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UTILIZATION OF CONSTRUCTION AND DEMOLITION GLASS WASTE FOR M25 GRADE

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Abstract – *In this research work Glass powder which is come from broken pieces of waste glass of buildings and other structure construction and demolition waste are used as partial replacement material for ordinary Portland cement of 43-grade for producing concrete cubes. Glass powder based concrete cubes are cast practically and the strength of the concrete have been investigated and reported in terms of compression. Strength, workability and durability of waste glass powder replaced concrete can be comparable with the normal concrete. The present thesis work is aimed at concrete mix with partial replacement of glass powder by cement (0%, 10%, 20% and 30%) that will reduce the extra burden on the use of cement and also reduce the cost of construction. In this mix design behavior of fresh concrete and hardened concrete evaluated.*

Key Words: Glass powder, Ordinary Portland cement 43-grade, Concrete, Workability and Compressive strength.

1. INTRODUCTION

Disposal and safe collection of waste glass is one of the major problem. In our country glass waste generated from construction and demolition of building and other structure are not properly recycled but dumped in an open area. So, therefore this problem can be reduced by reusing the waste pieces of glass. In this research work glass powder which is produced from waste pieces of glass are used as a partial replacement with ordinary Portland cement of 43-grade in manufacturing of the concrete for M25 grade. Due to the high silica content glass powder shows the pozzolanic behaviour with the replacement on cement when particle size of glass is less than 90 micron. In this experimental investigation, we determine the optimum strength of concrete in hardened state and also workability of concrete using a varying proportion of glass powder with the replacement of cement and also determine the other physical properties of concrete and compare it with conventional concrete properties.

1.1 Objectives

1. To find out its utilization in the construction sector.
2. To relieve the extra burden on cement by replacing it with glass powder made from C & D waste.
3. To find out the comparison of a physical characteristic of cement with waste glass.
4. To detect the behavior of fresh and hardened concrete with waste glass.

1.2 Advantage over normal concrete

The normal concrete is vital and economical but the maintenance cost of normal concrete is large on the other hand if the concrete is replaced with glass waste then cost is less and also workability, durability, and strength is very precious as compared to normal concrete. Replacement of glass powder with cement in concrete improves the compressive strength and workability at less to moderate grade and proportions as compared to normal concrete. Glass waste betters the flow ability and durability at all ages of concrete. It gives the lighter section and less permeability at a hardened state. It reduce the extra burden on the use of cement

2. MATERIALS USED FOR EXPERIMENT

2.1 Cement

Ordinary Portland Cement of 43 Grade of company name Shree cement, available in the market was used for the experiment. Care has been taken to find that the cement was made in airtight containers from single batching to prevent it from the effect of atmospheric conditions. After that cement was tested and checked for physical properties such as standard consistency, initial and final setting time, fineness and compressive strength according to IS: 8112-2013. Calculated Specific gravity of cement was 3.15 obtained.

2.2 Glass powder

Waste glass finds from building demolition and construction was been collected and produced into the powder form. Waste pieces of glass were hard and strong material. These waste pieces of glass create problem in crushing so, therefore pulverize machine was used for making glass powder for a period of 30 to 40 minutes which were resulted in particle size less than 150 microns and sieved over 90 micron. Glass is transparent and made by melting of materials such as soda ash, silica and CaCO3 at higher

temperature and after that cooling was done for solidification. Specific gravity and water absorption of glass powder was 2.57 and 1.24%.

Fig-1: Glass powder

Table-1: Chemical composition

Composition (% by mass)	Glass powder	Cement
Silica (SIO_2)	72.2%	20.2%
Sodium oxide (Na_2O)	13.8%	0.19%
Iron oxide (Fe_2O_3)	0.4%	3.9%
Alumina (Al_2O_3)	0.5%	4.7%
Magnesium oxide (MgO)	3.6%	2.6%
Calcium oxide (CaO)	9.4%	61.9%
Potassium oxide (K_2O)	0.1%	0.82%
Sulphur trioxide (SO_3)	-	3%

2.3 Coarse aggregate

Coarse aggregates of size 10mm and 20mm collects from nearly situated crushing plants was used. As per IS: 383-1970 Sieves of 40mm, 20mm, 12.5mm, 10mm, 4.75mm and 2.36mm were used for gradation of the coarse aggregate of 10mm and 20mm. The aggregates were checked and tested for their physical requirements such as specific gravity, gradation impact value, water absorption and bulk density according to IS: 2386-1963. Calculated specific gravity was 2.66 and calculated water absorption was 0.12%.

2.4. Fine aggregate

Sand of Banas river available nearby was used in the experiment. Sand is granular material available naturally and is mainly consist of mineral particle and rock particle. The most important part of sand is silica (SiO2) and is known as quartz. The selected river sand belongs to grading zone II. As per IS: 383- 1970 IS sieve of 10mm, 4.75mm, 2.36mm, 1.18mm, 600mic, 300mic and 150mic were used for gradation of fine aggregate. The fine aggregates were tested for their physical properties such as specific gravity, gradation, water absorption and bulk density according to IS: 2386-1963. Calculated specific gravity and water absorption were 2.61 and 1.10% obtained.

2.5 Admixture

Kavassu plast sp-431 company super-plasticizer was used for making concrete cubes as an admixture. It is a water reducing chemical in concrete and chloride free super-plasticizer. It gives high workability to concrete mixes and can also be used for producing higher early and final strengths. It is a black and brown liquid.

2.6 Water

Water plays a very important role in taking the strength of concrete. It helps in complete hydration process of concrete. Clean and fresh water which is free from any type of visible impurities was used in the experiment.

3. EXPERIMENTAL WORK

3.1 Mix design

Concrete Mix design as per IS: 10262- 2009 for M25 grade having proportion of (cement : Coarse aggregate 10mm : Coarse aggregate 20mm : Fine aggregate : Admixture : Water) 1.21 : 1.39 : 2.12 : 2.76 : 0.009 : 0616 in kg was prepared. The calculated target mean strength was 31.6 Mpa and water cement ratio was 0.48. Concrete were casted with partial replacement of cement with 0%, 10%, 20% and 30%.

3.2 Casting of cube

Total of 15 types of mixes were casted in this experiment for compressive strength test. The size of the formwork used to produce the samples was the cubical size of 150mm x 150mm x 150mm. All specimens were operated for 7 and 28 days curing time. Cement was replaced by 10%, 20% and 30% of glass powder. Mix proportion for % replacement of glass powder with cement

Table-2: Mix proportion for % replacement of glass powder with cement

Ingredients (kg)	0%	10%	20%	30%
Cement	1.21	1.089	0.968	0.847
Glass powder	0	0.121	0.242	0.363
Coarse aggregate 10mm	1.39	1.39	1.39	1.39
Coarse aggregate 20mm	2.12	2.12	2.12	2.12
Fine aggregate	2.76	2.76	2.76	2.76
Admixture	0.009	0.009	0.009	0.009
Water	0.616	0.616	0.616	0.616

3.3 Test on concrete

(i) Test on fresh concrete

Slump cone test was conducted to determine the workability of concrete in this experiment. Equipment required for this test is the mould for slump test, measurement scale, base plate, temping rod etc. Mould in the shape of frustum of a cone having bottom diameter 20cm, top diameter 10cm and height 30cm were used. Steel temping rod of 16mm diameter and 60cm long were used.

(ii) Test on hardened concrete

For detecting the strength of hardened concrete compressive strength test was conducted. As per IS: 516- 1959 Compressive strength of all concrete mix of the cubical mould of size 150mm X 150mm X 150mm were determined. The cubical mould was tested after 7 and 28 days period of curing fully underwater.

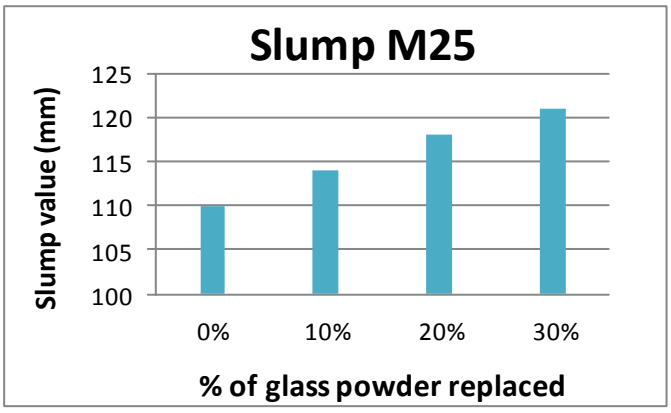
4. RESULTS

4.1 Fresh concrete result

Slump test was used to determined workability of fresh concrete mix in the experimental work. Slump value of all three types of replaced mix concrete was shown in the table and also graphically.

Table-3: Slump value on replacement of GP into cement for M25 grade

Sr. No.	% replacement of glass powder with cement	Initial height (mm)	Slump (mm)
1.	0%	300	110
2.	10%	300	114
3.	20%	300	118
4.	30%	300	121



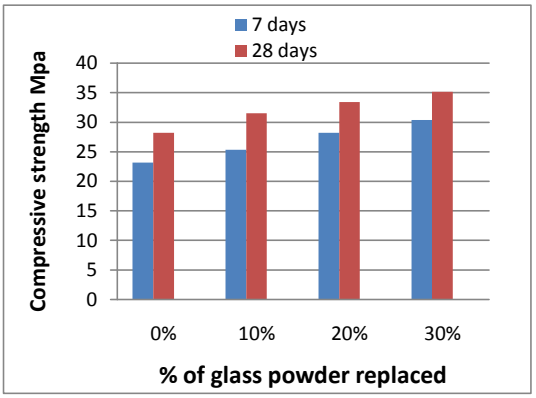
Graph-1: Effect of glass powder on slump of concrete

4.1 Hardened concrete result

Test on the compressive strength of the concrete was conducted to detect the physical properties of hardened concrete. In the test load carrying capacity of the concrete cubes was determined. The cubical mould was tested after 7 and 28 days period of curing fully underwater.

Table-4: Compressive strength of cube at 7 and 28 days on replacement of glass powder with cement

% replacement of glass powder with cement	At 7 days compressive strength Mpa	At 28 days compressive strength Mpa
0%	23.14	28.18
10%	25.32	31.50
20%	28.20	33.37
30%	30.33	35.12



Graph-2: Compressive strength of concrete for 7 and 28 days on replacement of glass powder with cement

7. CONCLUSIONS

This research work has shown the use of waste glass in producing concrete/mortar can provide an alternative way to relieve the environmental impact due to uneven disposal of C & D waste and also reducing the extra consumption of raw materials. The following conclusion is drawn from the present experimental work are:

1. Water absorption percentage decreases when glass powder content increases in cement. Glass powder shows the pozzolanic behavior with cement.
2. For better workability, a super plasticizer was used which results in a significant increment of workability.
3. Due to the lower water demand of glass powder slump value of concrete mix up to 30% replacement sluggishly increases and the value of slump was

121mm as compared to slump value of standard control mix 110mm in M25 grade of concrete.

4. At 7 days compressive strength of concrete in which glass powder replaced with cement was found to sluggishly increase in strength up to 30% replacement and the value of strength at 30% was 30.33N/mm2 as compare to standard control mix of M25 grade (23.14N/mm2). High variation in percentage was found as 10.2% for M25 grade.
5. At 28 days compressive strength of concrete in which glass powder replaced with cement was found to sluggishly increase in strength up to 30% replacement and the value of strength at 30% was 36.12 N/mm2 as compared to standard control mix of M25 grade (28.18 N/mm2). High variation in percentage was found as 10.5% for M25 grade.
6. The Surface finish of Cubes cast with glass powder and plywood dust was smooth and better than the surface finish of normal concrete cubes.

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