Partial Replacement Cement in Concrete Using Waste Glass

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Abstract

This paper investigates the performance of concrete containing glass powder as partial substitution of cement. Portland cement (PC) was partially replaced with 0-40% glass powder. Testing included ultrasonic pulse velocity, compressive strength and absorption. Specimens were cured in water at 20°C. The results indicate that the maximum strength of concrete occurs at around 10% glass powder. Beyond 10% glass powder the strength of concrete reduces and is lower than that of the control.

1. INTRODUCTION

Due to global warming the need to cut down energy consumption has increased. The effect of global warming has impacted everyone on the planet and is a well-recognized concept. High levels of energy are needed to produce cement, which release large amounts of carbon dioxide (CO2) and also contributes to the green house gases. Atmospheric levels of carbon dioxide have risen by about 30 percent over the past 200 years. Each year approximately 111 million tones of controlled waste from household, commercial and industrial waste are disposed of in landfill sites in worldwide causing a rise in land fill costs and environmental problem. Recycling of construction waste help saving the limited landfill space and save waste save waste disposal costs. The energy required to reuse the recyclable materials is less that of virgin materials. Use of recycled materials in construction is the most attractive option because of the large quantity due to widespread sites of construction. Recycled aggregate can be used in as replacement in asphalt concrete, unbound base course, pipe bedding, landfill gas venting systems and gravel backfill for drains.

The use of recycled waste glass in Portland cement and concrete has attracted a lot of interest worldwide due to the increased disposal cost and environmental concern. Glass used for containers, jars and bottle is soda lime silica counts for 80 percent of the recycled glass. based application. The main concerns for the use of crushed glass as aggregate for Portland cement concrete are the experiment and cracking caused by the glass `aggregate due to alkali silica reaction. Due its silica content ground glass is considered a pozzolinc materials and as such can exhibit properties similar to other pozzolanic materials such as fly ash, metakaolin, slag and wheat husk ash.In this paper preliminary result of an experimental investigation on the use of glass powder to partially replace cement in concrete application.

Although their is strength reaction in the presence of glass powder , however, glass powder can be used to replaces 30 percent of the cement in concrete mix with satisfactory strength development due to its pozzolani creation.

2. MATERIALS AND METHOD

The control mix (c1) has proportion (by weight) of 1 (cement): 2(sand): 4(coarse aggregate) and the water to cement ratio (w/c) is 0.5. In mixes C2,C3, C4,C5, the cement is partially replaced with 10%,20%,30% and 40% glass powder.

For each mix, 3 cubes of 150*150*150mm in size were prepared. Before casting, the slump test was conducted to assess the workability. Specimens were cast in steel moulds and placed in a room at 20 C to 24 C hour until demoulding. Thereafter all specimens were placed in water at 20 C . the cubes were used to determine compressive strength was determined at 28 days only.

3. OBJECTIVE

To evaluate the utility of Glass powder as a partial replacement of cement in concrete .To study and compare the performance of conventional concrete and Glass powder concrete. To understand the effectiveness of glass powder in strength enhancement.

TABLE 1: Chief constituents of Portland Cement

Lime	62%
Silica	22%
Alumina	05%
Calcium Sulphate	04%
Iron Oxide	03%
Magnesia	02%
Sulphur	01%
Alkalis	01%

TABLE 2: Constituments Of Glass

Silica	72.50%
Alumina	01.06%
Lime	08%
Iron Oxide	0.36%
Magnesia	4.18%
Sodium Oxide	13.1%
Potassium Oxide	0.26%
Sulphur Trioxide	0.18%

Thus the above tables are showing chemical properties of glass and Portland cement from the above table. we conclude that the present of silica in cement is the binding property for the concrete, the strength of the concrete mainly depends upon the binding property of cement. In the glass silica is rich. When we use the glass in concrete it increase the binding strength and automatically strength of concrete increased.

4. EXPERIMENTAL WORKS IMAGES

Fig. 1: crushing of glass pieces using loss angles machine

Fig. 2: glass powder passed through 300 micron sieve

Fig. 3: UTM for compressive strength

5. RESULT

Figure 4 shows the slump value for concrete with varying amount of glass powder as partial replacement of cement. There is a systematic increases. In slump as the glass powder in the mix increases. The slump ranged from around 40mm for the reference mix(i.e. 0% glass powder) to 160mm at 40% glass powder.

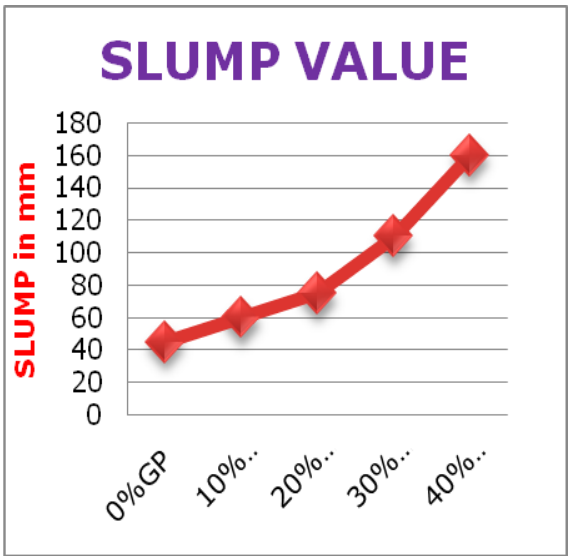

Fig. 4: Slump values of concretes with varying amounts of glass powder

The density values for the various mixes with and without glass powder is presented in figure 5. The densities ranged from 2180 to 230 kg/m3. All densities seem to be similar except the mix With 40% glass powder where a slight drop is observed. The average density for all mixes ia about 2280 kg/m3.

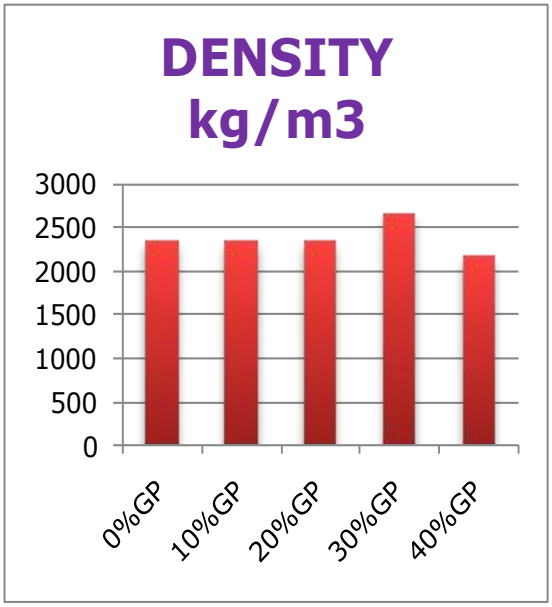

Fig. 5: Density of concretes with varying amounts of glass Powder

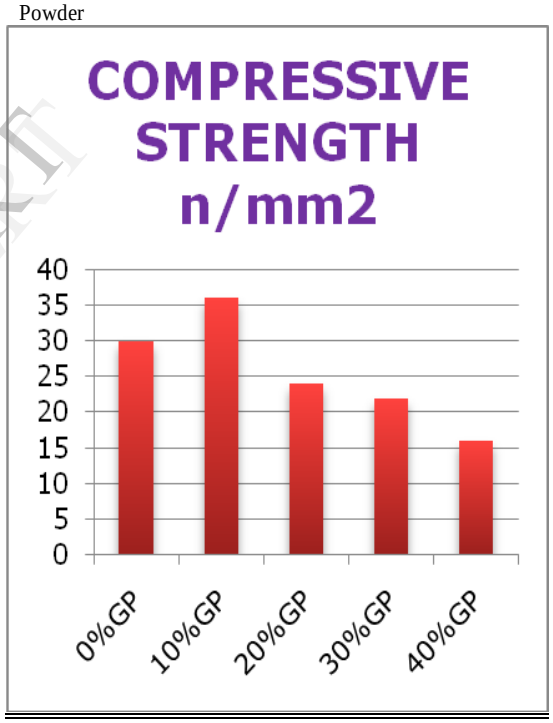

Fig. 6: Compressive strength of concretes with varying amounts of ground glass at 28 days of curing

The compressive strength values at 28 days of curing are shown in figure 6. There is an increase in compressive strength at 10% glass powder compared to the control. All other concrete mixes contain glass powder (above 20%) show a systematic reduction in strength with the increase in glass powder content.

6. CONCLUSIONS

Using ground glass powder can reduce the use of cement and the associated energy demand impact on air pollution and CO2 emission. The slump of concrete seems to increase in glass powder in the concrete mix. At 10% glass powder content the compressive strength of concrete is higher than that of the control. Above 20% glass powder the strength substantially decrease.

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