Analysis of Waste Glass Powder as Pozzolanic Material in Concrete

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Abstract: Glass is used in many forms in day-to-day life. It has limited life span and after use it is either stock pile 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 failure and increase due to alkali-silica reaction. The research shows that there is strength loss due to fine aggregate replacement also.The aim of the present work was to use 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.

Keyword; Concrete,glass powder,cement,aggregate compressive strength.

I. INTRODUCTION

Concrete is a blend of cement, sand, coarse aggregate and water. The key factor that adds value to concrete is that it can be designed to resist harshest environments significant role. Today global warming and environmental waste have become manifest harms in recent years, concern about environmental issues, and a substitution from the mass-waste, mass-consumption, mass-production society of the past to a zero-release society is now viewed as significant. Normally glass does not harm the environment in any way because it does not give off pollutants, but it can harm humans as well as animals, if not dealt carefully and it is less friendly to environment because it is non-biodegradable. Glasses and its powder has been used as a construction material to decrease environmental problems. The coarse and fine glass aggregates could cause ASR(alkali-silica reaction) in concrete , but the glass powder could suppress their ASR tendency, an effect similar to supplementary cementations materials (SCMs). Therefore, glass is used as a replacement of supplementary cementitious materials.

2. Material and experimental study:

2.1 Material used:

Ordinary Portland cement used for this experiment was Vikram Premium ordinary Portland cement of grade 43 conforming to IS: 12269-1987. Coarse aggregate may be either gravel or crushed stone. Makes up 40%-45% of the mixture, comprised of particles greater than 1/4". Ordinary traditionally used gravel or commonly named as black metal was used for this experimental work. Numbers of test were conducted to check the suitability of the coarse aggregate in the concrete mix.

Fine aggregate normally called sand, this component can be natural sand or crushed stone, and represents particles smaller than 3/8". Generally accounts for 30%-35% of the mixture. Sand of zone 2 was used for this experimental work after performing the same test as on coarse aggregate.

Coarse Aggregate The aggregates which are retained over IS sieve 4.75 mm are called as coarse aggregate. The coarse aggregate used in the present study was nearby available crushed stones of maximum size of 10 mm.

Glass powder in this study flint glass powder is used. The particle size of powder is such s 99% passing with 150 micron and 95% with 90 micron IS sieve.

Table -1 Comparative physical properties of glass powder and cement Physical properties of glass powder and cement

Physical properties	Glass powder (%)	Cement (%)
Specific gravity	2.65	3.15
Fineness	100	96

Table -2 Comparative chemical properties of glass powder and cement

Chemical properties	Glass Powder (%)	Cement (%)
Cao	9.80	60 -65
SiO2	73.10	17 -25
Al2O3	1.33	3 -8
Fe2O3	0.65	0.5 -6
Mgo	3.50	0.1 -4
SO3	-	1.2 -3
Alkali's (K2O, Na2O)	11.2	0.4 -1.3

2.2 Mix proportioning and testing of specimen :

For this study M30 grade concrete mix have been designed according to the specification of IS: 10262-2009.the cement content in this mix is 410.42 kg/m3 and water cement ratio is 0.48.the actual proportion of mix obtained is 1:2:4 and cement is replaced in range of 10, 20, 30 and 40 %. No admixture used in this work.Total 11 numbers of cubes of size 150 mm x150 mm x150 mm are casted and tested in the standard compression testing machine at age of 7,14 and 28 days of curing. useful recycled materials, glasses and glass powder are mainly used in fields related to civil engineering, for example, in cement, as pozzolana(supplementary cementitious materials) , and coarse aggregate. Their recycling ratio is close to 100%, and it is also used in concrete without adverse effects in concrete durability . Therefore, it is considered ideal for recycling.

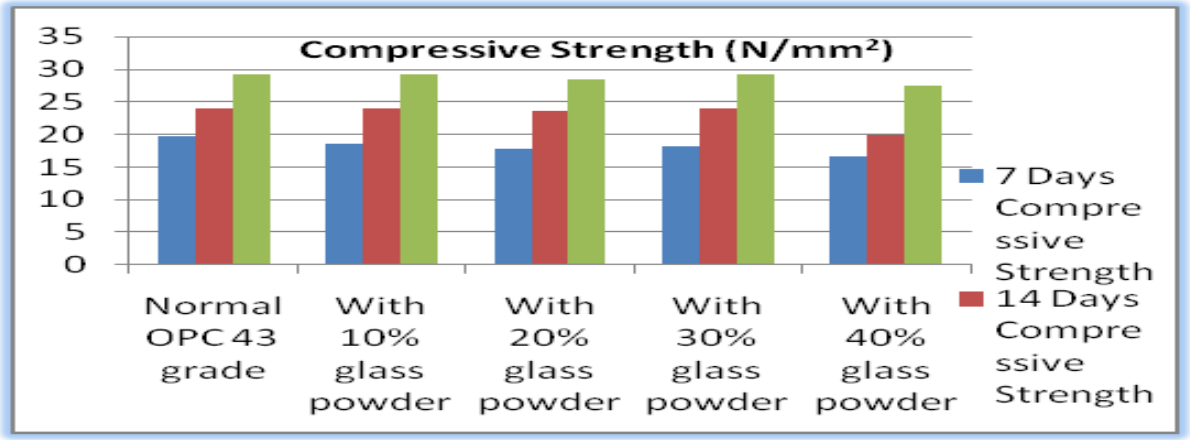

Chart -1: comparison of compressive strength of samples

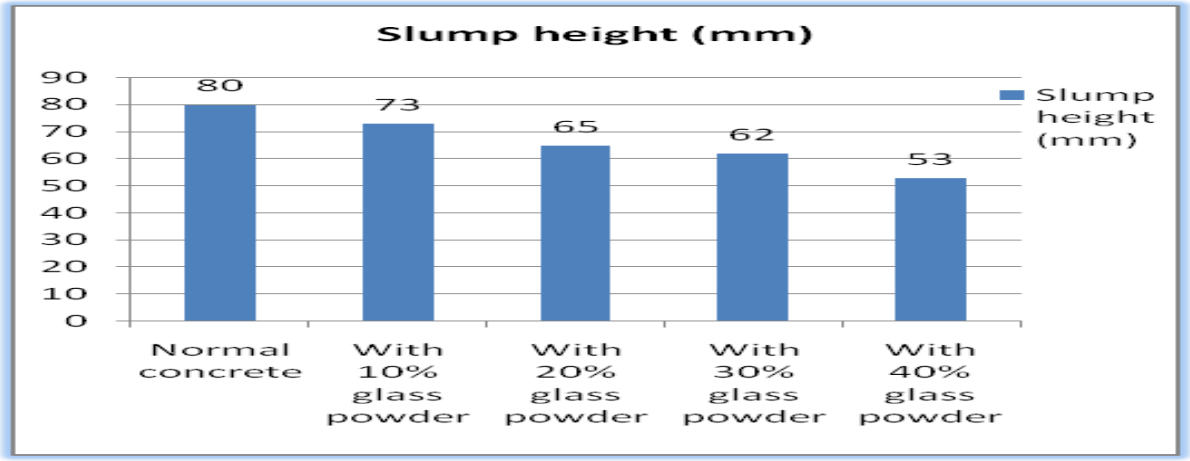

CHART -2: COMPARISON OF SLUMP VALUE OF SAMPLE

Fig -1: compression testing machine

3 .Results and discussion:

From the test results it is clear that percentage reduction in the slump value is 8.7%, 18.7%, 25% and 33% for the10, 20, 30 and 40 percent replacement of cement respectively. Which shows that water requirement of mix after adding glass powder is increases s the percentage of glass powder increases.The test results of 7 days of concrete cubes are 84%, 76%, 79% and 70% of normal mix for the 10%, 20%, 30% and 40% replacement of cement in mix respectively and results of 14 days are 93%, 92%, 92.5% and 84% for the10%, 20%, 30% and 40% replacement of cement which shows that glass powder have not been added early strength. Due to addition of glass powder strength at the initial ages of concrete is not fully obtained. The test results of 28 days compressive strength are 99%, 98.70% 99.60% and 95.5% of normal concrete mix for 10, 20, 30 and 40 percent replacement of cement with glass powder, it men at

the later age glass powdered concrete gin the sufficient strength and 30% replacement of cement give approximately equal strength to the normal concrete mix so that 30% glass powder is effectively used in concrete mix as a replacement of cement.

4. CONCLUSION

- Waste glass, if ground finer than 100µm shows a pozzolanic behavior.
- The smaller particle size of the glass powder has higher activity with lime resulting in higher compressive strength in the concrete mix.
- Compared to fly ash concrete, finer glass powder concrete had slightly higher early strength as well as late strength.
- Micro structural examination shows that glass powder produces a denser matrix which improves the durability property of concrete.
- The coefficient of capillary absorption test also indicates that incorporation of finer glass powder improves durability.
- Glass powder of size 150µm - 100µm exhibit initiation of alkali aggregate reaction. The presence of ettringite confirms this.
- The data presented in this study indicates that silica fume is best SCM. It gives highest compressive strength because of its smaller grain size and spherical shapes.
- The results obtained from the present study shows that there is great potential for the utilization of best glass powder in concrete as replacement of cement.
- The fine glass powder can be used as a replacement for expensive materials like silica fume and fly ash.

5. REFERENCES:

[1] Thanongsak, N., Watcharapong, W., and Chaipanich. A., (2009), "Utilization of fly ash with silica fume and properties of Portland cement-fly ash-silica fume concrete". Fuel, Volume 89, Issue 3, March 2010, Pages 768-774.

[2] Patel, A, Singh, S.P, Murmoo, M. (2009), "Evaluation of strength characteristics of steel slag hydrated matrix" Proceedings of Civil Engineering Conference-Innovation without limits (CEC-09), 1^{8th} - 1^{9th} September‟ 2009.

[3] Li Yun-feng, Yao Yan, Wang Ling, "Recycling of industrial waste and performance of steel slag green concrete", J. Cent. South Univ. Technol.(2009) 16: 8−0773, DOI: 10.1007/s11771-009-0128-x.

[4] Velosa, A.L, and Cachim, P.B.," Hydraulic lime based concrete: Strength development using a pozzolanic addition and different curing conditions" ,Construction and Building Construction Materials, Vol 23,Issue5,May2009,pp.2107-2111.

[5] Barbhuiya S.A., Gbagbo, J.K., Russeli, M.I., Basheer, P.A.M. "Properties of fly ash concrete modified with hydrated lime and silica fume", [a]Centre for Built Environment Research, School of Planning, Architecture and Civil Engineering, Queen‟s University Belfast, Northern Ireland BT7 1NN, United Kingdom Received 28 January 2009; revised 1 June 2009; accepted 3 June 2009. Available online 15 July 2009.

[6] Gonen,T. and Yazicioglu,S. " The influence of mineral admixtures on the short and long term performances of concrete" department of construction education, Firat University, Elazig 23119, Turkey.2009.

[7] Mateusz R.J. O. and Tommy N. " Effect of composition and Initial Curing Conditions of Ternary(OPC/FA/SF) concrete", Scaling Resistance of Journal of Materials in Civil Engineering © ASCE/October 2008, PP 668-677.

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