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"Experimental Investigation on the Properties of Concrete with Partially Replacement of Cement by Glass Powder"

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ABTRACT: *Concrete is a construction material composed of Cement, fine aggregate, coarse aggregate and water with or without admixtures. The concrete industry is one of the heaviest consumers of natural resources due to which sustainability of concrete industry is under threat. The biggest problem facing the concrete industry is the environmental and economic concern. Currently, in India, it is estimated that the annual consumption of cement concrete is to the tune of 400 million tonnes. Hence, till date, cement is still challenging as an uncompetitive material thereby warning the need to research and find out materials for replacing this partially or fully. In this research study, the Ordinary Portland Cement (Grade 43) has been partially replaced by Waste Glass Powder (GLP) accordingly in the proportion of 0%,* 5%, 10%, 15%, 20%, 25%, 30%, 35% & 40%, by weight of M-40 grade concrete. Concrete mixtures were produced, tested and compared in terms of Compressive Strength, Split Tensile Strength and Flexural Strength of the conventional concrete at a period of 28 days.

Key word: Cement, Concrete, Pozzolanic Material, Strength, Waste Glass Powder, **Compressive Strength, Split Tensile Strength and Flexural Strength**

I. INTRODUCTION

Cement is one of the most extensively used versatile materials in construction industry. The development of the construction industry at a global level needs more and more amount of Portland cement for sustainable development. Manufacturing of Portland cement is an energy intensive process and releases very large amount of greenhouse gases into the atmosphere, which affect the earth's ecosystem. Efforts are being carried out to conserve energy by means of promoting the use of industrial wastes or by-products, which contain amorphous silica in its chemical composition, as mineral admixture for partial replacement of cement.

II. MATERIALS AND METHOD

Waste Glass Powder

Glass powder is a highly fine powder made from ground glass. High precision machining equipment is necessary to prepare it, as it needs to be very uniform with an even consistency. The process involves dry or wet grinding to achieve particles of the desired size. Pigments can be added to make coloured glass powders. The glass powder is formed by crushing, milling, dry or wet grinding and sieving to achieve particles of the desired size. Glass powder particle size range is between 30 microns and 0.4 microns. Glass powder is used in a wide variety of applications so they come in a range of particle sizes and particle distributions. Glass powders are used to fabricate glass products, glazes, vitrified grinding wheels, and bonded abrasives.

III. LITERATURE REVIEW

Many works have been carry out to explore the benefits of using various waste materials such as granite dust, marble dust, stone dust and glass powder in making and enhancing the properties of concrete.

Abdullah Anwar2016, The Influence of Waste Glass Powder As A Pozzolanic Material In Concrete. In this research study, theOrdinary Portland Cement (Grade 43) has been partially replaced by Waste Glass Powder (GLP) accordingly in the proportion..

Patel Dhirendra et al investigated the strength characteristics of pre cast blocks incorporating waste glass powder and studied that the moderate level decrease in the compressive strength at 28 days occurs. and coarse glass powder as partial replacement of cement and results showed that 15% dosage for replacement is optimal.

IV. OBJECTIVE

Cement is replaced by glass powder in different percentages like 0%, 5%, 10%, 15%, 20%, 25%, 30%,

35%, 40%, Strength properties of concrete such as compressive strength, tensile strength, flexural strength and impact strength were studied when the cement is replaced by waste glass powder.

The objective of this study is to search alternatives material which can fully or partially replaced naturally available material in construction.

V. EXPERIMENT AND METHODOLOGY

Plan of Experimentation

The Experimental investigation is planned as follows.
1. To find the properties of the materials such as cement, sand, coarse aggregate, water and Waste glass Powder

2. To obtain Mix proportions of OPC concrete for M40 by IS method (10262-2009)

3. To prepare the concrete specimens such as cubes for compressive strength, cylinders for split tensile test, prisms for flexural strength and also cubes for durability studies in laboratory with 0%, 5%, 10%, 15%, 20%, 25%, 30%, 35% & 40%, replacement of Glass powder with OPC for M40 grade concrete.

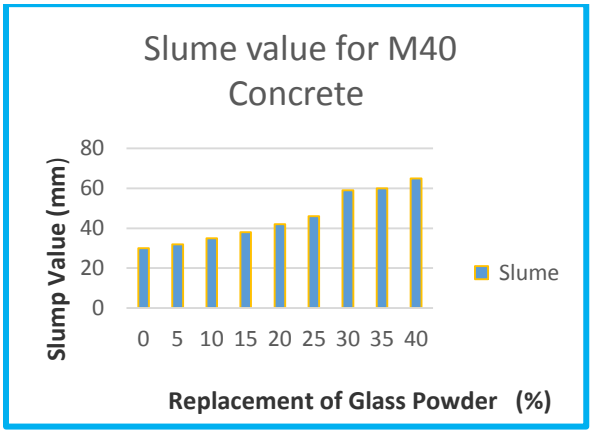
4. To cure the specimens for7,14 and 28 days
5. To evaluate the mechanical characteristics of concrete such as compressive strength, split tensile test, flexural strength.

6. To evaluate and compare the results.
7. To check the economic viability of the usage of Glass Powder, Keeping in view of the safety measure

VI. RESULT

Tests for Workability

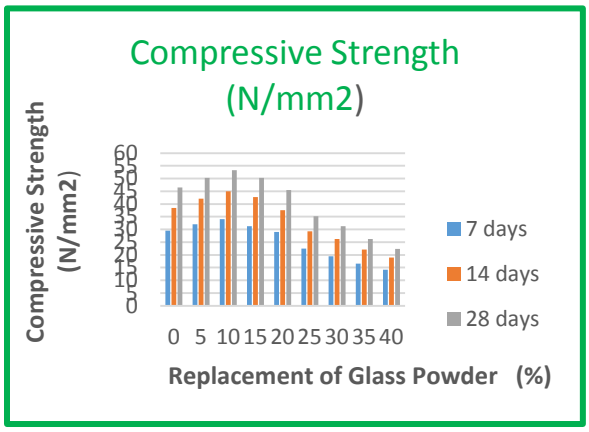
The workability is tested in this work via a slump check. Once the concrete is freshly mixed it is then checked by filling in the slump cone with the fresh concrete. The workability is determined by extracting the slump cone and calculated by the concrete subsidence this value is called the concrete slump value



Percentage Content of Waste Glass Powder **vs** Slump Value

Compressive Strength Test

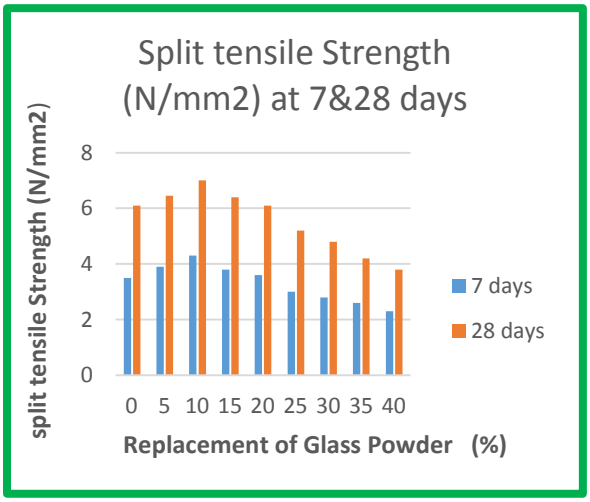
CTM of 2000 kN capacity was used with load rate of approximately 140 kg/cm /min until failure for Compressive strength test. The test results for compressive strength are presented



Percentage Content of Waste Glass Powder vs Compressive Strength at7,14& 28 days

Split Tensile Strength Test

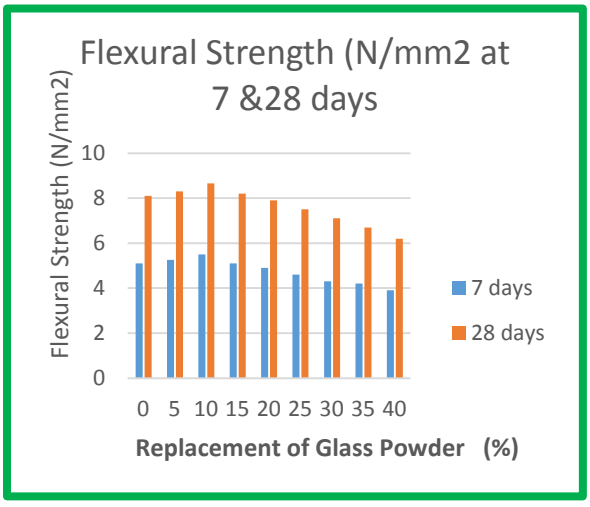
For split tensile strength, the load was applied without shock and increased continuously at a nominal rate within the range 1.2 N/mm2/min to 2.4 N/mm2/min until failure of the specimen. The test results for split tensile strength are presented



Percentage Content of Waste Glass Powder vs Split Tensile Strength

Flexure Strength Test

he prism specimens was placed in the machine in such a manner that the load was applied to the uppermost surface as cast in the mould, along two lines spaced 13.33cm apart. The axis of the specimen was carefully aligned with the axis of the loading device. The load was applied through two similar steel rollers, 38mm in diameter, mounted at the third points of the supporting span that is spaced at 13.33cm center to centre. The load was applied without shock and increased continuously at a rate of 180 kg/min until the specimen failed. The test results for Flexural strength are presented



Percentage Content of Waste Glass Powder vs Flexural Strength of Concrete at 7 and 28 days

VII. CONCLUSION AND DISCUSSION

- From the experiment, it was found that At period of 28 days, Conventional Concrete shows the Compressive Strength as 45.5 MPa, Split Tensile Strength as 7 MPa and Flexural Strength as 8.65 MPa.
- The maximum values of Compressive Strength, Split Tensile Strength and Flexural Strength were found at 10% replacement of cement by glass powder. With 10% replacement of cement by waste glass powder the increase in compressive strength was 15.56%, split tensile strength was 8.16% and flexural strength was 8.57%
- From the experiment it was found that However, upto 20% replacement of cement by waste glass powder the concrete gives satisfactory strength results in terms of compressive strength, split tensile strength and flexural strength for M-40 grade
- Therefore, considering the strength criteria of concrete, the replacement of cement by waste glass powder is feasible upto 20% .

DISCSSION

The production of Glass Powder is capable of reducing the impact of emissions produced by the cement manufacturing industries by acting as a replacement for cement. By experimental analysis it has been observed that the compressive and the flexural strength is compatible for replacement of cement. It will also overcome the problem of hydration which takes place in cement. In the environmental context it would act as an eco-friendly material and economically it is much feasible in terms of cost. Overall it is a feasible material for the replacement of cement. It can be concluded that glass powder can be used in concrete to enhance its strength and workability, but glass powder increase much final strength,. So, glass powder also gives better strength as compared to ordinary concrete.

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