

Partial Replacement of Coarse Aggregate with Waste Glass in Concrete

Shalini Singh

U.G. Student, Department of Civil Engineering, SRM College of Engineering & Management, Lucknow, India

ABSTRACT: Concrete is a composite material made by mixing fine aggregate, coarse aggregate, cement and water. Due to depletion of natural resources, now we are using the waste material in producing concrete. Waste glass is a major part of the solid waste. Glass is found in many forms like glass, bottles, sheet plate etc. These waste glasses are not easy to decompose they are creating many environmental problems. These waste glasses partially replace coarse aggregate in concrete in different percentage 5%, 10%, 20%, 30%. The compressive strength of these concrete blocks is tested in SRMCEM lab. This help to reduce the cost of the project.

KEYWORDS: Waste, Partial Replacement, Glass, Coarse Aggregate, Cement.

I. INTRODUCTION

The concrete is widely used in all construction fields. Natural resources are very rare. Concrete produced by using natural resources are very costly. In order to reduce the cost of the concrete, we are using waste glass. The waste glass is produced at an increasing rate due to rapid industrialization and improved standard of living. Most of the waste glasses are dumped using the sanitary landfill. Glass can be recycle using different techniques [1] Due to the environmental point of view it is very important to use recycle waste glass in place of coarse aggregate [2].

The glass is a material containing silica, soda ash, CaCO_3 [3]. These glasses are collected and then broken into small pieces which pass through 20mm sieve and retained on 16 mm. The waste glass provides a good aesthetic appearance. The glass water absorption value is nearly zero and is related to the strength of concrete [4]. Glass has a property of high reflectivity.

The main aim of the experiment is to produce economical and environmentally friendly concrete. The waste glass may open a new idea of economic and pollution free concrete construction to achieve the desired strength [5].

II. EXPERIMENTAL PROGRAM

The concrete block of dimension 150x150x150 mm is made using the different percentage of waste glass. The compressive strength of block is tested using the compressive testing machine. The compressive strength of the block was tested on 7 and 28 days for a mix of 1:1.6:4 at a w/c of 0.48.



Fig.1. Compressive testing machine

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Fig.1 shows the compressive testing machine of SRM college. The blocks of different percentage replacement are tested in this machine at 7 and 28 days. The compression testing machine applies loads which help to break the block and the reading is noted down as the block develops cracks.

III. MATERIALS

CEMENT- The ordinary Portland cement was used during the experiment. The OPC have faster setting time

FINE AGGREGATE- These are the sand which is locally available. These are formed by finely dividing the rock and minerals.

COARSE AGGREGATE- These are the material which retained on 4.75 mm IS sieve. These are also easily available in the local material.

GLASS- These are the material available in the local shops. They are broken into small pieces.

WATER- This is used to develop adhesion and used to form the paste. Water is also used for the purpose of curing.



Fig.2. Waste glass.

Fig.2 shows the crushed waste glass. The waste glass are collected and then broken into the small pieces of maximum size of 20 mm as they are used in place of coarse aggregate in concrete. The waste glass are collected from different sites. They are handle with care in order to avoid any accident due to the sharp edge of waste glass.

IV. RESULTS AND DISCUSSION

A. TESTING ON CEMENT

Cement are tested in laboratory and following results are obtained-

Table1 - Result of testing on cement

S.NO	CHARACTERISTICS	TEST RESULTS	I.S. CODE
1.	Consistency	30%	
2.	Initial Setting Time min	250	Not less than 30 min
3.	Final Setting Time min	480	Not more than 600 min
4.	Fineness	0.5%	Should be less than 10%

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From the test performed on the cement, the obtained test result are following IS Standards. This cement can be used for the purpose of cube casting. This cement is ordinary Portland cement so the result shows that this cement is good quality cement having good setting time and very fine. This cement provides good strength and adhesive property to the concrete.

B. TESTING ON FINE AGGREGATE

The following tests are performed on fine aggregate and results are obtained

Table2- Result of testing on fine aggregate

S NO.	PHYSICAL PROPERTY	TEST RESULT
1.	Bulking of sand	2.7%
2.	Specific Gravity	3.03
3.	Silt content	2%
4.	Water Absorption gm	160

The table 2 shows results are according to the IS Standard and the material, therefore, has good properties and can be used in the concrete mix. The fine aggregate have less silt content so it is very helpful to be used in concrete mix. The fine aggregate have less water absorption and this shows that aggregate will not absorb much water and hence less quantity of water is utilised and this saves water.

C. TEST ON GLASS WASTE

The following test are performed on coarse aggregate and result are as follows

Table3- Result of testing on coarse aggregate

S NO.	CHARACTERISTICS	OBTAINED VALUE
1.	Maximum size (mm)	20.00
2.	Crushing Value (%)	237
3.	Impact value (%)	8.84
4.	Abrasion value (%)	35
5.	Specific gravity	2.1
6.	Water Absorption	9

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The table3 shows the test result of coarse aggregate which is within the range of IS code. They have all the properties which are required in a good grade aggregate. The result shows that aggregate can bear the load without much damage. They can easily bear the abrasive forces which are acted upon it. The aggregate will not absorb much water and hence they require less amount of water

D. TEST ON GLASS WASTE

The following test are performed on the glass waste these tests are similar to coarse aggregate

Table4- Result of testing on glass waste

S.NO	CHARACTERISTICS	RESULT VALUE
1.	Impact Value (%)	19.3
2.	Specific gravity	2.70
3.	Crushing Value (%)	24.09
4.	Abrasion Value (%)	32.96

Table 4 shows the test performed on the waste glass. These are similar to the coarse aggregate. This test result helps to analyse the difference in the properties of waste glass and aggregate. These tests help us to understand whether glass will provide the same strength as concrete does. The glass are strong and does not crushed easily on application of load. The glass can also easily bear the impact acting over it.

Table5- Result of sieve analysis of waste glass

S.No.	IS Sieve	Weight of aggregate Retained (gm)	Cumulative Weight Retained (gm)	Cumulative Weight Retained as % of Total aggregate	Cumulative % Passing as % of Total aggregate
1.	20mm	649	649	16.25	83.75
2.	16mm	808	1457	36.45	63.55
3.	12.5mm	843	2300	57.5	42.5
4.	10mm	600	2900	72.5	27.5
5.	4.75mm	891	3791	94.71	5.28
6.	Pan	201	3992	99.8	0.2

Table 5 shows the result of sieve analysis on the waste glass. The sieve analysis is done in order to decide the grade of aggregate. Different sizes of sieves are used and placed together and the glasses are passed over these sieve. This is

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Vol. 6, Issue 4, April 2017

used to decide the quantity of different sizes of waste glass used. This test is similar to that of coarse aggregate. The sieve analysis is also used to analyse the fineness modulus of waste glass.

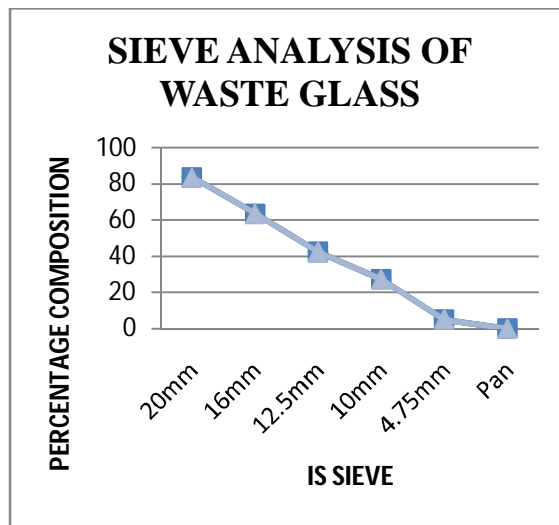


Fig.3- Sieve analysis of waste glass

Fig.3 shows the particle size distribution curve this curve is between the percentage of waste glass passing through the different sieve and different size of IS sieve. This graph is very useful to analyse the grade of the waste glass. According to the grade of aggregate we decide the quality of aggregate which we used. Here waste glass is used in place of the aggregate.

E. COMPRESSIVE STRENGTH TEST

The compressive strength of the concrete is tested on 7 days and 28 days on compression testing machine.

Table6- Result of compressive strength of concrete

S.NO	PERCENTAGE REPLACEMENT	7DAYS COMPRESSIVE STRENGTH	28DAYS COMPRESSIVE STRENGTH
1.	0%	16	26
2.	5%	11	21.33
3.	10%	15.63	24.6
4.	20%	15.16	23.16
5.	30%	13	21

Table 6 shows the compressive strength for 7 days and 28 days at different percentage of replacement. After casting of blocks they are placed in the curing tank where they are cured for 7 days and 28days and after the completion of the

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Vol. 6, Issue 4, April 2017

curing the compressive strength of these block are tested in the compression testing machine by applying 40KN/mm² load and the reading is noted when the crack are developed in the block.

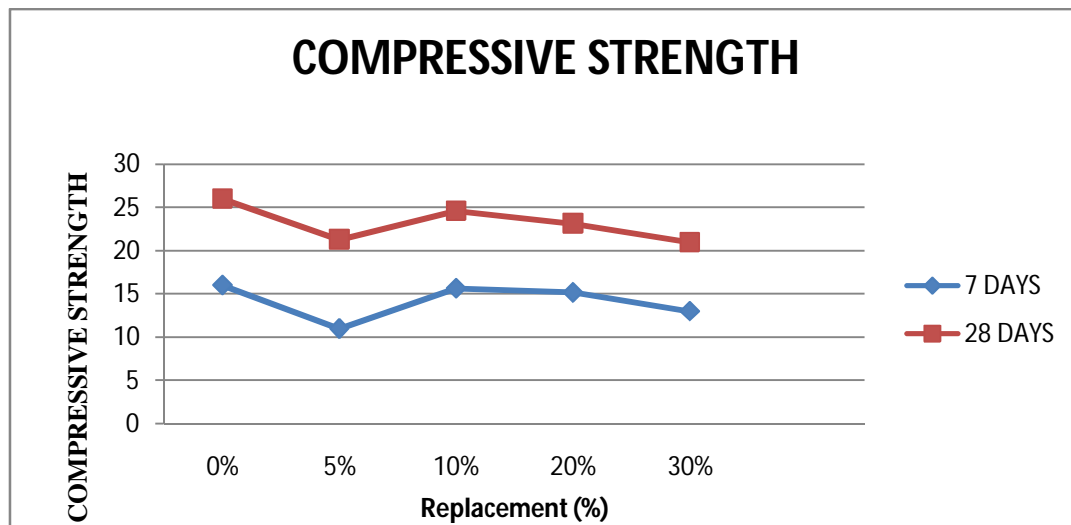


Fig. 4. Compressive Strength

Fig.4 shows a graph between compressive strength of concrete block and percentage replacement. Compressive strength after 7 days and 28 days curing both are plotted. At different percentage of replacement of waste glass the graph is plotted and which shows firstly increment in the strength after 10% there is decrease in the strength is shown in the graph as the percentage of replacement increase.

V. CONCLUSION

- There is a decrease in compressive strength with increase in the percentage of the waste glass.
- There is a marginal increase in strength of concrete at 10% replacement.
- This project help in reduction of the glass waste produced on a day to day life. These waste is better utilised in the production of concrete

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