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Strength Properties of Concrete Containing Waste Glass Powder

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Abstract
The aim of this paper is to study the behavior of M-30 grade of concrete to determine the compressive strength and split tensile strength by partially replacement of cement by waste glass powder. Cement was partially replaced by waste glass powder in 10%, 20% and 30% by weight. All the tests were performed according to Bureau of Indian standards. The results thus obtained were compared and examined with respect to the control specimen. The addition of waste glass powder enhances its compressive strength as well as split tensile strength. The optimum percentage of partially replacing cement by glass powder was 10% which showed the maximum improvement in compressive and split tensile strength.

Keywords – Concrete, Waste Glass Powder, Pozzolanic Materials, Compressive Strength, Split Tensile Strength.

I. INTRODUCTION

Concrete is a major construction material used all over the world and cement is a major component of concrete. While making cement carbon-di-oxide (CO_2) is produced which contribute to green house gases.Environmental issues are of major concern in the development of cement and concrete industry [Naik and Mariconi, 2005].There is need to replace a part of cement by some pozzolanic material to reduce the cement consumption and to control the environmental pollution to some extent. In recent researches it has been shown that waste glass in powdered form can be used in concrete to enhance the strength characteristics to certain extent.

Glass is a widely used product in our daily life in various forms. It is a transparent material produced by melting a mixture of material such as silica, soda ash and calcium carbonate at high temperature followed by cooling and solidification, without crystallization. Since waste glass has silica content it exhibits pozzolanic properties and so by partially replacing cement with such pozzolanic material can meets the need of both the construction and environmental aspects.

Waste glass is generated in large quantity all over the world. In India, 0.7% of total urban waste comprises of glass [1]. The land filling of such material is undesirable.Because of its non biodegradable properties it is less eco friendly and hence utilization of this waste is needed. There is huge potential for using waste glass in the concrete construction sector. Waste glasses when reused in making concrete products, there is a decrement in production cost [3]. A high amount of waste glass as aggregate decreases the concrete unit weight (Christopher cheeseman, 2011, Mageswari.L.M and B.Vidivelli, 2010). The use of fine glass powder as a cement replacement material has yielded positive results (Malek Batayneh, Iqbal Marie, Ibrahim Asi,2007)

This paper envisages the effect of waste glass powder as a partial replacement of cement in concrete.

II. EXPERIMENTAL INVESTIGATION

Test specimen details: - Experiments were conducted on cubes and circular specimen.The cube specimen of dimensions 150mm x 150mm x150 mm and cylindrical specimens of height 300mm and 150mm diameter were used. The ingredient used in concrete was PPC (JP cement), Local River sand confirming to zone II (specific gravity 2.61) and clean portable water. A design mix of M-30 was used to prepare the specimens.

Cement was partially replaced by 10%, 20% and 30% of glass powder by weight.

Fig.1- Testing of Cube specimen

Fig.2 – Testing of Cylinder specimen

III. EXPERIMENTAL RESULTS AND DISCUSSION

For cube specimen total four sets of cubes GP-0,GP-10,GP-20 and GP-30 were tested for their compressive strength and for cylindrical specimen total four sets CGP-0,CGP-10,CGP-20 and CGP-30 were tested for split tensile strength for different proportions of waste glass powder i.e 0%,10%, 20% and 30% respectively. It was observed that the specimen having glass powder 10% has maximum compressive and split tensile strength when compared to that of the specimens without glass powder.

IV. RESULTS

The compressive strength values at 28, 56 and 90 days of curing are shown in Table-1 and average split tensile strength at 28 days are shown in fig-4.There is an increase in compressive strength and split tensile strength at 10% glass powder. All other concrete mixes containing glass powder (above 10%) show a gradual reduction in strength with the increase in glass powder content.

Table-1 Average compressive strength of specimen

S. No.	Cube Specimen Designation (sets)	No. of cube specimens	Avg. compressive strength (N/mm^2) 28 days	Avg. compressive strength (N/mm^2) 56 days	Avg. compressive strength (N/mm^2) 90 days
1	GP-0	3	40.25	42.14	42.99
2	GP-10	3	41.99	43.74	44.32
3	GP-20	3	35.31	36.47	37.20
4	GP-30	3	33.71	34.73	35.45

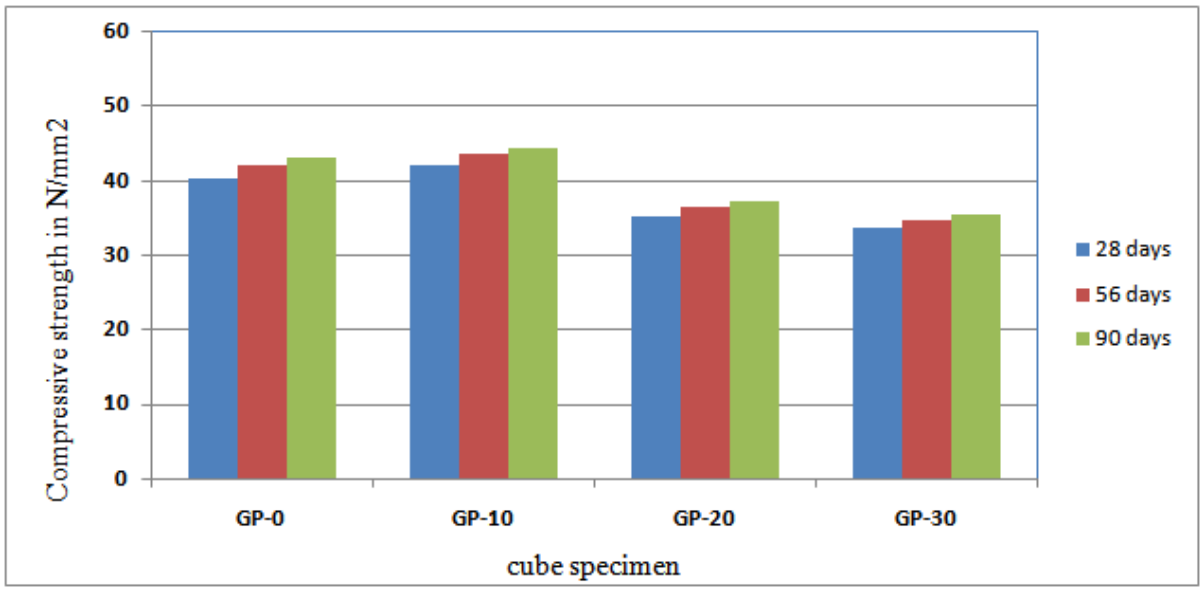

Fig-3 Average Compressive strength of specimens

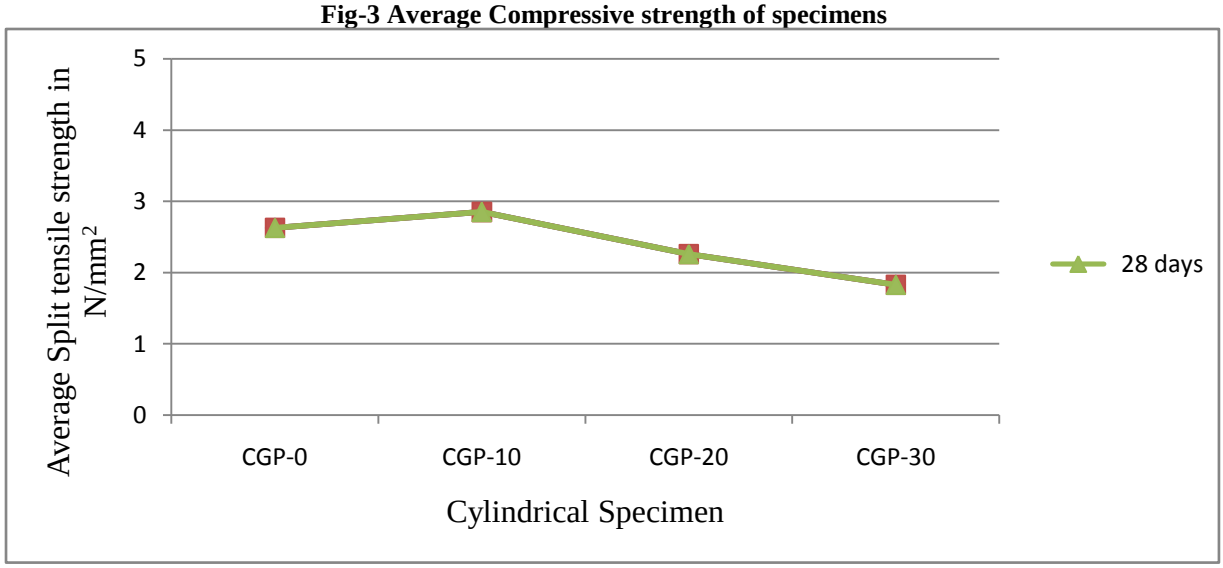

Fig-4 Average split tensile strength of specimens

V. DISCUSSION

From the test result (shown in fig.3 and fig.4) it is clear that there is significant increase in strength of specimens partially replaced with 10% waste glass powder (GP-10). Specimen having glass powder more than 10% shows a subsequent reduction in strength.

VI. CONCLUSIONS

From the series of tests conducted on the concrete specimens with different proportions of waste glass powder following conclusions are drawn:

- There is a gradual increase in the strength of concrete with the addition of glass powder.
- At the replacement of 10% of cement by glass powder meets maximum strength as compare to that of normal concrete and other percentage of replacement of cement.

From the study it can be concluded that waste glass powder can be used to increase the strength upto certain extent.

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