingredients, and addition rates. In exacting, five variety of high strengthening steel fiber were used and five pullout rates from quasi-static to impact rates were applied. In addition, the effect of decreased quantity of glass fine particles, as key matrix constituent, on pullout behavior was explored. Investigational outcome explain that the addition reply of all of the fiber types exhibit increasingly rate sensitivity as the addition speed enlarges and turn into important through impact loading. It is mainly important in the soft and warped fibers and smallest amount in the hooked fibers. Also, examines electron microscope analyses are offered and used to make clear the machinery of rate augmentation from a microscopic perspective.

Anju Ramesan et. al. [2015] they studied about suitability of functions concrete of light weight with plastic aggregate. the weight appropriateness of recycled fibers a C.A. in concreting by performing different experiments similar to workability by slump test, compressive force of cube and cylinder, splitting tensile power analysis of cylinder, flexural strengthening of Reinforced cement concrete Beams, to find out the function and performance in concrete. Cause of substitute of C.A. with various percentages (0% to 40%) of plastic aggregate on behavior of concrete was investigational analysis and the finest particle replaced with of coarse aggregate was achieved. The outcome explained that adding of plastic aggregate to the concrete combination enhanced the material goods of the resulting mixture.

Sahil Verma et. al. [2015] they investigated about the use the waste fiber crushed bottles of suitable volume in concreting with half-done substitution of F.A.or it have the potential of dumping of massive quantity of catastrophic waste in a beneficial way. The ecological belongings could be significantly reducing by proper encaptsulaion of this unuseful plastic bottle. The analysis also provides the similarity of compressive strengthening of conventional concrete with the concrete made from the partial substitution of aggregates with Polyethylene Terephthalate bottles. Therefore concrete with waste polymers could be utilized as an efficient plastic waste organization performance in future.

B. Patnaik et .al. [2015] they learned about the power and durability elements of cement having copper waste as a half-done substitution of sand and results have been introduced in this paper. Two various types of Concrete Grade (M20 and M30) were utilized with various extents of copper slag substitution (0 to half) in the solid concrete. Strength and Durability properties, for example, sulfate resistivity, compressive strengthening, flexural strengthening, were assessed for both blends of cement concrete. test results clarifies that the strength elements of cement concrete having copper slag as a halfway replacement of Sand (up to 40%) in cement concrete however as far as of stability the solid concrete discovered to be low impervious to corrosive assault and better opposition against sulfate attack.

V. CONCLUSION

In this chapter will present a conclusion outlining the main findings as well as possible recommendation for additional research. This research has helps to identify factor causes of Fly ash & Glass Powder waste replacing with cement in concrete.

Following assumptions are to be taken for this analysis is as follows:

1. A Fly ash & Glass Powder waste is such type of waste used as a substitute to Cement in concrete.
2. From this analysis, fly ash & Glass Powder waste particles are used because it is low cost material which would help to resolve solid waste disposal problem or save atmosphere from pollution.
3. Concrete manufacturing cost reduces when in concreting cement replaced by Fly ash & Glass Powder waste.
4. More Amount of Fly ash & Glass Powder waste increasing the density of mix so its directly increase the Self-weight of mix.

5. The Compressive Strengthening of mix with half substitute of cement with Fly ash & Glass Powder waste up to 20% can be comparable with conventional Concrete.

Partial substitution of Fly ash & Glass Powder waste in mix shows good resistance against sulphate attack.

REFERENCES

[1] IS: 516 (1959). "Indian Standard methods of tests for strength of concrete." Bureau of Indian standards, ManakBhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[2] IS: 4031 (1996). "Indian Standard method of physical tests for hydraulic cement." Bureau of Indian standards, ManakBhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[3] IS: 456 (2000). "Indian Standard Plain and Reinforced Concrete Code of Practice." Bureau of Indian standards, ManakBhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[4] IS: 10262 (1982) (Reaffirmed 2004). "Recommended Guidelines for Concrete Mix Bureau of Indian standards, ManakBhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[5] Ghambhir, M. L. (2003). Concrete Technology (2nd edition), Huang, B., Li, G., Pang, S., and Eggers, J., (2004). "Investigation into Waste Tire Rubber- Filled Concrete. Journal of Materials in Civil Engineering, 16(3), 187-194.

[6] IS: 383 (1970). "Indian Standard Specification for Coarse and Fine Aggregates from Natural Sources for Concrete (Second Revision)." Bureau of Indian standards, ManakBhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002.

[7] O. Olanike, "A Comparative Analysis of Modulus of Rupture and Splitting Tensile Strength of Recycled Aggregate Concrete", American Journal of Engineering Research e-ISSN: 2320-0847, Volume-03, Issue-02, pp-141-147, 2014.

[8] Anju Ramesan, Shemy S. Babu, Aswathy Lal, "Performance of light weight concrete with plastic aggregate", International Journal of Engineering Research and Applications, Vol. 5, Issue 8, August 2015, pp.105-110.

[9] Binaya Patnaik, Seshadri Sekhar.T, Srinivasa Rao, "Strength and Durability Properties Of Copper Slag Admixed Concrete" International Journal of Research in Engineering and Technology, e-ISSN: 2319-1163, p-ISSN: 2321-7308, Volume 4, Issue 1, Feb 2015.

[10] Chinmay buddhadev, Jayesh kumar pitroda, Prof. Chetna m. Vyas, "A review of innovative use of copper slag and foundry sand in design mix concrete" Journal Of International Academic Research For Multidisciplinary,Impact Factor 1.625, ISSN: 2320-5083, Volume 2, Issue 12, January 2015.

[11] Jeffrey W. Bullard , Hamlin M. Jennings, Richard A. Livingston, Andre Nonat, George W. Scherer, Jeffrey S. Schweitzer, Karen L. Scrivener, Jeffrey J. Thomas, "Mechanisms of cement hydration" , Elsevier 2011.

[12] K. Wille, S. El-Tawil, A.E. Naaman, "Properties of strain hardening ultra high performance fiber reinforced concrete (UHP-FRC) under direct tensile loading", Elsevier, 2014.

[13] Khalid Raza, Apoorv Singh, R. D. Patel, "Strength Analysis of Concrete by Using Iron Slag as A Partial Replacement of Normal Aggregate in Concrete", International Journal of Science and Research, ISSN: 2319-7064, Volume 3 Issue 10, October 2014.

[14] Kittinun Sirijaroonchai, Sherif El-Tawil, Gustavo Parra-Montesinos, "behavior of high performance fiber reinforced cement composites under multi-axial compressive loading", Elsevier, 2010.

[15] M.A.Rasheed, S. Suriya Prakash, "mechanical behavior of sustainable hybrid-synthetic fiber reinforced cellular light weight concrete for structural applications of masonry", Elsevier, 2015.

[16] M.C.G. Juenger, Rafat Siddique, "Recent advances in understanding the role of supplementary cementitious materials in concrete", Elsevier 2015.

[17] M. Etxeberria, E. Vázquez, A. Marí, M. Barra, "Influence of amount of recycled coarse aggregates and production process on properties of recycled aggregate concrete", Elsevier 2007.

[18] M.Chockalingam, D.Jayganesh, J.Vijayaraghavan, Dr.J.Jegan, "Scope for Reuse of Copper Slag in Concrete", International Journal of Civil Enigneering and Technology, e-ISSN: 0976-6316, Volume 4, Issue 6, 2013.

[19] P.F. Castro, A. Mendes Neto, "Assessing strength variability of concrete structural elements", 8th International Conference of the Slovenian Society for Non-Destructive Testing, Sep. 2005.

[20] Pranshu Saxena, Ashish Simalti, "Scope of Replacing Fine Aggregate With Copper Slag In Concrete" International Journal of Technical Research and Applications, e-ISSN: 2320-8163, Volume 3, Issue 4, August 2015, PP. 44-48.

[21] S.W. Tang, Y. Yao, C. Andrade, Z.J. Li, "Recent durability studies on concrete structure", Elsevier, 2015.

[22] Sahil Verma, Sahil Arora, "Replacement of Natural Sand in Concrete by Polyethylene Bottles" International

Research Journal of Engineering and Technology (IRJET), Volume: 02 Issue: 01, Apr-2015.