IARJSET
ISSN (Online) 2393-8021
ISSN (Print) 2394-1588
International Advanced Research Journal in Science, Engineering and Technology
ISO 3297:2007 Certified
Vol. 5, Issue 3, March 2018

Experimental Investigation on Fine Aggregate Replaced by Waste Glass Powder in Concrete

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Abstract: The waste glass is affected the some environmental factors. Generated waste glass is made up to the powder form and it is economically, when it is used in concrete. Fine aggregate of the concrete is replaced by these waste glass powder in partially (0% - 30%). Objective of the investigation is increase the compressive strength due to using waste glass powder in M_{40} grade of concrete. The results are compared with the conventional concrete.

Keywords: Waste glass powder, Concrete, Compressive strength, Fine aggregate.

I. INTRODUCTION

The use of normal aggregates in concrete is have some difficulties like high cost and available of material. The material demand and high cost of material is affect the building construction in India. So the various materials are used to alternative for fine and coarse aggregate in nowadays concrete. The waste glass powder is the perfect alternative for fine aggregate in concrete. The use of waste glass powder in concrete is reducing cost of the construction and it is preventing the environment from some affection because the waste glass is dumped in landfill directly. The waste glass is generated from the by- products of glass manufacturing industries. The waste glass powder is prepared with landfill waste glass and unnecessary brittle glass in by-product industries. The one of the advantage is increase the compressive strength of the concrete compared to the normal concrete.

II. MATERIAL USED

A. CEMENT:

Composition of cement is lime (calcium oxide, CaO), Silica (silicon dioxide, SiO_2), and alumina (aluminium oxide, Al_2O_3). Cement is a most one of the binding material in concrete structure. It is bonding with the stones and the bricks in strongly. In this experiment OPC 53grade (Ordinary Portland Cement) was used.

Table 1. Composition of cement in percentage:

Ingredient	Percentage in cement
Lime	60-65
Silica	17-25
Alumina	3-8

B. WASTE GLASS POWDER

Glass powder is prepared by the brittle glasses. The glass is the composition of silicon dioxide (SiO_2), sodium oxide (Na_2O) from sodium carbonate (Na_2CO_3), calcium oxide (CaO). The glass is strongest and brittle material. Below 600 micron size particles was used in this project.

C. Fine aggregate:

River sand is used to the concrete as fine aggregate. It is consist of natural sand or crushed stone. The fine aggregate common size is below 4.75mm.

D. Coarse aggregate:

Coarse aggregate is prepared by mining and quarries. It is looks like a brittle stone. The coarse aggregate is grained for necessary size. The coarse aggregate size is above 4.75mm.

E. Water:

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Water is used to mixing the whole materials. The workability of the concrete is based on water. Water is reacted to the cement in hydration process. Use of water P^H is 6-7.

III. EXPERIMENTAL

A. Mix proportioning:

The M_{40} grade concrete mix ratio of this experiment is 1:1.5:2.5. the various percentage of waste glass powder is mixing the concrete in 0%-30%. Each percentage of fine aggregate replaced concrete casting specimens for testing.

B. Mixing, Casting, Curing:
The required amounts of materials are batched as per mix ratio. Cement, coarse aggregate, fine aggregate and water mixed with the required amount of waste glass powder in percentage. The concrete mixing is prepared with the 0% of waste glass powder. It is a conventional concrete. The fine aggregate replaced by the waste glass powder in concrete mixing as per 10%, 15%, 20%, 25% and 30%. And these concrete mixings are casting in the 150mm*150mm*150mm size of cubes and 150mm diameter, 300mm height of cylinder. The moulds were removed after 24 hours. The specimens were kept in water for 7-28 days curing.

Figure 1. Demoulding:

Figure 2.Curing:

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C. Testing:

After curing process the specimens were tested. The cubes are tested for the compressive strength and the cylinders are tested for the split tensile strength at 7, 14 and 28 days curing.

Figure 3.Compressive test:

Figure 4.Split tensile test:

IV. RESULT

Table 2. Compressive strength of fine aggregate replaced concrete,

S.no	Percentage of waste glass powder	Compressive strength (N/mm^2)		
		7 days	14 days	28 days
1	0	27.23	32.35	37.48
2	10	25.76	29.78	35.85
3	15	15.84	21.42	26.82
4	20	30.67	34.95	39.72
5	25	17.77	23.56	32.89
6	30	22.66	26.46	33.51

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Table 3. Split tensile strength of fine aggregate replaced concrete

S.no	Percentage of waste glass powder	Split tensile strength (28 days)
1	0	2.18
2	10	1.84
3	15	0.98
4	20	2.26
5	25	1.92
6	30	1.96

Chart 1. Compressive strength of concrete:

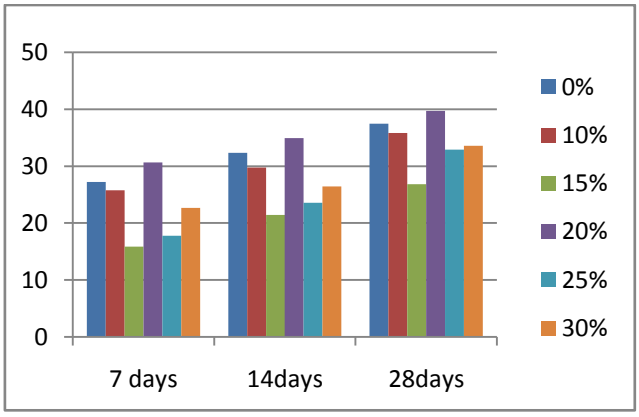
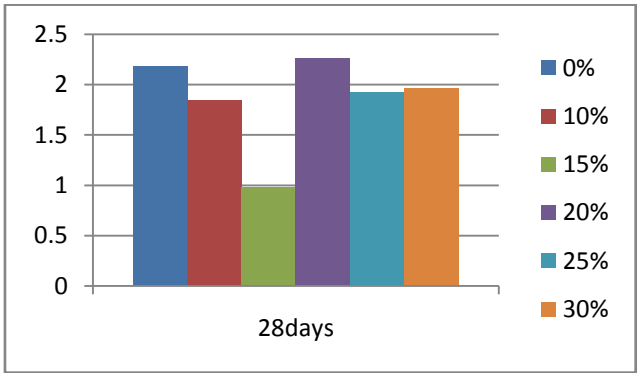


Chart 2.Split tensile strength of concrete:



V. CONCLUSION

This experimental investigation reveals that the compressive and split tensile strength of the concrete is increased at 20 percentage replacement of fine aggregate compared to the conventional concrete.

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