Partial Replacement of Fine Aggregates with Waste Glass in Concrete

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Abstract— One of the largest industry which consumes natural resources is Concrete industry and it is a serious concern because it not only affect our environment but also survival of concrete industry is under high risk. The use of waste material in concrete minimize the disposal problem of the waste. The research is to check the potential of concrete by replacing its partial amount of fine aggregates with Waste Glass. The ratio of variation varies 0%, 5%, 15%, 25%, 35%. Concrete used is of M 25 grade. Cube specimen of size 150mm were made to check for compressive strength and cylinder specimen of 300mm in length and 150mm in diameter were made to check for split tensile strength test at 7, 14 and 28 days. Cubes were also tested for water absorption test after 28 days.

Key words: Fine Aggregates, Concrete

I. INTRODUCTION

Waste is the product of various human activities includes industrial waste, house waste, medical waste etc. Particularly, construction waste is the result of destruction, repairing installation of existing structures. Construction waste comprises of tiles, bricks, sand, stone etc. Use of glass is increasing with time due to which quantity of waste glass is also increasing and this problem can be overcome by using this waste glass in construction. There are many studies emerging in world showing reuse of waste glass in Concrete. Glass can be used as a replacement of fine aggregates in concrete mix. This will also save landfill space where waste glass is to be dumped as glass is non-biodegradable and it also save our natural resources. It will also be economically helpful as less labor will be required for transporting waste glass from place to place.

In India, 0.7% of total urban waste consists of waste glass. In UK, 3 million tons of waste glass is produced annually. Waste glass when crushed can be used in various places such as filtration, grit plastering, replacement of fine aggregates in concrete etc. In last few years, quantity of waste glass has increased due to increase in Glass products. When waste glass is used as a replacement of fine aggregates, it will down the production cost of concrete. In this research, waste glass was crushed into powder using Los Angeles abrasion machine and then sieved it through 1.18mm IS sieve and then uses it as a replacement in fine aggregates.

II. RESEARCH SIGNIFICANCE

Successful use of waste glass will result in reducing the environment problem as well as health problem related to waste glass. It will also save the landfills which were used as a dumping area. From all constituents of concrete, waste glass is least expensive and is ,much cheaper than natural resources like aggregates, thus it is great idea to replace the aggregates with waste glass to save money as well as disposal problem. It is expected that resulting concrete would increase infrastructural durability but care should be taken while adding the amount of glass because adding too much of glass can weaken the concrete.

III. MATERIAL

The material used are as follows:

1) Cement:

cement is important part of concrete because it gives concrete its strength. There are many type of cement used in specific conditions but in my research work we used ACC Ordinary Portland cement (43 grade).

2) Aggregates:

The Fine aggregates used in this research are taken from river with max size of 4.75mm.

Coarse aggregates used are of machine crushed stone passing through 20mm IS sieve and retained on 4.75mm IS sieve.

3) Waste Glass Powder:

Window waste glass was used and it was collected from Gupta Glass, Banihal, J&K, and then crushed in Los Angeles abrasion apparatus and then sieved through 1.18mm IS sieve.

Composition of Waste Glass

Oxides	% Content
SiO_2	70.4
Al_2O_2	1.9
Fe_2O_3	1.2
MgO	10.3
Na_2O	14.0
K_2O	0.4

Table 1: Shows Chemical Composition of waste Glass in Percentage

IV. METHODOLOGY

Fig 1. Cube moulds with Concrete

Fig 2. Curing of Cubes

The effect of waste glass and waste paper sludge on the strength of concrete for M25 grade can be studied by varying the percentage of waste glass in concrete by replacing it with fine aggregate. Waste glass powder content is varied by 0%, 5%, 15%, 25%, and 35% of weight of fine aggregate. Compressive strength, and tensile strength of concrete is determined by performing various tests in lab related to them. Cubes of size 150mm are casted to check the compressive strength and 300mm length and 150mm diameter cylinders are casted to check the tensile strength of concrete. All the specimens were cured for the period of 7, 14 and 28 days before crushing and thus compression test and split tensile test is performed.

V. TESTING AND RESULTS

A. Slump Test

Slump test was carried out in three stages. Firstly, with the replacement of fine aggregates by waste glass powder and it was noted that the slump was maximum for 35% of replacement of fine aggregates as waste glass powder does not absorb more water than fine aggregate.

Waste glass %	Slump value
0	24
5	28
15	33
25	38
35	45

Table 2: Slump Value by replacing Fine Aggregates with Waste Glass Powder.

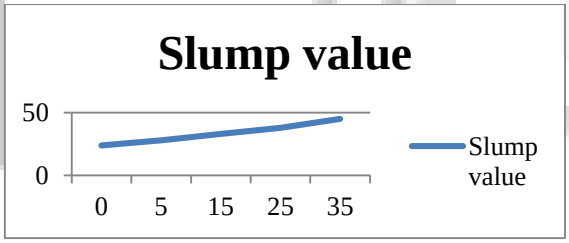

Fig 3. Graph Showing Slump Value Variation.

B. Compressive Test

For compressive strength test, cube specimens of dimensions 150 x 150 x 150 mm were cast for M25 grade of concrete. The moulds were filled with 0%, 5%, 15%, 25%, and 35% of waste glass. Vibration was given to the moulds using table vibrator. The top surface of the specimen was leveled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank wherein they were allowed to cure for 7, 14 and 28 days. After curing, these cubes were tested on compression testing machine and the failure load was noted. The compressive strength was calculated as follows.

Compressive strength = Failure load / cross sectional area

Waste Glass %	Compressive Strength of Specimen in N/mm^2		
	7 Days	14 Days	28 Days
0	21.10	25.37	27.17
5	23.64	28.19	30.78
15	24.39	30.53	32.64
25	26.03	31.36	34.03
35	22.14	27.30	29.17

Table 3: Compressive strength test of specimen by replacement of fine aggregates with waste glass powder.

C. Split Tensile Strength Test

This test method is used for the determination of splitting tensile strength of cylindrical concrete specimen of 150mm diameter and 300mm length. The moulds were filled with 0%, 5%, 15%, 25%, and 35% of waste glass. Vibration was given to the moulds using table vibrator. The top surface of the specimen was leveled and finished. After 24 hours the specimens were demoulded and were transferred to curing tank wherein they were allowed to cure for 7, 14 and 28 days. After curing, these cubes were tested on split tensile strength.

Waste Glass %	Split tensile Strength of Specimen in N/mm^2		
	7 Days	14 Days	28 Days
0	2.08	2.28	2.58
5	2.05	2.24	2.55
15	2.03	2.16	2.39
25	1.93	2.02	2.26
35	1.77	1.84	2.03

Table 4: Split Tensile Strength test of specimen by replacement of fine aggregates with waste glass powder.

D. Water Absorption Test

Cube of 150mm was made from fresh concrete without any replacement and then the dry weight of cube specimen was noted after removing it from mould and weight of cube specimen was again noted after curing it for 28 days.

E. Replacement of fine aggregate with Waste Glass Powder.

Cube specimen was made by replacement of fine aggregates with Waste Glass powder at 5%, 15%, 25% and 35%. The dry weight of cube specimen was measured after removing it from mould and weight of cube specimen was again noted after curing it for 28 days.

Waste Glass %	Dry weight before curing (g)	Wet weight after curing for 28 days (g)	Water absorbed (g)
0	8427	8511	84
5	8398	8473	75
15	8301	8352	51
25	8221	8263	42
35	8137	8174	37

Table 5: Shows variation in weight after adding Waste Glass.

VI. CONCLUSION

On the basis of test and their results, following readings are noted:-

- There is 20% increase in compressive strength by replacing 25% of Fine Aggregates with Waste Glass Powder after 7, 14 and 28 days.
- Workability increases with increase in Waste Glass Powder due to less absorption of water by Glass.
- Use of waste material like glass will reduce environment waste and also less the disposal problem of these non-biodegradable waste.

- Use of waste glass also help in maintaining our natural resources like river sand and maintain balance in our environment.
- Use of waste glass in appropriate percentage in concrete results in improvement in strength of concrete.

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