Partial Replacement of Aggregates With Glass In Green Concrete

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Abstract- *Development and Growth of construction industry is addicted to Concrete and fossil fuels, and these two are the biggest issues making CO2 growing in the environment. About 8- 10% of carbon dioxide (CO2) emissions are generated from manufacturing and transporting by the concrete industry. CO2 is major gas just after steam causing the greenhouse effect. Moreover, when natural aggregates are crushed and heated at elevated temperatures, greenhouse gases are released to the atmosphere creating environmental burdens. There is a necessity to build a bright and sustainable future. In order to outline the sustainability of modern construction sector. Green concrete is defined as a concrete which uses waste material as at least one of its components, or its production process does not lead to environmental destruction, or it has high performance and life cycle sustainability. The main aim of this literature review is to identify how green concrete can help towards promotion of sustainable built environment. The present study outlines literature related to green concrete manufactured from some industrial wastes such as fly ash, glass modified and recycled aggregate concrete. The suitability of green concrete as an alternative for demolishing the carbon emissions is studied, hence reduces negative impact on environment and improves the sustainability of concrete structures. It can be concluded that green concrete has the ability to minimize waste and encourage sustainability. The emphasis is given to encourage the usage of green concrete as it is not just because of simple carbon dioxide reduction but also overall waste could be minimized.*

Keywords- Compressive Strength, Waste Glass Concrete, Environment Friendly, Workability, Durability

I. INTRODUCTION

GREEN CONCRETE:

Green concrete is defined as a concrete which uses waste material as at least one of its components, or its production process does not lead to environmental destruction. It should also have high performance and life cycle sustainability. In other words, green concrete is an environment friendly concrete. Green concrete improves the three pillars of sustainability: environmental, economic, and social impacts. The key factors that are used to identify whether the concrete is green are: amount of Portland cement replacement materials, manufacturing process and methods, performance and life cycle sustainability impacts. Green Concrete is cheap to produce because it is prepared by waste materials which lowers the energy consumption, increases its strength and durability. Green Concrete was first developed by Dr.W G in 1998.

II. RECYCLED CONCRETE AGGREGATE

After demolition of old roads and buildings, the removed concrete is often considered worthless and disposed of as demolition waste. By collecting the used concrete and breaking it up, recycled concrete aggregate (RCA) is created.

III. WASTE GLASS

Ground waste glass was used as aggregate for mortars and no reaction was detected with fine particle size, thus indicating the feasibility of the waste glass reuse as fine aggregate in mortars and concrete. Estimated cost for housing is more and some construction materials like natural sand are also becoming rare. Waste glasses are used as aggregates for concrete. In this study, an extensive experimental work was carried out to find the suitability of use of waste glass in concrete with the following objectives: 1. to study the workability of concrete mode using glass waste as partial replacement of fine aggregate. 2. To study the compressive strength of concrete mode using glass waste as partial replacement of fine aggregate.

IV. GLASS AS AGGREGATE FOR CONCRETE

The use of waste glass as aggregate for concrete has been attempted decades ago. Those early efforts were thwarted by the problem of alkali-silica reaction (ASR), which was not well understood then. Therefore, a high priority was assigned to gaining such an understanding, when a major research effort was initiated at Columbia University some six years ago. It was also expected that the glass aggregate would affect

the mechanical properties of the concrete. The use of recycled glass in concrete opens a vast new market for mixed as well as color sorted broken glass in a variety of specialty products or in local concrete operations. Recent research findings will make it possible to utilize glass also in regular concrete applications, thereby expanding and developing markets for recycled glass.

V. ADVANTAGES OF GLASS AS AGGREGATE IN CONCRETE

- Glass improves the fluidity of fresh concrete enabling the achievement of very high strength without use of super plasticizers.
- Improves the aesthetic value of the concrete in which it's used due to color addition in the case of brown or green waste glass used, and light reflection.
- Glass has almost zero water absorption which results in more workable fresh concrete without adjusting the quantity of water used.
- Glass has excellent durability and chemical resistance.

VI. DISADVANTAGES OF GLASS AS AGGREGATE IN CONCRETE

- Alkali silica reaction which compromises the durability of concrete by causing cracking.
- Challenge of acceptance in the construction industry as glass aggregate may be seen as inferior or unsafe.

VII. MATERIALS AND PROPERTIES

MATERIALS USED

In this investigation, the following materials were used:

- Portland Pozzolonic Cement conforming to IS: 169-1989
- Fine aggregate and recycled coarse aggregate conforming to IS: 2386-1963.
- Water.
- Glass

VIII. EXPERIMENTAL METHODOLOGY

INTRODUCTION

In this, various series of different test were accomplished on the waste glass used as partially replacement with recycled coarse aggregate, concrete cubes to get strength characteristics of the use of waste glass for probably using it in normal strength concrete practice. The several such as compressive and workability are relatively important mechanical properties of any hardened concrete including use waste glass and RCA in concrete. The use of waste glass in concrete must embrace the same conventional concreting practices to guarantee the hardened concrete properties. This section will discuss on the results that are attained from the testing and compare it from the testing and compare it with the standards accordingly. The results are such as water absorption test, slump tests, compression cube test.

IX. MIXING OF CONCRETE

The mixing process is carried out by hand mixing. The ingredients are laid in uniform layers, one by one in the order –recycled coarse aggregate, waste glass, fine aggregates and then cementitious materials. Dry mixing is done to obtain a uniform color. After dry mixing, water is added to prepare concrete. Afterwards that workability test are done instantly after the proper mixing of concrete and the test are done.

X. MIX PROPORTION

The concrete mix proportions ordinary grade concrete and standard grade concrete are designed using IS: 10262- 1982. The mix we use in our experimental work is the nominal mix which is M20 with the generally used mix proportion of 1:1.5:3 and with the water cement ratio of 0.5. Therefore, the mixture proportions used in experimental laboratory for tests is M20 as per Indian standard.

XI. MIXING AND CASTING OF CONCRETE SPECIMENS

The objective of mixing is to get a homogenous and consistency of cement, water, sand, aggregate, waste glass to meet the all requirement of the standard. There are 18 cubes and 3 different batches of M20 mix design mixed and it was moulded in accordance with IS: 10262-2019

Specimen casting
Waste Glass 10% - 6 cubes
Waste Glass 20% - 6
Waste Glass 30% -6 cubes

18 Cubes
9 for 7 days.
9 for 28 days.

XII. RESULT

RESULT OF TEST ON AGGREGATES

PARTICULARS	COARSE AGGREGATE	FINE AGGREGATE
Fineness %	7.173	2.451
Zone	Zone 3	Zone 3
Specific gravity	2.65	2.82
Water Absorption	3.90%	-
Impact Value	16.46%	-
Crushing Value	21.76%	-

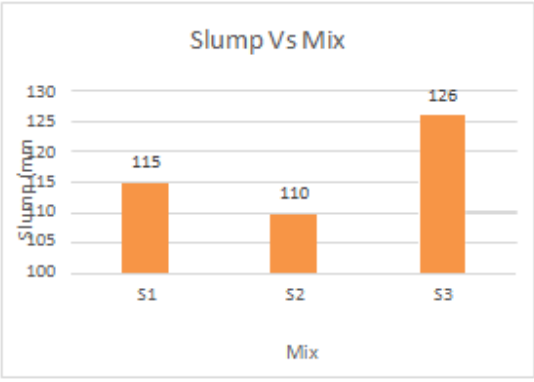
RESULT OF TEST ON CEMENT

S. No.	PARTICULARS	RESULT
1	Normal consistency of cement	32%.
2	Fineness of cement	4.8%
3	Initial Setting Time	30 minutes
4	Final Setting Time	600 minutes which is approximately 10 hrs.

RESULT OF TEST ON FRESH CONCRETE

SLUMP TEST RESULT

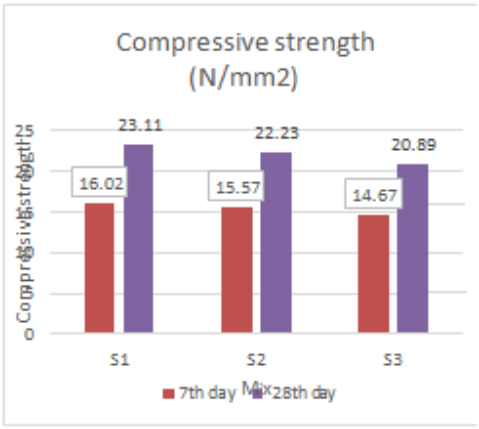
S. No.	MIX	SLUMP (mm)
1	S1 (10%)	115
2	S2 (20%)	110
3	S3 (30%)	126



RESULT OF TEST ON HARD CONCRETE

COMPRESSIVE STRENGTH TEST

MIX	7th day (N/mm²)	28th day (N/mm²)
S1	16.02	23.11
S2	15.57	22.23
S3	14.67	20.89



Compressive Strength (N/mm2) of Cubes at 7 and 28 Days.

XIII. DISCUSSION

It is observed that when coarse aggregate is replaced by 20% glass waste, the compressive strength at 3 days is found to increase by about 9.1% on average. The compressive strength at 7days is found to be 12.7%. However, it is evident that increase in compressive strength at 28 days is 14.55% at same replacement level.

It is observed that on replacing coarse aggregate by 30% glass waste on average there is an increase in compressive strength at 3 days by 8.08%, the compressive strength at 7 days is 10.29%. However, at 28 days, compressive strength is 13.05%.

It is seen that there is an increase in compressive strength for 20% respectively whereas a compressive strength is decreased marginally at 30% replacement level.

XIV.CONCLUSION

- While using waste glass as coarse aggregate replacement, 28 days strength is found to marginally increase up to 20% replacement level.
- Marginal decrease in strength is observed at 30% replacement level of waste glass with coarse aggregate.
- Waste glass can effectively be used as coarse aggregate replacement.
- The optimum replacement level of waste glass as coarse aggregate is 10%.
- There is a decrease in compressive strength with increase in the percentage of the waste glass.
- With increase in waste glass content, percentage water absorption decreases.
- Workability of concrete mix increases with increase in waste glass content.

- Use of waste glass in concrete will eradicate the disposal problem of waste glass and prove to be environment friendly thus paving way for greener concrete.
- Use of waste glass in concrete will preserve natural resources particularly river sand and thus make concrete construction industry sustainable.

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