UTILIZATION OF GLASS POWDER AS A CEMENTITIOUS MATERIAL IN MORTAR

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ABSTRACT. Disposal of waste glass derived from bundling glass, beverage bottles, and so forth is one of the significant issues in the environment. This challenge keeps on expanding with increment the measure of waste glass and reduction the limit of landfill space. Hence, studies have been carried out to locate the handy approaches to reuse waste glass in building material, for example, cement, mortar, and concrete.
In this study impact of waste glass powder (WGP) as cement substitution material on the fresh properties of mortar were explored. The properties of mortar researched incorporate setting time, workability, strength activity index and compressive strength. Results from the investigation demonstrate that utilization of 10% waste glass powder in mortar cube substitute to cement increase strength around to 12%. Additionally, usage of glass powders up to 20% improves the properties of mortar with waste glass powder (GP). However, the workability of mortar decreases as the replacement percentage of glass powder increases because of the fine surface area of glass powder.

Keywords: Waste glass, strength activity index, flow test, compressive strength

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INTRODUCTION

Manufacturing process, industrial waste and municipal solid waste are the wellsprings of make in charge of the making many waste materials. Concern connected with disposing the generated wastes extremely increased with increasing consciousness about the atmosphere. Hence, it become necessary to reuse the waste materials alternative to disposal.

Large of natural ingredients are used in worldwide for the manufacturing of cement and concrete. During twenty centuries different studied has been carried out for the usage of recycled glass as aggregate in manufacturing of cement. But it is observed that cement formed by these aggregates cracked because of the alkali-silica reaction (ASR) [1-2]. Due to the worry of the natural effect of waste glass, a considerable measure of studies has been done as of late for the utilization of recycled glass as in concrete. These examinations inquired about the properties of the waste glass aggregate, and endeavoured to find the perfect level of recycled glass which used as aggregate with no effect on the properties of the concrete. It also observed that particle size of recycled glass plays important role in the ASR [3]. Bearing in mind this situation, recycled glass of finer milled powder size may be used as supplementary cementitious materials. Because finer size waste glass content high amount of silica content, waste glass powder shows a suitable pozzolanic material for production of concrete composites. On the other hand, particle size of recycled glass plays vital role for pozzolanic activity. Shi and Wu specified that mortar congaing waste glass powder of size less than 100µm shows strength activity index more than 74% [4]. Also, Nassar and Soroushian observed that the partial substitution of cement with waste glass powder improves the compressive strength of modified concrete in compared to control concrete [5].

By observing the previous research, properties of mortar/concrete. In this research study the effect of glass powder on the properties of mortar. This study includes strength activity index, flow test and Compressive strength respectively.

EXPERIMENTAL

For the sample preparation, Portland cement of grade 53 conforming to IS 12269:1987 [6], Quartz sand of size less than 2.36mm sieve as per IS460 (Part 1) [7] used. The GP used in this study of size finer than 20µm and specific gravity of 2.25 respectively. Similarly, cement had specific gravity of 3.10 and average particle size of less than 50µm. The particle size of GP and Cement is calculated by Blaine's Air permeability method.

Table 1 Chemical composition of used materials by XRF

	CEMENT	WGP
SiO_2	20.6	80.84
Al_2O_3	4.8	1.10
Fe_2O_3	3.5	0.04
CaO	64	7.50
MgO	0.1	0.38
K_2O	3.4	0.30
Na_2O	0.3	9.64
SO_3	0.3	0.20
Loss on ignition		0.8

The portland cement substitution was 0, 10, 20 and 30% of mass respectively. For all the mortar paste the constant water/cementitious ratio 0.35 was chosen. The mix proportions used in this research in the proportion of 1:3.

RESULT AND DISCUSSIONS

Strength Activity Index

As per the requirements of ASTM C 618 [8], GP can be used as a pozzolanic material if it satisfies the requirement mentioned in code. If the addition of SiO_2 + Al_2O_3 + Fe_eO_3 is greater than 70%. Also, SAI should be minimum of 75% of control mortar at curing of 7 and 28-days age.

$$SAI = \frac{average\ compressive\ strength\ of\ blended\ cement\ mortar}{average\ compressive\ strength\ of\ control\ mortar\ bars}$$

From the table1, it is observed that chemical composition of GP satisfies the requirement of ASTM C 618. Also, SAI of GP at 7 and 28 days is more than 100% as presented in figure 2. Also, for 56 days is greater than 75% up to 20%. But beyond that SAI less than requirement. Hence up to 20% it satisfies the pozzolanic activity which shown in figure 2.

Flow Test

The workability of mortar is calculated by the flow table test as per IS:1727(1967) [9]. The results of flow table are presented in figure 1 with different percentage of GP. In this test maintaining constant flow of 110mm, the water content for different variation of GP is shown in the figure 1. From the results, it can be said that the increase in the percentage of GP increases the water content. The increase in water content because of smaller particle size of glass powder.

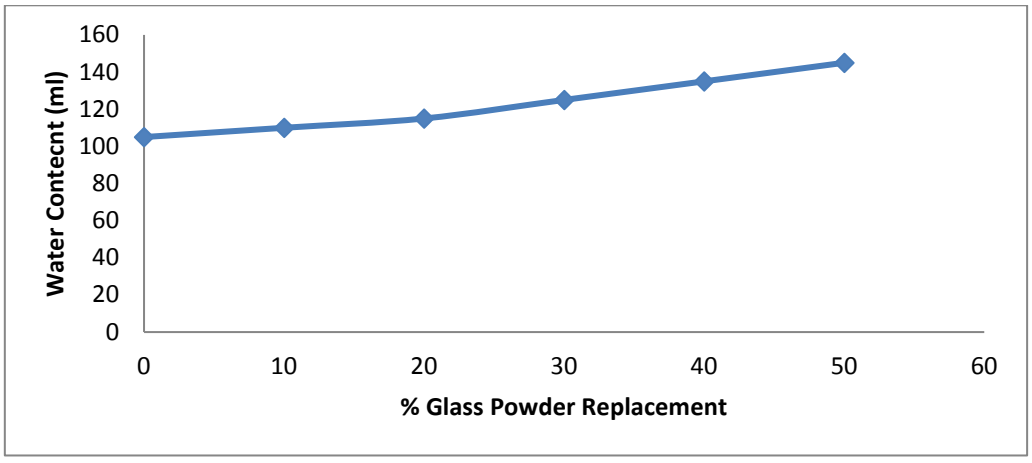

Figure 1 Water content for mortar modified with WGP as a cement replacement keeping flowability 110mm.

Compressive Strength

Compressive strength with the addition of recycled glass powder in mortar at different age given in figure 2. Lower mean compressive strength compared to control mortar were

obtained at 7, 28 and 56 days. Except 30% GP substitution, all other cement replacement gives the maximum compressive strength compared to control mortar at 56 days. The results satisfy with the previous research by Nassar and Soroushian [5]. From the results, it can be seen that the GP replacement of 10% increases the compressive strength around to 6% at 28 days compared to control concrete. At 56days age, the20% GP gives the maximum compressive strength compared to control mortar around to 11%.

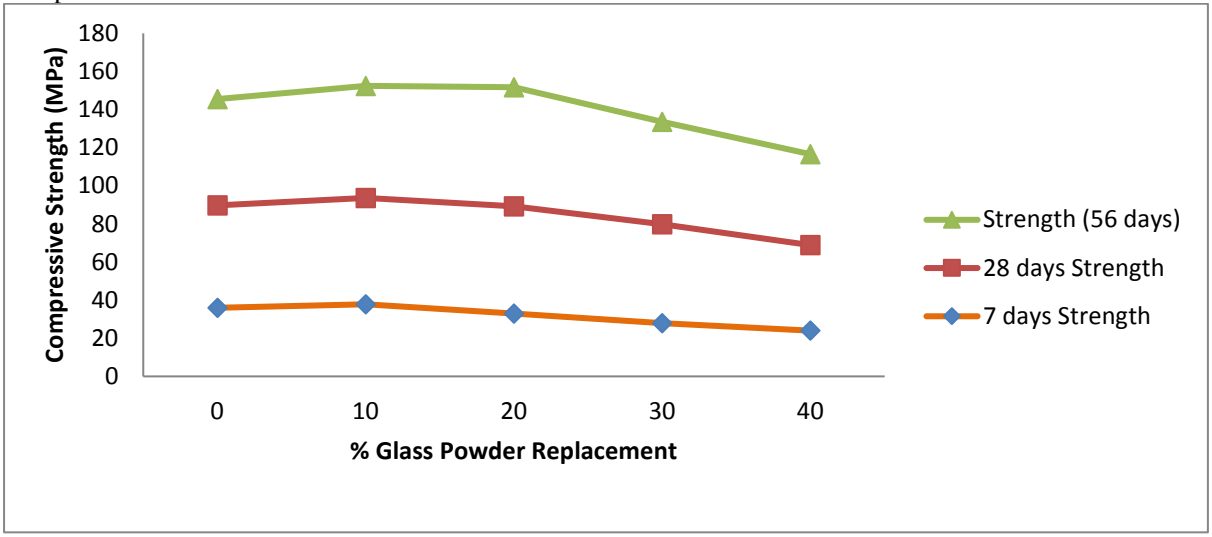

Figure 2 The compressive strength of Mortar mix grade 53MPa

CONCLUDING REMARKS

This research evaluates the effect of incorporation of glass powder on the properties of mortar pastes with partial replacement of cement is investigated. From the results, it is clear that the pozzolanic activity of glass powder is depend on the particle size of glass powder. As the finer size glass powder improves the properties of the cement mortar. Also, on other hand, up to 20% replacement of glass powder with cement content improves the compressive strength around to 11% respectively at 56 days age.

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