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USE OF GLASS POWDER AND QUARRY DUST AS FINE AGGREGATE IN CONCRETE

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Abstract - This paper presents an evaluation of the use of glass powder and quarry dust as partial replacement of fine aggregate in concrete Generally Concrete is used more than any other man-made material in the world. The wastes are disposed as landfills which are unsustainable by converting the waste to developed the sustainable environment and economical. For this purpose the test were carried to determine the properties of glass and quarry dust. Glass were crushed and sieved for particle size, specific gravity, bulk density tests are examined. The admixtures are finely divided materials which are added with fine aggregate in small amount, generally increasing range of 10% of work replacement with granulated waste materials such as glass and quarry dust can be used in cementitious concrete composites without seriously hindering its mechanical properties up to the composition range used in the study (10% and 20%) respectively. The use of admixtures like glass and quarry dust as partial replacement of fine aggregate improves the strength and durability it also reduces the CO_2 emission and cost by using recycled materials. In this paper we have concluded the granulated waste materials are used for concrete materials to evaluate the effectiveness of glass powder and quarry dust in strength enhancement and cost reduction. Strength and the result were compared with conventional concrete. Finally the effect of waste glass powder and the quarry waste in the production of high strength concrete was discussed.

Keywords: Glass Waste, Quarry dust, Compressive Strength of Concrete, Flexural strength, admixtures, Durability.

I. Introduction

The concrete is used worldwide has increased phenomenally, especially in infrastructure projects. In fact, these developments have complimented and improved the performance and use of concrete in structures. The knowledge of concrete controlled protection, maintenance, testing, and repair is vital for a discerning designer to ensure its optimal use. The large num of failures of structures has underlined the need for a better understanding of the behavior of concrete, especially in challenging environmental condition. In most codes of practice, the allowable concrete stresses are limited to about 50 percent of the ultimate strength; thus the fatigue strength of concrete is generally not a problem. This study investigated the compressive strength, split tension test and flexural strength of various sizes in plain cement concrete.

II. Properties of the Material Used

Cement: Raw materials for manufacturing cement consist of basically calcareous and siliceous (generally argillaceous) material. The mixture is heated to a high temperature within a rotating kiln to produce a complex group of chemicals, collectively called cement clinker.

Specific Gravity - 3.15

Iniital and Final Setting time is 30 mins and 10hrs.

Aggregates: One of the most important factors for producing workable concrete is good gradation of aggregates. Good grading implies that a sample contains minimum voids.

Coarse Aggregates: Size is 20mm

Specific gravity is 2.78

Fine Aggregate Size is 4.75mm to 150 micron

Specific gravity is 2.65

III. Mix Design

Specific Gravity (coarse aggregate) = 2.7

Specific Gravity (fine aggregate) = 2.7

Specific Gravity (cement) = 3.15

Compaction factor = 0.9

Quality = good

Degree of exposure = mild

To find fck:

fck = fck + ts (using IS 10262, 1992)

= fck+1.65×5

= 80+1.65×5

= 88.53 N/mm^2 (compressive strength)

Water Cement Ratio is 0.283

Using "Fig 1- Generalized Relation between Free Water-Cement Ratio and Compressive Strength of Concrete" of IS 10262-1992

Water and Sand (%)

Density of Mix 1

(Without Micro Silica Fume):

10*2.65*(100-1.5) + (495*(1- 2.65/3.15)) – 140*(2.65-1) = 2457 kg/m^3

Aggregates = 2457 – 140 – 495 = 1822 kg/m^3

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Sand = 1822 x 0.45 = 820 kg/m^3 (say)

12.5 mm Aggregate = 1822 x 0.55 =1002 kg/m^3 (say)

Density of Mix 2

(With Micro Silica Fume):

10*2.65*(100-1.5) + (450*(1-(2.65/3.15)) + 45*(1-(2.65/2.20))) – 140*(2.65-1) = 2440 kg/m^3

Aggregates = 2440 – 140 – 450 – 45 = 1805 kg/m^3

Sand = 1805 x 0.45 = 810 kg/m^3 (say)

12.5mm Aggregate = 1805 x 0.5 = 995 kg/m^3 (say)

Table – I : Mix Proportions

Mix proportion	Cement	Fine Aggregate	Course Aggregate
Without Micro Silica fume	1	1.65	2.02
With Micro Silica fume	1	1.80	2.21

IV. Mechanical Properties of the Concrete

A. Compressive strength on concrete Cubes

The various strength of concrete is determined. The determination of compressive strength has received a large amount of attention because the concrete is primarily mean to with stand compressive stresses. Compression testing specimens used to determine the compressive strength. The cubes sizes are usually of 100mm or 150mm side.

TABLE II. Compressive Strength of Plain Cement Concrete with Micro Silica

Designation	Compressive Strength of Cubes (N/mm²)	
	7 Days	28 Days
Plain Cement Concrete with Micro Silica	65.30	85.60
	63.20	86.30
	65.80	85.90
	64.74	85.90

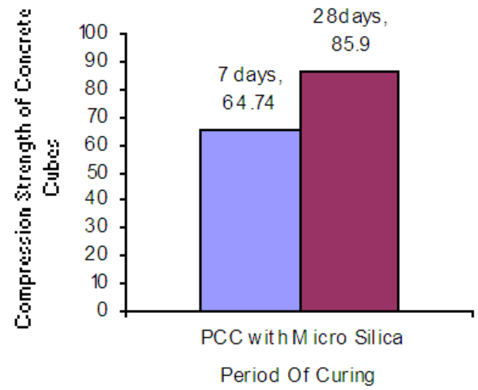

Fig. 1 Comperssive Strength of Cube for PCC with Micro Silica Fumes

TABLE III. Comperssive Strength of Cube for PCC without Micro Silica Fumes

Designation	Compressive Strength of Cubes (N/mm²)	
	7 Days	28 Days
Plain Cement Concrete without Micro Silica	55.20	68.60
	55.60	67.30
	56.70	68.90
	55.83	68.26

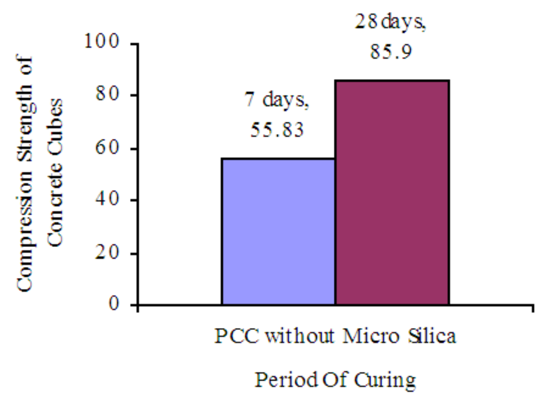

Fig. 2. Comperssive Strength of Cube for PCC without Micro Silica Fumes

A. Split Tensile Strength on the Concrete Cylinder

The test is carried out by placing a cylinder specimen horizontally between the loading surface of a compression testing machine and the load is applied until failure of the cylinder, along the vertical diameter. 2P/ΠLD

Where, p is the compressive load on the cylinder

L is the length of the cylinder

D is its diameter

TABLE IV. Split Tensile Strength of Plain Cement Concrete with Micro Silica

Designation	Split Tensile Strength of Cubes (N/mm²)	
	7 Days	28 Days
Plain Cement Concrete with Micro Silica	4.23 4.55 4.23	5.14 5.36 4.98
	4.38	5.16

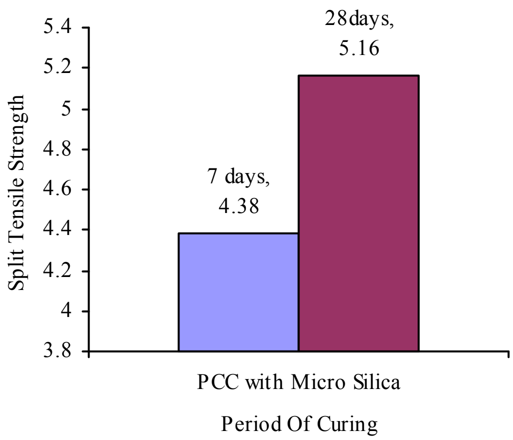

Fig 3 : Split Tensile Strength of Plain Cement Concrete with Micro Silica

Table – V: Split Tensile Strength of Plain Cement Concrete without Micro Silica

Designation	Split Tensile Strength (N/mm²)	
	7 Days	28 Days
Plain Cement Concrete without Micro Silica	3.25 3.89 3.78	4.78 4.89 4.98
	3.64	4.88

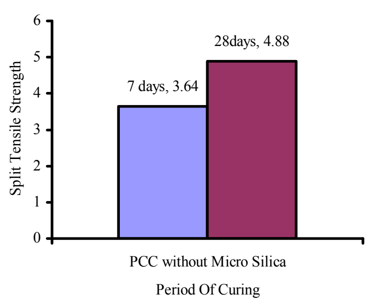

Fig 4 : Split Tensile Strength of Plain Cement Concrete without Micro Silica

B. Flexural strength on concrete

The cylindrical specimen is placed horizontally between the loading surfaces of a compression testing machine. Narrow packing strips of suitable material such as plywood is used to reduce the high compression stresses. The load is applied without shock and increasing continuously at a rate of the specimen. The load is increased till the specimen fails and the continuous load applied to the specimen during the test is recorded, the figure shows the split tensile testing machine for the concrete cylinder.

TABLE VI. Tensile strength test on Beam

Designation	Flexural Strength of Beam (N/mm²)	
	7 Days	28 Days
Plain Cement Concrete Prism	3.25 3.89 3.78	4.78 4.89 4.98
	3.64	4.88

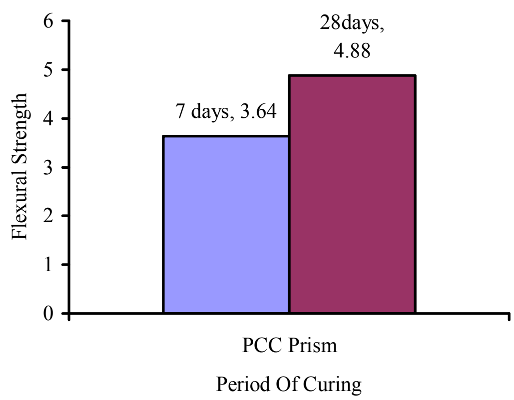

Fig 5 : Tensile Strength of Beam

V. Conclusion

This study was conducted to evaluate the effect of using solid waste materials as substitutes for fine aggregates and coarse aggregates on the mechanical properties of cementitious concrete composites

The compressive strength of concrete was decreased by 5% in replacement of fine aggregate and coarse with mixed concrete

The density of concrete also decreased by 15% which becomes lighter than the conventional concrete of density 2400 kg per metre cube. These types of concrete can be adopted in any type of building work which has to withstand more loads. Due to its Workability and self-compacting nature, it can be used more in precast structures.

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