AN EXPERIMENTAL IVESTIGATION OF PARTIAL REPLACEMENT OF CEMENT BY USING GLASS POWDER IN CONCRETE

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Abstract – *Green house gases,such as CO2 causes global warming to the atmosphere.Among the green house gases,CO2 contributes about 65% of global warming.The global cement industries contributes about 7% of green house gas emission to the earth's atmosphere.Consequently efforts have been made in the concrete industry to use waste material as partial replacement of coarse or fine aggregates and cement.Waste glass is one material when ground to a very fine powder shows pozzolanic properties which can be used as a partial replacement for cement in concrete. An attempt have been made to find out the strenghth of concrete containing waste glass powder as a partial replacement of cement for concrete.Cement replacement by glass powder ranging from 5% to 40% increment of 5% have been studied.A test was conducted for testing compressive strength and flexural strength at the age of 7,28 and 90 days and compared with those of conventional concrete .Results showing that replacement of 20% cement by glass powder was found to have higher strength.*

Key Words: Concrete,Glass powder,Strength

1. INTRODUCTION

The interest in the construction community in using waste or recycled materials in concrete is increasing because of the emphasis placed on the sustainable construction,the waste glass from the in and around of small shops is packed as a waste and disposed as landfill.Glass is an inert material which could be recycled and used many times without changing its chemical property.Besides using waste glass as cullet in glass manufacturing ,waste glass is crushed into specified sizes for use as aggregate in various applications such as water applications such as water filtration,grit plastering ,sand cover for sport turf and sand replacement in concrete.Since the demand in the concrete manufacturing is increasing day by day, the utilization of riversand as fine aggregate leads to exploitation of natural resources,lowering of water table, sinking of the bridge piers,etc as common treat.Attempts has been made in using crushed glass as fine aggregate in the replacement of river sand.The crushed glass was also used as coarse aggregates in concrete production but due to its flat and elongated nature which enhances the decrease in the workability and attributed the drop of compressive strength.Glass is amorphous material having high silica content,thus making it potentially pozzolanic when particle size is less than 75µm.Studies have shown that finely ground glass doesnot contribute to alkali-silica reaction.A major concern regarding the use of glass in concrete is the chemical reaction that takes place between the silica-rich glass particle and the alkali in pore solution of concrete,which is called Alkali-Silicate reaction can be very detrimental to the stability of concrete ,unless appropriate precautions are taken to mimimize effects.ASR can be prevented or reduced by adding mineral admixtures in the concrete mixture,common mineral admixtures used to minimize ASR are pulverized fuel ash(PFA),Silica fume (SF) and metkaolin(MK).Glass has a high silica content has led to laboratory studies on its feasibility as a raw material in cement manufacture.The use of finely divided glass powder as a cement replacement material has yielded optimal results.Optimal range of this glass powder is chosen based on cement paste studies.

1.1 MATERIALS AND METHODS

i. Cement, water and Aggregates: Concrete has been prepared by mixing various constituents like cement, aggregates, water etc. which are been economically available. Ordinary Portland cement of 43 grade conforming to IS 8112 was used throughout in the work. The fine aggregate used in this investigation was clean for river sand, whose maximum size is 4.75 mm, conforming to grading zone II. Machine crushed blue granite stone angular in shape was used as the coarse aggregate. Two size of coarse is used; one 16 mm passing through 12.5 mm retained and other 25 mm passing through 20mm retained. As per IS: 2386 – 1963 recommendations the following properties of the coarse aggregates were determined.

ii. Glass powder: Waste glass is available locally in Pondicherry shops is been collected and made into glass powder. Glass waste is very hard material. Before adding the glass powder in the concrete it has to be powdered to desired size. In this studies glass powder ground in ball/pulverizer for a period of 30 to 60 minutes have resulted in particle sizes less than size 150 µm and sieved in 75 µm.

iii. Superplasticizers: Also known as high range water reducers, are chemical admixtures used where well-dispersed particle suspension is required. These polymers are used as dispersants to avoid particle segregation, and to improve the flow characteristics of suspensions such as in concrete application.

1.2 TESTING OF MATERIALS

Sl.no	Laboratory tests	Values
1	Fineness of cement	5.5%
2	Consistency	32%
3	Initial setting time of cement	38 minute
4	Specific Gravity	3.15

Sl.no	Laboratory tests	Values
Test for fine aggregate		
1	Specific gravity	2.67
2	Bulk density	1.75kg/l
Test for coarse aggregates		
1	Specific gravity	2.74
2	Bulk density	1.65 g/l

2. MIX DESIGN

The grade of concrete used is of M_{30} mix. Tests done with constant strength for conventional mix of strength of 30N/mm^2.Mix design calculation done as per IS 10262:2009.Based on percentage of glass powder used the strength and density of conventional concrete mix will get vary.

2.1 DESIGN DATA

The Characteristic compressive strength required in the field at 28 days is 30N/mm^2.The maximum size of aggregate is 20mm. The specific gravity of fine aggregate is 2.79.Specific gravity of coarse aggregate is 2.73.Specific gravity of cement is about 3.15.Degree of quality control is of good and type of exposure is severe.The target mean compressive strength at 28 days is about 38.25 Mpa.Strength of concrete mainly depends upon the strength of cement paste.The strength of paste increases with cement content decreases with water content.It is desirable to establish a relation between concrete strength and free water cement with materials and conditions to be used.Thus water cement ratio adopted is 0.45.The ratio obtained by the mix calculation .For the above mixes the fresh concrete properties and the harden concrete properties studies include compressive test and flexural test.

2.2 RESULT

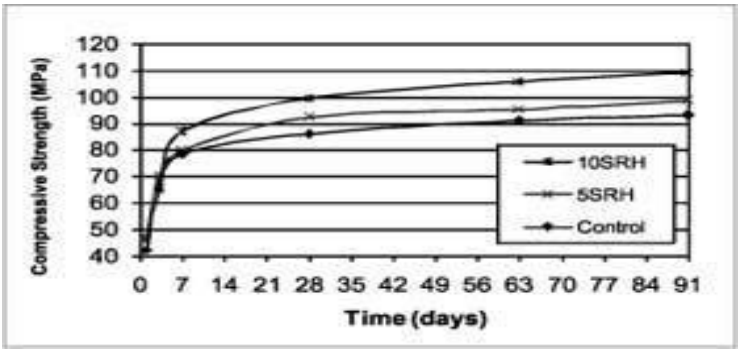


Fig:2.2.Variation of compressive strength development in concrete.

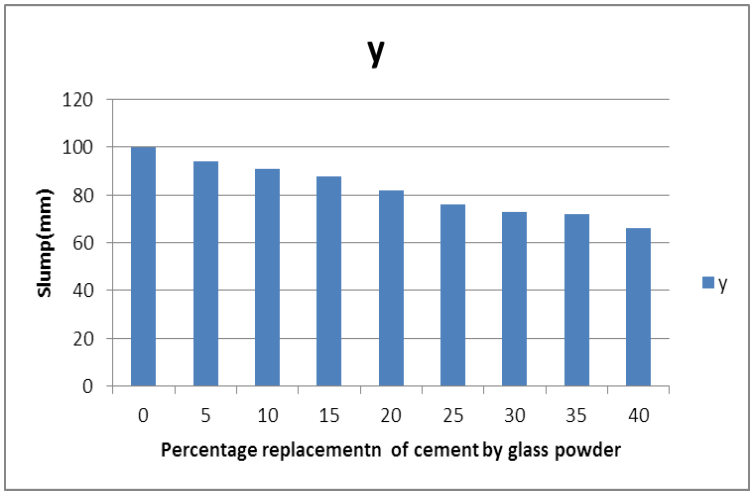
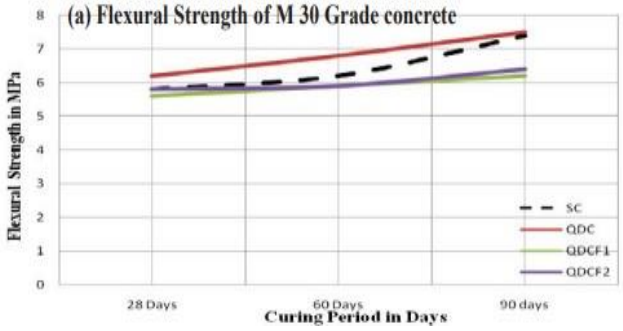


Fig:2.3.Variation of slump of concrete with cement replacement by glass powder.



3. CONCLUSIONS

Based on experimental observations, the following results are drawn:

- As the percentage of glass powder increases the workability decrease.Use of superplasticizer was found necessary to maintain workability with restricted watercement ratio
- Compressive strength increases with increase in percentage of glass powder upto 20% replacement and beyond 20% strength drops down.
- Considering the strength criteria ,the replacement of cement by glass powder is feasible.Therefore we can conclude that the utilization of waste glass powder in concrete as cement replacement is possible.
- Very finely ground glass has been shown to beexcellent filler and may have sufficient pozzolonic properties to serve as partial cement replacement,the effect of ASR (Alkali silica reaction) appear to be reduced with the finer glass particles,with the replacement level.

REFERENCES

1) Bajad,M.N. and Modhera,C.d.(2010). “Experimental Investigation in Developing Concrete Containing Waste Glass Powder As Pozzolana”.

2) Journal of Information,knowledge and research in Civil Engineering.

3) Shetty M.S.,(2006). “Concrete Technology Theory and Pratice” S.Chand and Company LTD., New Delhi.

4) Is 516(1959) Methods of test for strength of concrete,Bureau of Indian Standards, New Delhi.