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Improvement of Concrete Strength Properties by Using Waste Glass Powder

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ABSTRACT: *In a growing country like India a huge amount of industrial waste are polluting the environmental. Every year, millions of tonnes of glass waste pose terrible problems related to the environmental condition all over the world. The glass is mainly composed of silica. Its use in concrete could be a beneficial solution for the environment and also economic problems. In addition the waste can improve the properties of construction materials. The recycled glass has been used in the form of powder. The glass powder was tested with concrete..*

In this Experimental work, the effect of partially replacing of waste glass powder in concrete is studied .The cement is replaced by waste glass powder in various percentages. (0%,10%,15%,20% and 25%) respectively by volume of cement .As shows the effect on compressive strength and flexural strength After curing 7days, 14 days and 28 days. The percentage of cement by waste glass powder increases at about 15% and later decreases. The workability of concrete reduces monotonically as the percentage increases.

Key Words -Concrete, Waste glass powder, Compressive strength, Flexural strength.

1 INTRODUCTION

The interest of the construction community in using waste or recycled materials in concrete is increasing because of the emphasis placed on sustainable construction, the waste glass from in and around the 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. In developing countries such as India, where the rapid urbanization are vigorously embarked upon to improve the standard of living, the major problem is environmental pollution by the increasing generation of domestic and industrial waste. Disposal of wastes has become a major problem in metropolitan areas in India, especially the disposal of waste glass generated from domestic and industry in the country.

This study has been conducted through basic experimental research in order to analyze the possibilities of waste glass used in construction work. If the large amount of waste materials generated is used instead of natural materials in the construction industry, there would be three benefits: conserving natural resources, disposing of waste materials and freeing up valuable land for uses others uses [Mahzuz.H.M.A. et AL 2011]. Glass is a common product that founds in different form of bottles, jars, windows and bulbs etc. therefore, the civil engineers have been challenged to convert this waste glass to useful building and other construction materials.

2 MATERIALS

2.1 Cement

Ordinary Portland cement of grade 43 is used. **(IS 8112)**

2.2 Fine Aggregate

Natural sand which passes through 4.75 mm IS sieve.

SP = 2.6 [Specific Gravity]

The sand used is of zone 1conforming to **(IS 383)**

2.3 Coarse Aggregate

Locally available 20mm and 10mm size crushed granite

SP= 2.87 [Specific Gravity]

Water Absorption 0.13%.

2.4 Waste Glass Powder

The commonly used glass of doors, windows, and decorative items is collected and converted into powder of desired size. Size is less than 90 micron.

Waste Glass Powder

2.5 Chemical Composition of Waste Glass Powder

Table 1. Chemical composition of the raw materials (weight %).

	Kaolin	Feldspar	Glass Powder	Quartz
SiO_2 (%)	46.960	67.020	70.0	99.810
Al_2O_3(%)	38.050	19.220	2.0	0.120
Fe_2O_3(%)	0.460	0.190	< 0.1	0.080
MnO (%)	0.008	0.007	-	0.002
CaO (%)	0.020	0.060	6.0	0.010
Na_2O (%)	0.030	3.750	20.0	0.030
K_2O (%)	1.140	9.420	-	0.060
TiO_2(%)	0.030	0.000	< 0.1%	0.073
P_2O_5(%)	0.108	0.035	-	0.020
LOI (%)	13.200	0.300	-	0.100
Total (%)	99.990	100.000	98.0	99.900

2.6 Water

Fresh water available in the laboratory is used in this work.

3 WORKABILITY TEST

The experimental program consists of following tests which were performed in this study.

3.1 STANDARD CONSISTENCY

- Standard consistency of cement is calculated using the vicat apparatus.
- In this test sample of cement is taken and weighed percentage of water is added to it.

- A paste is prepared and vicat plunger is released upon it.
- This procedure is followed till the plunger penetration is 33-35 mm from the top.

Table 1:- Standard Consistency Test Result:

Percentage of cement replaced by waste glass powder	Standard consistency (in %)
0%	30.25
10%	31.50
15%	31.75
20%	34.00
25%	35.50

RESULTS

In this study total of 45 cubical standard specimen of dimension 150X150X150mm and 10 cubical specimen of dimension 500X100X100mm is casted and compressive and flexural strength is tested.

The slump value taken is 100 mm.

Table 2:- Workability Test Result:

Percentage replacement of cement by glass powder	Slump Value (mm)
0%	89
10%	80
15%	76
20%	69
25%	64

Slump Test in Lab

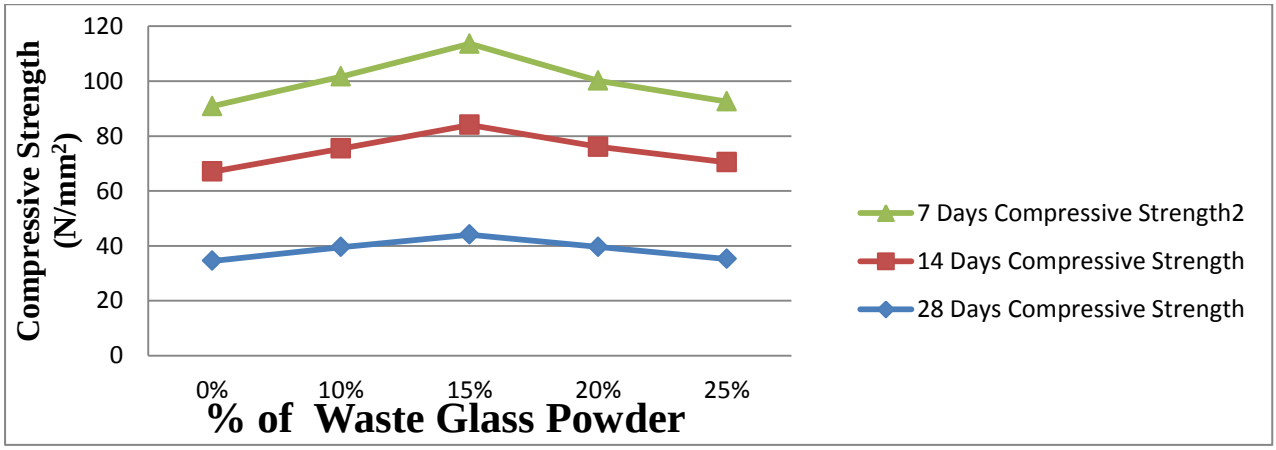
4 COMPRESSIVE STRENGTH TEST

The compressive strength of cubical specimen at 7 days, 14 days and 28 days is calculated. The compressive strength calculated is the average of strength of three cubical specimens that are casted for each proportion.

Table no. 3 Compressive Strength Results:

% of cement replaced	7 Days Compressive strength (N/mm²)	14 Days Compressive strength(N/mm²)	28 Days Compressive strength (N/mm²)
0%	23.80	32.54	34.51
10%	26.21	35.87	39.56
15%	29.54	40	44.08
20%	24.03	36.50	39.59
25%	22.17	35.07	35.21

Graph No.1 Graphical Representation of Compressive Strength Result:



5 FLEXURAL STRENGTH RESULTS:

The flexure strength is obtained for the beams. The beams were placed in CTM, bat the arrangement for that is different. Additional setups were installed in the CTM. It includes four points load setup, two at bottom side and two at upper side. The rate of loading was 0.1KN/Sec.

The flexure strength for the beam can be determined by using formula:

$\sigma_{c} = 3PL/4bd^2$ { if cracks occurs at the middle, third span of the beam.}

$\sigma_{c=} 3Pa/4bd^2$ {if the cracks occurs at the outer third span of the beam}

Where,

P= load in KN

L=length of beam

B=width of beam

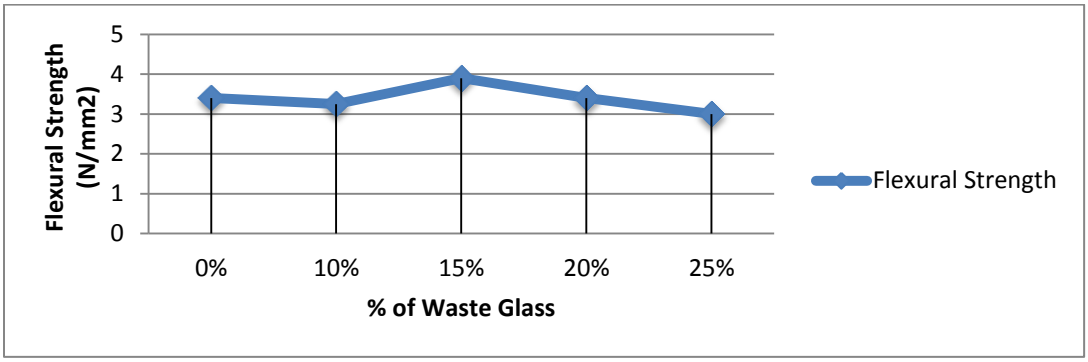
D=depth of beam

a = distance between cracks and the nearest support.

Table No. 4 Flexural Strength

Cement Replaced	Strength (N/mm²)
0%	3.4
10%	3.25
15%	3.9
20%	3.40
25%	3.00

Graph No.2 Graphical representation of flexural strength result:



6 CONCLUSIONS

- According to the analysis of the whole study on the comparison between control cubes and modified cubes.
- The workability gradually reduces from 0% to 25% as partial replacement of cement with waste glass powder is done
- At 15% partial replacement of cement by waste glass powder the compressive strength of concrete is same as that of control concrete at 7 days and 14 days and 28 days. At this replacement 28 days compressive strength is slightly more than control concrete.
- The flexural strength of concrete is maximum (i.e.3.9 N/mm²) when 15% partial replacement is done.
- The standard consistency of cement increases as waste glass powder is added to it.

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