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The Study of Impact of Waste Glass Powder (WGP) and Fly ASH When Combined with Steel Fibers in Concrete

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Abstract

Since the cost of cement in concrete is very expensive, it needs to be replaced and the materials used should c ontain pozzolanic materials when mixed with concrete, should be resistant to natural processes and should hav e low value similar to cement. Glass waste is obtained from glass fibres produced from alkali-free glass.

This alkalifree glass is ground into a fine powder of less than 75 microns to make a pozzolanic material. It is u sed as pozzolan in the manufacture of hydraulic cement. Calculate the compressive strength of cast iron as per IS: 516-1969. The hybrid design used is M25 as per IS: 10262-2019.

Glass powder constitutes 0%, 10%, 15% and 20% of the entire cement in the concrete while the percentage of fly ash constitutes 30%, 25%, 20%, 15% and 10% of the total cementitious content

Keywords: Waste Glass powder (WWGP), Poly carboxylate Eather based super plasticizer (PCE)

1. Introduction

Cement production causes many environmental p roblems, especially air pollution and global warm ing. Partial replacement of cement in concrete wit h cheap organic materials is a strategy to reduce t he use of OPC and thus reduce the environmental impact from building construction in general. Thi s method is considered as a new way to increase t he use of this material in construction. Abbas et al . 2018 described SFRC, a uniform and nonunifor m fiber matrix modified concrete composite. The properties of steel fibers should be related to the p roperties of the matrix rock, the geometry of the s teel fibers, the emission rate, the number, distribu tion and orientation of the fraction, and the streng th of the fiber-matrix interface.

The production of steel fibers is important in impr oving the flexural strength, tensile strength, tough ness, energy absorption and durability of concrete

2. Materials used

2.1 Cement: OPC 53 grade cement(ultratech company) isused. The Physical properties of OPC 53 grade cement are available by the manufacturer directly and it is declared it Material testing Certificate (MTC).

2.2 Waste Glass Powder: WasteGlass powder is taken from various sources like, from waste glass containers, bottle, sheets etc is crushed in a crusher to form powder. The main component of waste glass powder is Silicon dioxide(SiO_2). he primary chemical component of waste glass is silicon dioxide (SiO_2).

2.3 Fly Ash:

Fly ash is a supplementary cementitious material (SCM) that exhibits pozzolanic activity. In simple terms, this means that when finely divided fly ash reacts with calcium hydroxide (a by-product of cement hydration) in the presence of moisture, it forms compounds with cementitious properties.

2.4 Coarse Aggregates and fine aggregates: The Natural Sand confirming Zone-II is used for this study which is locally available river sand. The Natural Crushed stone aggregate is used as coarse aggregate.

3.Methodology

Following test has been performed

Compressive strength test: In this test compressive strength of concrete cubes is determined after 7 days and 28 curing of concrete. The 150mm cubic mould is used. The compression testing machine is used to determine the compressive load carrying capacity of concrete cubes.

Flexural strength test: In this test flexural strength of beam specimen is determined using 2 point loading flexural testing machine. The beam mould specimen used in this study is 500mm length and 100mm X 100mm cross-sectional dimension.

Split tensile strength: In this test the cylindrical mould specimen having 300 mm height and 150mm diameter is prepared and split tensile strength of specimen is determined using compressive strength testing machine.

3. Results and Discussion

Table 4.1: Split tensile strength test results

% Fly Ash Content	Sample No.	Waste Glass Powder %	Split Tensile Strength (Mpa)
			28 Days
0	CM	0	4.31
30	WGP0	0	4.36
25	WGP5	5	4.28
20	WGP10	10	4.12
15	WGP15	15	3.95
10	WGP20	20	3.89

Table 4.2: Compressive Strength test results

% Fly Ash Content	Sample No.	Waste Glass Powder %	Compressive Strength (Mpa)	
			7 Days	28 Days
0	CM	0	22.25	33.65
30	WGP0	0	23.08	36.45
25	WGP5	5	23.24	36.83
20	WGP10	10	22.45	34.45
15	WGP15	15	22.13	32.23
10	WGP20	20	21.57	31.16

Table 4.3: Flexural Strength Test Results

% Fly Ash Content	Sample No.	Waste Glass Powder %	Flexural Strength (Mpa)
			28 Days
0	CM	0	3.58
30	WGP0	0	3.43
25	WGP5	5	3.38
20	WGP10	10	3.28
15	WGP15	15	3.15
10	WGP20	20	3.06

Conclusions

- Compressive strength of Mix posses WGP 5% And Fly Ash 25% more than the control mix. Then after the replacement of fly ash with WGP slightly reduces the compressive strength significantly. PercentageReduction in Compressive strength for mixes CM, WGP0, WGP5, WGP10, WGP15 and WGP20 is 0.0%, 8.3%, 9.5%, 2.4%, -6.4% and -7.4% respectively
- Very less Reduction in Split tensile strength of mixes shows down trend with replacement of cement with fly ash and waste glass powder. PercentageReduction in split tensile strength for mixes CM, WGP0, WGP5, WGP10, WGP15 and WGP20 is 0.0%, 1.2%, -0.7%, -4.4%, -8.4% and -9.7% respectively.
- Very less Reduction in Flexural strength is seen when replacing cement with fly ash and waste glass powder. The rate of reduction of flexural strength with increase of waste glass

powder content in place of fly ash is observed.PercentageReduction in Flexural strength for mixes CM, WGP0, WGP5, WGP10, WGP15 and WGP20 is 0.0%, -4.2%, -5.6%, -8.4%, -12.0% and -14.5% respectively.

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