Waste Glass Powder as Partial Replacement of Cement-Review

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***ABSTRACT* - Safe disposal of the huge amount of waste glass has become a serious environmental concern in many countries. Plastic is generated in large quantities all over the world.it is believed that the breakdown of plastic takes time of more than thousand years. Improper plastic waste management leads to several environmental and health hazard. On the other hand, the production of concrete uses huge amount of natural resources and adds greenhouse gases to the environment. Therefore, researchers have been working on the reuse of waste glass as a supplementary cementitious material in the production of cement, mortar and concrete. Glass is principally composed of silica .Use of milled waste glass in concrete as partial replacement of cement could be an important step towards development of sustainable infrastructure systems.In this research compressive strength and flow tests on mortar and concrete were carried out by adding 0-25% ground glass in which water to binder ratio is kept the same for all replacement levels.With increase in glass addition mortar flow was slightly increased while a minor effect on concrete workability was noted. As with mortar, concrete cube samples were prepared and tested for strength. The compressive strength test result indicated that recycled glass mortar and concrete gave better strength compared to control samples. A 10% replacement of cement with waste glass was found convincing considering cost and the environment.**

Keywords: Waste glass, Recycling, Supplementary cementitious material, Compressive strength.

I .INTRODUCTION

Million tons of waste glass is being generated annually all over the world. Once the glass becomes a waste it is disposed as landfills, which is unsustainable as this does not decompose in the environment. Glass is principally composed of silica. Use of milled (ground)waste glass in concrete as partial replacement of cement could be an important step toward development of sustainable (environmentally friendly, energy-efficient and economical) infrastructure systems. The concept of recycling and sustainability has been introduced to maintain the level natural resources. Industrial wastes are being produced per annum by chemical and agricultural process in India. By the inclusion of industrial waste in concrete, the energy and the environment can be saved. The use of these by-products offers environmental advantages like divert the material from the waste stream, reduce the energy used in processing virgin materials, use of virgin materials, and decreases pollution During manufacturing of one ton of ordinary During manufacturing of one ton of ordinary Portland cement an equal amount of carbon-dioxide is released into the atmosphere which is harmful to the environment. So, there is a need to choose an alternative Also, the cost of cement is also steadily increasing day by day. So, there is a great need to use industrial waste products in an appropriate manner to reduce cost and environmental problems. Concrete is a construction material which is composed of cement, fine aggregate and coarse aggregate mixed with water, which hardens with time. As per present world statistics, every year millions of tons of cement are required in the construction sector. In concrete mainly Ordinary Portland Cement is used. In addition, huge quantity of energy is required for the production of cement.

II. SCOPE OF THE STUDY

Use of glass powder as a partial replacement of cement can improve the chemical, mechanical and physical properties of concrete use of glass is an environmental friendly alternative to dumping it as a waste. It also reduces the consumption of natural resources. By using waste glass, production of cement can be reduced and also cost of cement production can be reduced.

- To control the environmental pollution.
- To produce low-cost concrete.
- Economical and profitable substitute to landfills, incinerator.

III. LITERATURE REVIEW

Dr. G Vijayakumar: The researcher was interested in finding out the mechanical properties like compressive strength and split tensile strength of concrete by replacing cement with waste glass powder. Cement manufacturing industry is one of the carbon dioxides emitting sources besides deforestation and burning of fossil fuels. The global cement industry contributes about 7% of greenhouse gas emission to the earth's atmosphere. In order to address environmental effects associated with cement manufacturing, there is a need to develop alternative binders to make concrete. Consequently, extensive research is on going into the use of cement replacements, using many waste materials and industrial by products. Efforts have been made in the concrete industry to use waste glass as partial replacement of course or fine aggregates and cement. In this study, finely powdered waste glasses are used as a partial replacement of cement in concrete and compared it with conventional concrete. Glass powder was partially replaced as 10%, 20%, 30% and 40% and tested for its compressive, Tensile and flexural strength up to 60 days of age and were compared with those of conventional concrete; from the results obtained, it is found that glass powder can be used as cement replacement material upto particle size less than 75µm to prevent alkali silica reaction.

Zainab Z Ismail: The aim objective of this work is to study of the use of waste glass powder obtained from grinding of crushed containers and building demolition to produce glass powder blended cement as concrete additives.. Also, the effect of using glass powder as cement replacement and as cement addition was studied in the term of physical and mechanical properties. The considered glass powder contents were0.0%, 5.0%, 10.0%, 15.0%, 20.0% and 25.0% by weight of cement. The test results showed that the glass powder had pozzolanic characteristic and the use of glass powder had insignificant effect on setting time and cement expansion. The use of 10% glass powder as cement replacement enhanced the mortar compressive strength by about 9.0%. Also, generally, the use of glass powder as cement replacement up to 15.0% enhanced the properties of concrete modified with glass powder

Ali A Aliabdo: The utilization of solid waste materials or industrial waste as partial substitution of cement is growing in construction industry all around world to reduce the consumption of cement consequently reduction in CO2 emission into the atmosphere and reduction in energy consumption. The aim of this study is to improve the strength of concrete made by replacing the cement with waste glass. In this study the cement was replaced with waste glass as 5, 10, 15, 20 and 25% by weight of cement with constant water to binder ratio of 0.5. Workability, density of hardened concrete, Compressive and tensile strength of control and modified concrete were tested. The experimental test results revealed that, significant improvement was observed at 10% replacement of cement with waste glass on the investigated properties of concrete.

M. Adaway :studied the properties of concrete made with recycled glass as partial replacement for cement in structural concrete and also studied its effect on compressive strength.Also the researcher aims to reduce the cost of concrete.Several tests including fresh state properties like workability and hardened state properties like compressive strength test, split tensile strength test and dry density test were performed on the partially replaced specimens of cubes (150mm X 150mm X 150mm) and cylinders (150mm X 300mm) after 3, 7 ,14 and 28 days of curing period. Later based on the results of properties of mixed concrete with plastic aggregates were examined and compared with the original control mix concrete with normal aggregates. Replacement of natural aggregates by recycled plastic aggregate (RPA) can be used as an alternative and sustainable approach towards environmental friendly construction practice Compressive strength was found to increase up to 15% replacement of glass powder and beyond the point decreases the strength. The workability of concrete followed a decreasing trend with the addition of fine glass powder.

IV. METHODOLOGY

• Collection of cement, fine aggregate, coarse aggregate, and waste glass powder.
• Properties of the sample such as specific gravity, water absorption, moisture content and size gradation are checked
• Preliminary testing of materials
• Mix design is calculated.
• Fresh properties of concrete
• With different percentage of waste glass powder as cement concrete cubes and cylinders are casted and cured.
• Compressive strength and split tensile strength are determined at 7 days and 28 days of curing.
• Results are then compared with those of conventional concrete.

TABLE. 1 CEMENT VS WASTE GLASS POWDER

CEMENT (%)	WASTEGLASS POWDER (%)
100	0
95	5
90	10
85	15
80	20

A. MATERIALS USED

The following are the materials used for waste glass powder concrete

TABLE. 2 SPECIFICATIONS OF MATERIALS USED

MATERIALS USED	
Cement	OPC 43
Fine aggregate	Crushed sand
Coarse aggregate	Crushed stone
Glass powder	
water	

A. TEST TO BE CONDUCTED

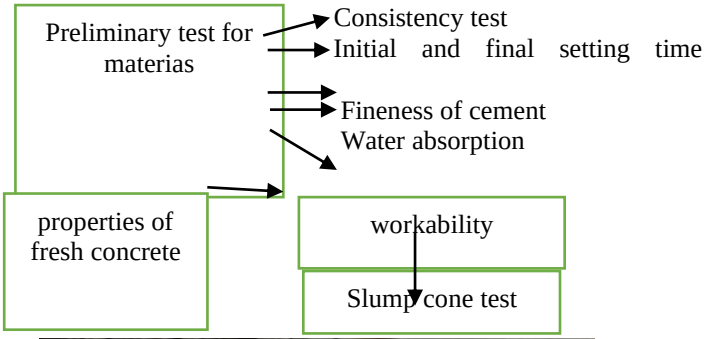


Fig:1 slump test

Fig:2 slump test

Properties of hardened concrete test
- Flectural strength test
- Compressive strength test
- Split tensile strength test

V. DESIGN MIX PROCEDURE

This study aims to make use of the waste material for replacing the cement and using in construction. Therefore, mix design of M20 grade concrete was done by following the guidelines of the Indian standards which is namely; IS: 456:2000, IS 10262:2009 and IS 10262:2019. With help of these codes the quantity of concrete required for 1 cubic meter can be estimated and at which water cement ratio concrete going to be mixed is also selected from these code

Table .3 ESTIMATION OF QUANTITY OF MATERIALS

S. No	MATERIALS AS PER IS456:2000	QUANTITY
1	CEMENT	380Kg/M*3
2	FINE AGGREGATE	828Kg/m*3
3	COARSE AGGREGATE	1040Kg/m*3
4	WATER	190Kg/m*3

After calculating the quantity of sample require, cubes and cylinders were made of specific size and shape. Cubes are made to test the compressive strength after 7- and 28-days curing. Cylinders are made to test the split tensile strength after 7- and 28-days curing.

Fig:3 Mixing of concrete

Fig:4 casting

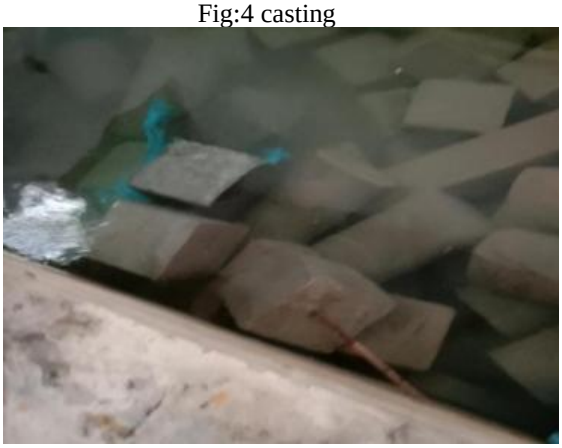


Fig:5 curing

VI. RESULT AND DISCUSSION

Experiment was conducted on concrete prepared by partial replacement of cement by waste glass powder. The waste glass powder was replaced by 5%,10%,15% and 20%.

Different tests for materials are conducted to check the suitability of available material. Tests on fine aggregate, coarse aggregate, cement and waste glass powder was performed. According to mix design every material should possess the same property and same value.

The compressive strength test on both conventional and glass powder added concrete was performed on standard compression testing machine. Totally 20 cubes specimen of size 150mm*150mm*150mm were casted, cured and tested. And also 8 cylinders were casted, cured and tested at the age of 7 days and 28 days.

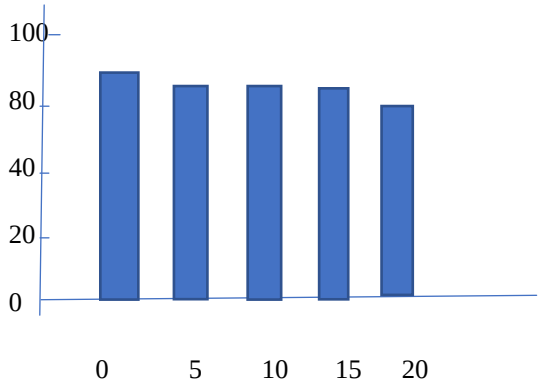
Table. 4 PRILIMINARY TEST RESULTS

Sl.no	Test for materials	Results
1	Consistency of cement	27%
2	Initial setting time of cement	29min
3	Final setting time of cement	7hrs
4	Specific gravity of cement	3.13
5	Fineness of cement	1.9%
6	Specific gravity FA	2.72
7	Specific gravity of CA Water absorption of CA	2.704 0.3%

A. WORKABILITY OF FRESH CONCRETE

In this research work, the workability of M20 grade concrete with different Percentage of cement replacement is checked.

Slump vs % replacement by glass powder



VII.CONCLUSION

1.Replacement of glass powder in cement by 5% 10%, 15% and 20% increases the compressive strength.

2.Replacement of gass powder in cement by 5%, 10% and 15% increase the flexural and split tensile strength when compared with conventional concrete.

3.However the researchers shows that concrete with 10% replacement shows better strength results.

4. In general, considering the similar performance with replaced material, glass addition can reduce cost of cement production upto 14%.

5.In addition, production of every six-ton glass powder concrete results in the reduction of each ton CO2 emission

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