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Effect of partial replacement of sand by glass powder and steel powder over the properties of concrete: Implementation

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ABSTRACT

In the present research, a series of experiments had been performed to compare the use of glass powder and steel powder as partial replacement of sand in different proportions. Blended cement prepared by mixing Portland cement with Fly ash in 1:0.5 and 1:1 proportion has been used for this study. Concrete mixes are modified by 10%, 15% and 20% and 25% of glass powder and steel powder in replacement.

Keywords: *Steel powder, Glass powder, Concrete, Workability, Compressive strength.*

1. INTRODUCTION

In the present research, a series of experiments had been performed to compare the use of glass powder and steel powder as partial replacement of sand in different proportions. Blended cement prepared by mixing Portland cement with Fly ash in 1:0.5 and 1:1 proportion has been used for this study. Concrete mixes are modified by 10%, 15% and 20% and 25% of glass powder and steel powder in replacement.

It is usually believed that concrete structures designed for a service life of more than 60 years would actually last much longer with no maintenance. But by the use of an inappropriate specification or the use of regular and improper materials or construction practice could be the cause of early deterioration.

The utilization of mineral admixtures or so-called supplementary construction materials offers new chances to concrete technology. With the appropriate selection of the blending material and its chemical admixture, it is now possible to make concrete for focused applications, having ultra-high strength, low permeability and high performance in different environments.

2. OBJECTIVES OF STUDY

In the present research, a series of experiments had been performed

- To compare and determine various mechanical properties of concrete mixes prepared by blending Portland cement and Fly ash cement in two different proportions.
- To determine the effect on properties of concrete mixes which are modified by adding 10%, 15% and 20% and 25% of glass powder and steel powder as partial replacement of sand.
- To study the variation of properties when ingredients are mixed in M20 proportions. The properties studied are 3 days, 14days and 28 days compressive strengths, workability and setting time.

3. METHODOLOGY

Experimental work had been conducted on cement concrete mixes by using a different type of binder mix modified with different percentages of steel powder and glass powder in partial replacement of fine aggregates. Two separate types of concrete mixes were prepared in first category Blended cement has been prepared by mixing Portland cement with Fly ash in 1:0.5 and 1:1 proportion has been used for this study. Concrete mixes are modified by 10%, 15% and 20% and 25% of glass powder and steel powder in replacement. For each replacement, several cubes have been cast for determining the compressive strength and workability.

4. EXPERIMENTAL PROCEDURE

Experiments have been performed for evaluating compressive strength of concrete blocks prepared by replacing sand with glass powder and steel powder in different percentage. Several concrete cubes have been prepared by replacing 10%, 15%, 20% and 25%, sand by weight with these waste materials. For preparing mix the cement, sand, and aggregate have been batched as 1:1.5:3 proportions for forming M-20 mix. Cube moulds of 15 x 15 x 15 cm have been used for casting cubes.
Normal consistency of different mortar mixes has been determined using the following procedure referring to IS 4031: part 4 (1988), two types of the blended mix with cement and fly ash ratio 1:0.5 (M1) and 1:1 (M2) has been prepared.

- 300 gm of sample coarser than 150-micron sieve has been considered.
- The optimum quantity of water has been mixed to the sample and blended comprehensively for 2-3 minutes.
- Cement paste has been placed in the Vicat's apparatus and tested under the needles of Vicat's apparatus.
- Reading has been noted when it was between 5 to 7 mm.
- The percentage of water which satisfies the above condition is normal consistency.

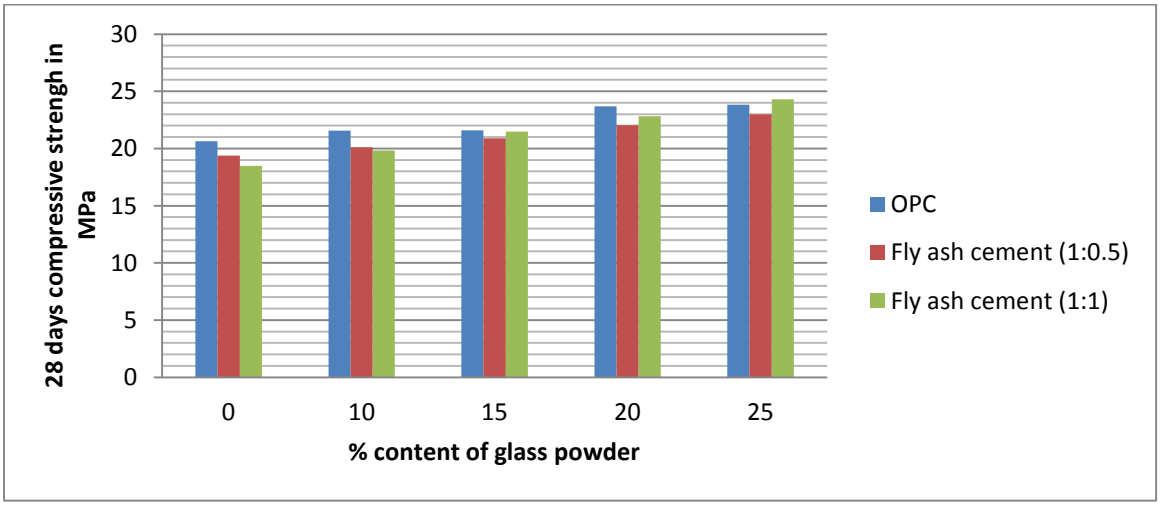
Mix	**Cement+Fly ash (grams)**	**Consistency (%)**
M1	300	31.5
M2	300	34

Before going to do experimental work the physical properties of sand were determined like specific gravity and water absorption. The physical properties of sand are given below:

Fine aggregate	**Specific Gravity**	**Water absorption in %**
Sand	2.55	1.52

5. RESULT

By replacing sand with glass powder in different percentages following results have been obtained:

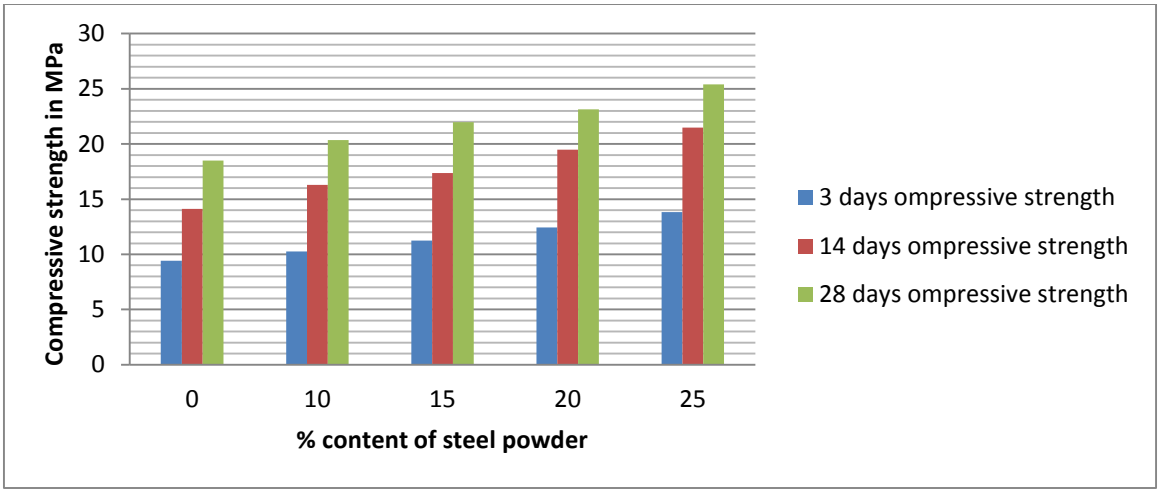


Compressive strength after 28 days

From the above graph, it has been found that –

- The early gain of strength is more in case of fly ash cement with 1:1 blend and gain of strength at later stages is more in case of ordinary Portland cement.
- The major explanation for an early gain of strength in fly ash and cement blend could be the rapid reaction among fly ash and glass powder particles due to fine particles.
- Early strength for all the mixes increases with initial 10% replacement by glass powder. The same is observed in case of 25% replacement.
- For all mixes, it has been observed that up to 25% replacement of sand with glass powder the compressive strength increases with increasing the content of glass powder as partial replacement of sand.

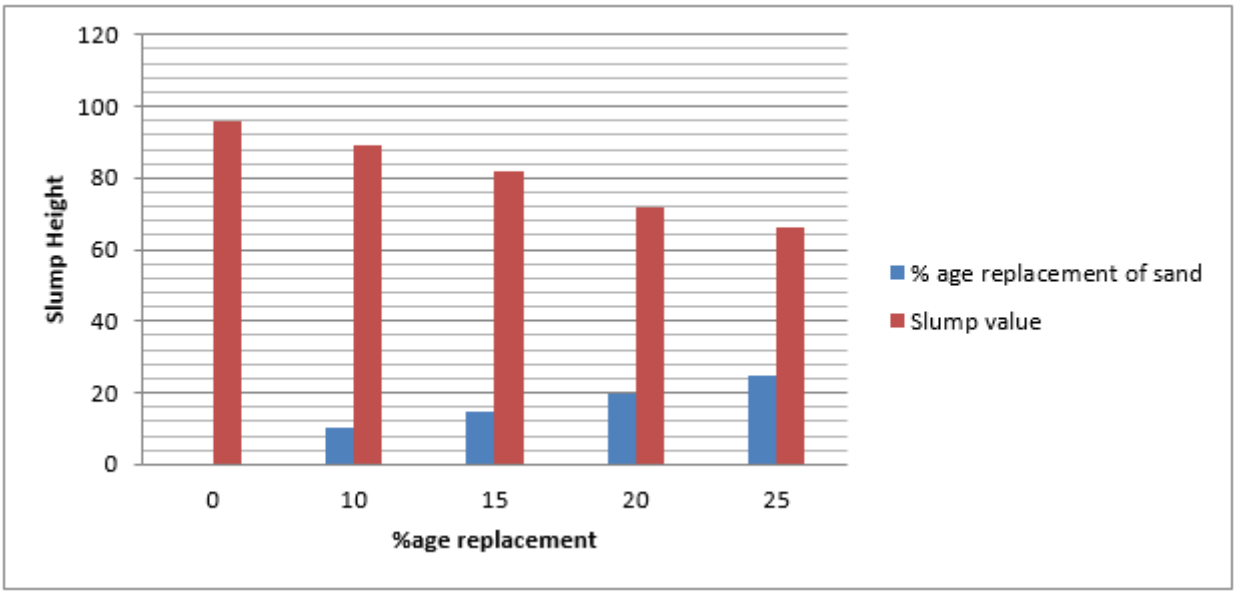
By replacing sand with steel powder in different percentages following results have been obtained:



Along with compressive strength workability of concrete is major parameter required for testing the quality of the concrete mix, again by mixing glass powder in cement concrete in different proportions such as in 10, 15, 20 and 25% following results were obtained.

Results of workability test

MIX	% Replacement	Slump Value
OPC	0	96
	10	89
	15	82
	20	72
	25	66
M1 (1:0.5)	0	98
	10	90
	15	85
	20	77
	25	70
M2 (1:1)	0	108
	10	100
	15	94
	20	88
	25	80



Slump height for OPC

6. CONCLUSION

The main conclusions are drawn are experiments have been done in order to examine Steel Powder and Glass powder as replacement of sand in concrete. Various Concrete mixes were prepared by replacing sand with these materials for determining compressive strength and slump values. It has also been noted that with the increase in the content of supplementary materials decreases the slump value or workability. The inclusion of glass powder increases the compressive strength up-to certain proportions. Steel powder increases the strength but reduces the workability.

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