



# Effects Of Milled Waste Glass On Properties Of Concrete

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**Abstract:** Concrete is the mostly used construction material. However, Cement, an essential constituent of concrete, its production leads to release of significant amount of CO<sub>2</sub>, a greenhouse gas. For the production of one ton of Portland cement approximately one ton of CO<sub>2</sub> with other greenhouse gases are created. The global cement industry emits about 7% of greenhouse gas to the atmosphere. As environmental issues are playing an important role towards sustainable development of cement and concrete industry so we need to replace cement by using waste material. One of the waste material is Glass. Tons of waste glass is being produced annually all over the world and this waste is disposed as landfills but as a matter of fact the waste of glass doesn't decompose in the environment. On one hand Large scale production of cement is causing environmental problems and on other hand depletion of natural resource. In this paper cement is been partially replaced by milled waste glass that is waste glass powder with the increment of 5% from 0% to 30%. Test was taken for Workability, Compressive and Flexural strength for 7 and 28 days and compared with the result of conventional concrete. So by getting good test results it shows that cement could be partially replaced by milled waste glass.

**Keywords:** Milled waste glass, Concrete, Partial replacement of cement.

## I. INTRODUCTION

Concrete is the most important content in building material. Strength, cost and durability of building is fully dependent upon it. Cement the most important material of concrete as its production causes harm to the environment, needs to be replaced. So the main aim of the project is to partially replace cement by milled waste glass. As waste glass is also one of the main causes of environmental pollution as it cannot be used as land filling. Recycling is one of the main solutions to use such type of waste so that it is safely converted and we can save our motherland.

Glass is an amorphous material which contains high silica which makes it potentially pozzolanic when particle size is less than 90 micron. By using waste glass powder in concrete production can make the construction industry more ecological. So waste glass when ground to a very fine particles shows pozzolanic property. As it contains SiO<sub>2</sub> it may improve strength by partially replacing cement by milled (ground) waste glass in concrete. Experimental studies have shown that finely ground glass does not lead to alkali-silica reaction.

So in this paper, milled (ground) waste glass are used as a partial replacement of cement in concrete by interval of 5% ranging from 5 to 30% and tested for compressive and flexural strength. These results are then compared with the results of conventional concrete.

## II. MATERIAL USED

**A. Cement:** The cement used in this study was 53 grade ordinary Portland cement confirming to IS 8112-1989.

**B. Fine Aggregate:** In this study locally available sand was used confirming to zone II with specific gravity 2.66. The test on sand was also conducted as per Indian Standard Specification IS: 383-1970.

**C. Coarse Aggregate:** Coarse aggregate was used of 20mm and less size with specific gravity 2.70. Test on coarse aggregate was also conducted as per Indian Standard Specification IS: 383-1970.

**D. Water:** In this study potable water was used confirming to IS 456: 2000.

**E Glass:** In this experiment glass powder which is having particle size less than 90 micron was used. The Glass powder was used as a partial replacement of cement.

Table 1: Chemical composition of glass powder

Composition	Glass Powder (%)
Silica (SiO <sub>2</sub> )	98.01
Aluminium Oxide (AL <sub>2</sub> O <sub>3</sub> )	0.33
Ferric Oxide (Fe <sub>2</sub> O <sub>3</sub> )	0.10
Titanium Dioxide (TiO <sub>2</sub> )	0.02
Calcium Oxide (CaO)	0.61
Magnesium Oxide (MgO)	0.35
Pottasium Oxide (K <sub>2</sub> O)	0.05
Sodium Oxide (Na <sub>2</sub> O)	0.06

### III. EXPERIMENTAL WORK AND TEST

**A. Mix Design:** Mix design carried out for M35 grade of concrete by IS 10262-2009 and resulting to the mix proportion of 1: 1.69: 2.28 with water cement ratio of 0.4. Here the replacement of cement by glass powder was 5% to 30% with the increment of 5% each.

**B. Workability Test:** In this experimental work, the slump value of fresh concrete was used in the range of 80mm to 110mm. It is a measure representing the consistency or workability of concrete.

**C. Compressive and Flexure test:** Concrete was prepared with different percentage for replacement of cement by waste glass powder ranging from 5% to 30% at increment of 5% each and was cured under normal condition. These were then tested at 7 and 28 days for determining the compressive and flexural strength and those results were compared with the results of conventional concrete.

### IV TEST RESULTS

#### A. Workability

Results of workability of concrete with partial replacement of cement by milled waste glass that is waste glass powder are shown in table 2 with the increment of 5% ranging from 5% to 30%.

Table 2: Results of workability of concrete

Mix Designation	% replacement of cement by glass powder	Slump (mm)
A1	0	63
A2	5	61
A3	10	55
A4	15	51
A5	20	49
A6	25	45
A7	30	43

#### B. Compressive strength

In Table 3 results of test conducted on hardened concrete with 0-30% of waste glass powder for 7 and 28 days are shown. The result shows that the compressive strength increases with increasing curing time.

Table 3: Results of compressive strength

Mix Designation	% replacement of cement by glass powder	7 days	28 days
A1	0	28.81	44.11
A2	5	31.30	47.09
A3	10	35.25	51.52
A4	15	38.98	56.46
A5	20	33.52	47.78
A6	25	29.54	45.13
A7	30	25.03	43.25

### C. Flexural strength

In table 4 results of flexural strength of concrete with cement replacement by waste glass powder for 28 days are shown.

Table 4: Results of Flexural strength

Mix Designation	% replacement of cement by glass powder	28 days
A1	0	4.05
A2	5	4.32
A3	10	4.65
A4	15	4.86
A5	20	4.47
A6	25	4.18
A7	30	3.99

## V DISCUSSION ON TEST RESULTS

### A. Workability

As the content of glass powder in concrete increases the workability of concrete decreases. The quantity of cement paste available for providing lubricating effect is less per unit surface area of aggregate as there is reduction in fineness modulus of cementitious material.

### B. Strength

As the percentage replacement of cement with glass powder increases strength of concrete up to 15%.

## VI CONCLUSION

- 1) Workability of concrete decreases as the percentage of glass powder in concrete increases.
- 2) Glass powder concrete increases the compressive strength as well as the flexural strength effectively as compared with conventional concrete.
- 3) By using waste glass powder in concrete will reduce the disposal problem of waste glass and prove to be environmental friendly.
- 4) By using glass powder in concrete in replacement of cement reduces amount of cement to be used in concrete. So there will be a small contribution to reduce carbon dioxide and other greenhouse gases which is caused during production of cement.

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