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Used Waste Glass Powder in Concrete

Sharad N. Thorat[1], Sandip L. Navale[2]

[1] Lecturer, Department of civil Engineering, Amrutvahini Polytechnic Sangamner, Maharashtra 422608.
[2] Lecturer, Department of civil Engineering, Amrutvahini Polytechnic Sangamner, Maharashtra 422608.

ABSTRACT-

The global cement industry contributes about 7% of greenhouse gas emission to the earth's atmosphere. In order to control environmental effects associated with cement manufacturing, there is a need to develop alternative binders to make good concrete.Cement manufacturing industry is one of the Carbon dioxide emitting sources besides burning of fossil fuels. The global warming is caused by the emission of greenhouse gases, such as CO2 (Carbon Dioxide). Consequently research is ongoing into the partial replacement of cement, using many waste materials as well as industrial by products. Like Fly ash and GGBS a waste glass powder can also use as a partial replacement of cement. The overall test results shows that Waste Glass Powder could be utilized in concrete as a partial replacement of cement which improves the mechanical properties of concrete.

Keywords–Carbon Dioxide, Concrete, Waste Glass Powder, Mechanical Properties.

INTRODUCTION :

Concrete is one of the world's most used construction material due to its availability, durability and economy. India uses about 7.25 million cubic meters of ready-mixed concrete every year. It finds applications in highways, tunnels, bridges, high-rise buildings, dams etc. Greenhouse gas like CO2 causes global warming and it leads to about 65% of global warming. The global cement industry emits about 7% of greenhouse gas to the earth's atmosphere. To minimize this environmental impact alternative binding material are introduced to make concrete.

Glass is an amorphous material which contain high silica thus making it potentially pozzolanic when size of particle is less than 75 micron. Due to its high silica content ground glass is considered as a pozzolanic material and as such can possesses properties identical to other pozzolanic material. In this study, finely powdered waste glasses are used as a partial replacement of cement in concrete production and compared it with conventional concrete. Concrete mixtures were prepared for different proportions of glass powder ranging from 5 to 30% with an increment of 5% and tested for compressive strength, Tensile, and Flexural strength after 7, 28 days of curing.

LITERATURE REVIEW :

Arredondo S. P et al (2012) Because of the significant environmental impact that the concrete production causes, and as sustainability contribution for this industry; presently some improvements are being implemented in its durability and its components are been replaced for alternative recyclable materials. Concrete carbonation is one of the main causes of reinforcement electrochemical corrosion.

Veena V. Bhat et al (2012) Glass is commonly used in building construction industries and large amount of glass is powdered daily. The disposal of waste glass is an environmental issue as waste glass causes disposal problem. Today the construction industry is in need of finding cost effective materials for increasing the strength of concrete structures. Glass powder finer than 600µ is reported to have pozzolanic behaviour. An attempt is made to investigate the possibility of using the waste glass powder as the partial replacement of ordinary Portland cement in concrete. Concrete with replacement of cement by waste glass powder such as 5%, 10%, 15% and 20% were produced and properties of this concrete has been compared with concrete of control mix with no replacement

OBJECTIVES OF INVESTIGATION :

Experiment was conducted on concrete prepared by partial replacement of cement by waste glass powder ranging from 5 to 30% with an increment of 5% having particle size less than 75 micron. The main objective of this investigation was to find out the effect of waste glass powder on the compressive strength, tensile strength and flexural strength as well as to evaluate the possibility of using glass powder in concrete as a partial replacement for cement without sacrificing the its strength.

Following are the main objectives of the investigation:

1. To investigate partial substitute for ordinary Portland cement.
2. To determine the percentage of glass powder which gives maximum strength when it was compared to the control mix concrete.

MIX MATERIALS :

The material details are as follows:

A. Cement

For this research, locally available cement which is of the ordinary Portland cement type (53 grade) was used throughout the work. Specific gravity of cement was 3.15.

B. Fine Aggregate

Locally available fine aggregate used was 4.75 mm size confirming to zone II with specific gravity 2.66. The testing of sand was conducted as per IS: 383-1970.Water absorption and fineness modulus of fine aggregate was 1.35% and 2.74 respectively.

C. Coarse Aggregate

Coarse aggregate used was 20mm and less size with specific gravity 2.70. Testing of coarse aggregate was conducted as per IS: 383-1970. Water absorption and fineness modulus of coarse aggregate was 0.7% and 7.17 respectively.

D. Water

The water used was potable, colourless and odourless that is free from organic impurities of any type.

E. Waste Glass Powder

In this experiments glass powder having particle size less than 75 micron was used. Physical and Chemical properties of Waste Glass Powder are tabulated as follows:

TABLE I

PHYSICAL PROPERTIES OF WASTE GLASS POWDER:

Sr. No.	Physical Property of Waste Glass Powder	Value
1	Specific Gravity	2.56
2	pH	10.16

TABLE II

CHEMICAL COMPOSITION OF WASTE GLASS POWDER:

Sr. No.	Composition	Waste Glass Powder (%)
1	Silica	98.01
2	Lead Oxide	Nil
3	Copper Oxide	Nil
4	Alumina	0.33
5	Ferric Oxide	0.10
6	Titanium Dioxide	0.02
7	Mangnous Oxide	Traces
8	Zirconium Oxide	Nil
9	Calcium Oxide	0.61
10	Magnesium Oxide	0.35

EXPERIMENTAL WORK AND TEST :

A. Mix Design

Mix design carried out for M35 grade of concrete by IS 10262:2009, having mix proportion of 1:1.52:2.04 with water cement ratio of 0.42. The partial replacement of cement by 5 % to 30 % at an increment of 5% each. Chemical admixtures are not used in the work.

B. Compressive, Flexural and Split Tensile Strength:

Concrete prepared with different percentage replacement of cement by 5 % to 30 % at an increment of 5% each was cured under normal condition as per recommendations of IS and were tested at 7 days and 28 days for determining the compressive flexural and split tensile strength compared with the test results of conventional concrete.

RESULTS :

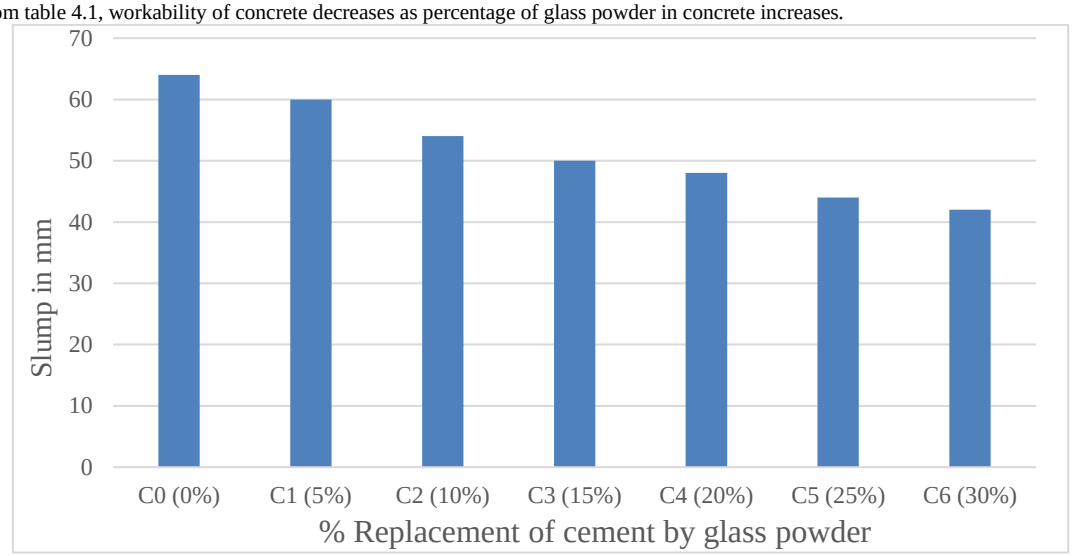
Workability Test:

For checking workability of concrete slump cone method is used. Table 4.1 and graph 4.1 shows the results of workability of concrete with cement replacement by glass powder in various percentages ranging from 5% to 30% in increments of 5% (0%, 5%, 10%, 15%, 20%, 25% and 30%).

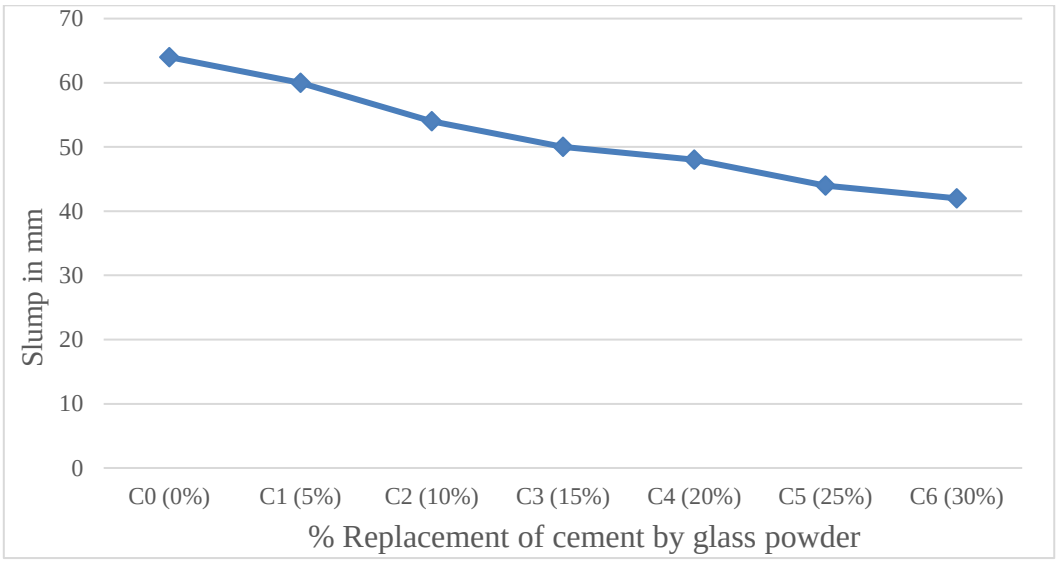
Sr. No.	Mix Notation	% Replacement of cement by glass powder	Slump (mm)
1	C1	0%	64
2	C2	5 %	60

3	C3	10 %	54
4	C4	15 %	50
5	C5	20 %	48
6	C6	25 %	44
7	C7	30 %	42

It is clear from table 4.1, workability of concrete decreases as percentage of glass powder in concrete increases.



Graph 4.1: Comparative slump test values of concrete with cement replacement with glass powder



Graph 4.2: Comparative slump test values of concrete with cement replacement with glass powder

CONCLUSION :

Based on experimental observations, following conclusions can be established:

1. As the Percentage of glass powder in concrete increases, workability of concrete decreases. A decrease of 3.23%, 12.91%, 19.36% workability was observed for 5%, 10% and 15% replacement respectively. As glass content increases, cement paste available is less for providing lubricating effect per unit surface area of aggregate which reduces the workability of concrete.
2. The replacement of cement by glass powder in concrete increases the compressive strength of concrete. For 28 days increase of 4.50 %, 14.53% and 25.70% strength can be achieved when 5%, 10% and 15% cement was replaced by glass powder in concrete. The strength improvement at early curing ages was due to good filling effect.
3. The replacement of cement by glass powder in concrete also increases the split tensile strength of concrete. Increase of 2.82 %, 7.05 % and 16.47 % strength can be achieved when 5%,10% and 15% cement was replaced by glass powder in concrete when water/ cement ratio was maintained constant

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