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An Experiment Investigation on Concrete by Partial Replacement of Fine Aggregate with Glass Powder for M_{25}

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Abstract

The concrete industry is one of the biggest consumers of natural resources, its sustainability is in risk. The largest problem the concrete industry is currently experiencing is the economic and environmental concern. The use of waste glass as a partial replacement for fine aggregates in concrete is discussed in this research as a means of addressing the economic and environmental concerns. For the M25 mix, waste glass powder was used in place of fine aggregates in weights of 0, 10, 15, and 25%. At 7 and 28 days, the concrete specimens underwent tests for compressive strength and splitting tensile strength, and the findings were contrasted with those of typical concrete. The findings showed that using waste glass powder to replace some of the fine aggregates up to 15%.

Keywords: Glass Powder, Natural Resources, Compressive Strength, Split Tensile Strength Test

1. Introduction

The usage of concrete is likely widespread throughout the world. There is an excessive demand for diverse materials made from industrial waste in this desolate environment. As the natural sand for the area, numerous materials have already been employed. The used waste glasses are also gathered from the stores. The collected glasses are crushed into sand size and can be used as a partial replacement for natural sand. To put it briefly, effective applications of glass as a finer mixture can transform this substance into a useful resource.

2. Objectives

The objectives of this study are as follows:

1. To compare and contrast the performance of conventional concrete and glass powder concrete.
2. To assess the usefulness of using glass powder as a partial replacement for fine aggregate in concrete.
3. To comprehend how well glass powder works to increase strength.

3. Materials

Raw materials required for the concreting operations of the present work are Glass powder, cement, fine aggregate, coarse aggregate, and water. The properties of cement are presented in Table 1.

Table 1: Physical Properties of Cement

Sr. No.	Property	Cement (53 Grade)
1	Specific Gravity	3.12
2	Fineness	9.19
3	Consistency	34%
4	Initial Setting Time	55 min
5	Final Setting Time	488min

3.1. Glass Powder

Glass waste was obtained for this experiment from a glass recycling business in Coimbatore. The crushing and milling processes were employed to create the glass powder that was used in this study. Glass is pulverised into a very thin powder called glass powder. To prepare it, high precision machining equipment is required since it must be extremely uniform and consistent. Depending on the applications and the degree of grinding, prices change.

Table 2: Physical Properties of Glass Powder

Physical properties	Values
Colour	Light Gray
Finesse modulus	2.31
Density, kg/m^3	1668
Absorption	0.41
Specific gravity	2.17

4. Concrete Mix Design

The mix proportion for glass concrete is 1:1.52:2.39.

5. Experimental Investigation

5.1. Compressive strength results

The compressive strength conducted in compression testing machine for the cast and cured specimens and the results are furnished in Table 3.

Table 3: Compressive Strength of Concrete with Percentage of Glass Powder

Sr. No.	% of Glass Powder	Compressive Strength, N/mm^2		
		28 Days	56 Days	90 Days
1	0%	32.12	34.80	37.32

2	10%	41.47	45.11	48.51
3	15%	43.93	47.75	51.03
4	20%	42.78	46.57	50.02
5	25%	41.48	45.04	48.52

5.2. Split Tensile Strength Results

The split tensile strength conducted in flexural testing machine for the cast and cured specimens and the results are furnished in Table 4.

Table 4: Split Tensile Strength of Concrete with Percentage of Glass Powder

Sr. No.	% of Glass Powder	Split Tensile Strength, N/mm^2		
		28 Days	56 Days	90 Days
1	0%	3.09	3.36	3.61
2	10%	3.99	4.34	4.65
3	15%	4.38	4.76	5.12
4	20%	4.25	4.61	4.95
5	25%	4.11	4.45	4.79

6. Conclusion

1. The maximum compressive strength is 43.93, 47.75 and 51.03 N/mm^2 for 28, 56 and 90 days by 15% partial replacing of glass powder.
2. The maximum split strength found is 4.38, 4.76 and 5.12 N/mm^2 for 28, 56 and 90 days by 15% partial replacing of glass powder.

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