An Experimental And Investigation of Glass Power As Partial Replacement of Cement In Concrete

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Abstract- *Cement manufacturing industry is one of the carbon dioxide emitting sources besides deforestation and burning of fossil fuels. The global warming is caused by the emission of greenhouse gases, such as CO2, to the atmosphere. Among the greenhouse gases, CO2 contributes about 65% of global warming. 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 ongoing 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 coarse 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. This paper presents the strength of the normal conventional concrete of M30 grade. In this study Glass Powder partially replaced at varying percentage at 10%, 20%, 30% and tested for its Compressive, Tensile, and Flexural strength up to 28 days of age and which are compared with those of conventional concrete.*

I. INTRODUCTION

Concrete is probably the most extensively used construction material in the world. The main ingredient in the conventional concrete is Portland cement. The cement production rate is approximately 2.1 million tonnes per year, and is expected to grow exponentially to about 3.5 billion tonnes per year by 2015. The production of 1 tonne of cement contributes to about 1 tonne of co2 into the atmosphere; approximately 7% world‟s co2 emission is accountable production of ordinary Portland cement. Cement production is consuming significant amount Portland of natural resources. It is need of time to design and construct the structures which greater durability and strength and which have led to develop concept of high performance concrete. The major intension in developing high performance concrete The major intension in developing high performance concrete is to have adequate resistance to aggressive environments and to make the structure impermeable.

METAKAOLIN:

Metakaolin is a dehydroylated form of the clay mineral kaolinite. Rocks that are rich in kaolinite are known as china clay or kaolin. The particle size of metakaolin is smaller than cement particles, but not as fine as silica fume. Metakaolin is manufactured from pure raw for material to strict quality standards. It is not a by-product. The resulting material has high pozzolanicity. Metakaolin is a high quality pozzolanic material, which is blended with will have cement in order to improve the durability of concrete and mortars.greater durability and strength and which have led to develop concept of high performance concrete.

The main advantages are,

- Increased compressive and flexural strengths.
- Increased resistance to chemical attack.

GLASS FIBERS:

Glass fiber has high tensile strength (2-4 GPa) and elastic modulus (70-80 GPa), brittle stress-strain characteristics (2.5-4.8 % elongation at break) and low creep at room temperature. Glass fibers are usually round and straight with diameters of 0.005 to 0.015mm They can be bundled with bundle diameter of 1.3 mm.Glass fiber E-glass, which is alumino-borosilicate glass, mainly used for glass-reinforced plastics. GFRC can have flexural strength as high as 27.57N/mm2 and it has a very high strength-to-weight ratio. Fiber Reinforced concrete is one of them and relatively a new composite material in which concrete is reinforced with short discrete (length up to 35 mm), uniformly distributed fibers so that it will improve many Engineering properties.

II. LITERATURE REVIEW INTRODUCTION

Investigations carried by various researchers in the area of metakaolin and glass fiber reinforced concrete are briefly narrated below.

REVIEW OF LITERATURE

Dr.H.Sudarsana Rao et al., carried out investigation on "Durability studies on metakaolin based glass fibre reinforced high-performance-concrete".The ductility of HPC can be improved by altering its composition through the addition of glass fibers. Acid attack tests have been conducted to measure the durability. Cubes have been cast, cured and then kept immersedintroduction two decades ago. This product has advantage of being light weight and thereby reducing the overall cost of construction, ultimately bringing economy in construction.Compressive strength, flexural strength and split tensile strength for these AR glass fibers are more as compared to other glass fibers. It can also be concluded that Flexural strength and split tensile strength shows almost 15 to 20% increase in strength as compared to 0% glass fibers. Also the percentage increase of compressive strength of glass fiber concrete mixes compared with 28 days compressive strength is found to be 20 to 25 %. in 5% concentrated solutions of HCl, H2SO4 and MgSO4 for 30, 60 and 90 days. The residual compressive strength of GFRHPC decreases with increase in age of acid immersion. Maximum loss of compressive strength occurs in case of H2SO4 acid immersion as compared to HCl and MgSO4 acids. Out of the three acids the least loss of compressive strength is recorded for HCl acid immersion.

B.B.Patil et al., carried out investigation on Strength and Durability Properties of High Performance Concrete incorporating High Reactivity Metakaolin.The present paper deals with the study of properties namely workability, compressive strength and durability of M60 grade HPC mixes incorporating different percentages of high reactivity metakaolin . The result of the study indicate that the workability and strength properties of HPC mixes improved by incorporating HRM up to a desirable content of 7.5% by weight of cement. HPC mixes have also indicated better resistance to the attacks of chemicals such as chlorides and sulphates when the HPC mixes were exposed to these chemical for 180 days period. is enhanced the resistance to chloride attack, sulfate attack & compressive strength at 28 days.Shrikant Harle, Prof. Ram Meghe carried out investigation on "Glass Fiber Reinforced Concrete & Its Properties".Glass fiber reinforced concrete (GFRC) is a recent introduction in the field of civil engineering. So, it has been extensively used in many countries since it

III. MATERIALS USED

Cement: Using ordinary Portland cement. The experiment uses the quality –guaranteed local cement. Portland Pozzolona Cement conforming to IS: 12269 was used in the present study.

Fine Aggregate:River sand is normally preferred over crushed sand since in the former; particle size is fully water worm by attrition which helps in reduction of water content of mix and also lesser resistance to pumping. The water absorption, fineness modulus, specific gravity, bulk density of river sand was monitored as per IS: 2386-1963 (Part I & II) / IS: 383-1970 and the results are given in Table 3.1.2. , 3.1.3 and Figure 3.3 represents the sieve analysis of river sand.

Coarse Aggregate: The Coarse Aggregate is the strongest and least porous component ofselecting the aggregate for HPC. The water absorption, fineness modulus, specific gravity, bulk concrete. Some important properties of coarse aggregate like crushing strength, durabilitydensity of all aggregates should be closely and continuously monitored as per IS: 2386-modulus of elasticity, gradation, shape and surface texture characteristic, percentage of1963(Part I & II) /IS: 383-1970. deleterious materials and flakiness and elongation indices need special consideration while

Water:Water to be used for mixing and curing should be free from impurities. Mixing water quality is required in accordance with the quality standards of drinking water.

Glass fibers:The Glass fibers are used as 1% in concrete. Glass fibers are different physical forms like microspheres, chopped or woven. It gives high tensile strength in concrete. Glass fiber obtained from covai seenu and company under the trade name csw glass fibers was used

Metakaolin:The mineral admixture Metakaolin is used for 20% replacement of cement in the present work. The glass fiber is of 6mm length. concrete. The Metakaolin is in conformity with the general requirements of pozzolana. Themineral admixture Metakaolin is obtained from the ASTRAA CHEMICALS. The metakaolin

Acids:The various acids used in the investigation are H_2SO_4 and M_gSO_4 each of 5% is in conformity with the general requirements of pozzolana concentration

Mix design for M35 grade concrete by Indian Standard recommended method of concrete mix design as per design code IS: 10262-2009

MIX CALCULATION:

The mix calculation per unit volume of concrete shall be as follows

a) Volume of concrete =1m^3

$$\text{Volume of cement} = \frac{\text{mass of the cement}}{\text{Specific gravity of cement}} \times 1/1000$$

=437/3.05*1/1000

=0.143m^3

b) Volume of water = mass of the water/specific gravity of water(1/1000)=197/1(1/1000)=1.97 m^3

c) Volume of fine aggregate=651.456kg

d) Volume of coarse aggregate=1026.75kg

IV. TESTING OF CONCRETE

FRESH CONCRETE: Though fresh state is transient, its condition seriously affects the behavioral properties of the final product. Poor compaction and improper curing will lead to porous concrete with low strength and high permeability. Fresh concrete is freshly mixed material which can be moulded into any shape. The relative quantities of cement, aggregate and water mixed together control the properties of concrete in wet state as well as in hardened state.

Properties of Fresh Concrete

The properties of fresh concrete are Compatibility

- Mobility
- Stability
- Consistency
- Segregation
- Bleeding
- Curing
- Workability

EXPERIMENTAL STUDY

HARDENED CONCRETE TEST:A time schedule for testing of specimens is maintained to ensure their proper testing on the due date and time. The cast specimens are tested as per standard testing procedures, immediately after they are removed from curing pond and wiped off the surface water. The test results are tabulated carefully. The various tests carried out for Normal & High Density Concrete are

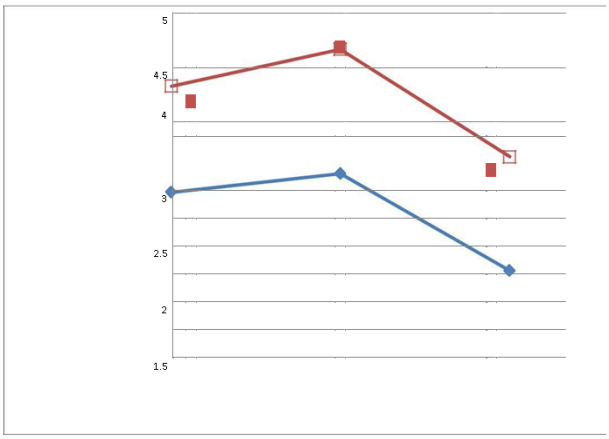
1. Compression strength test
2. Split Tensile test
3. Flexural test

COMPRESSIVE STRENGTH TEST

METAKAOLIN	GLASS FIBER	Compressive strength (N/mm^2) Cube 1 N/mm^2	Cube 2 N/mm^2	Cube 3 N/mm^2	Average N/mm^2
Conventional Concrete		28	28	27.11	27.70
10%	1%	28.88	28.88	29.33	29.03
20%	1%	24.88	25.33	24.88	25.1

SPLIT TENSILE STRENGTH TEST

METAKAOLIN	GLASS FIBER	Split Tensile Strength (N/mm^2) Cylinder 1 N/mm^2	Cylinder 2 N/mm^2	Cylinder 3 N/mm^2	Average N/mm^2
Conventional concrete		2.68	2.82	2.82	2.72
10%	1%	3.11	2.97	2.82	2.97
20%	1%	1.56	1.69	1.69	1.65



FLEXURAL STRENGTH TEST

METAKAOLIN	GLASS FIBER	Flexural Strength(N/mm²) Prism1 N/mm²	Prism2 N/mm²	Prism3 N/mm²	Average N/mm²
Conventional concrete		2.5	2.5	2	2.44
10%	1%	8	8.75	8.75	8.5
20%	1%	6.5	6.25	6.25	6.37

ACID ATTACK TEST

DAYS	Conventional concrete kg			C+1%GF+1(%M kg			C+1%GF+20%M kg		
Initial	8.230	8.435	8.455	8.115	8.020	8.150	8.210	8.130	8.105
7	6.210	6.415	6.405	6.150	6.170	6.165	6.230	6.180	6.305
30	4.015	4.220	4.400	4.250	4.016	4.146	4.215	4.175	4.210

V. CONCLUSION

- The gain in compressive strength is improved depending upon the replacement level of PPC by metakaolin.
- The addition of 10% replacement of metakaolin increases the compressive strength upto 10.31% and addition of 20% replacement of metakaolin decreases the compressive strength upto 5.66% compared to conventional concrete.
- The 10% metakaolin inclusion improves split tensile strength upto 12.01% and 20% replacement decreases upto 20.86% compared to conventional concrete .
- The replacement of 10% metakaolin improves upto 54% flexural strength. The replacement of 20% metakaolin improves upto 51.16% flexural strength.
- The addition of metakaolin in cement is also enhanced the resistance to acid attack and sulphate attack.

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