EXPERIMENTAL STUDY ON CONCRETE AS PARTIAL REPLACEMENT OF CEMENT BY GLASS POWDER

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Abstract - *The use of Glass Powder in the present days as a substitute for cement is to increase the strength of cement concrete. The Glass Powder was replaced by 0%, 5%, 10%, 15%, 20% & 25% for 7, 14 & 28 days for Cubes for Compressive strength and Cylinder are casting for Split Tensile Strength and other properties like compacting factor and slump were also determined for three mixes of concrete. The use of cement and production of cement creates much more environmental issues & costlier. To avoid such circumstances, the content of cement is reduced in concrete and replaced by Glass Powder which reduces cost & increases strength & durability of concrete. Concrete is the most widely used and versatile building material which is generally used to resist compressive forces. By addition of some pozzolanic materials, the various properties of concrete viz, workability, durability, strength, resistance to cracks and permeability can be improved. Many modern concrete mixes are modified with addition of admixtures, which improve the micro structure as well as decrease the calcium hydroxide concentration by consuming it through a pozzolanic reaction. The subsequent modification of the micro structure of cement composites improves the mechanical properties, durability and increases the service-life properties.*

***Key Words*: Glass Powder, Compressive Strength, Split Tensile Strength, Consistency, Mechanical Properties, and Slump test for Concrete.**

1.INTRODUCTION

Concrete is a most commonly used building material which is a mixture of cement, sand, coarse aggregate and water. It is used for construction of multi-storey buildings, dams, road pavement, tanks, offshore structures, canal lining. The method of selecting appropriate ingredients of concrete and determining their relative amount with the intention of producing a concrete of the necessary strength durability and workability as efficiently as possible is termed the concrete mix design. The compressive strength of harden concrete is commonly considered to be an index of its extra properties depends upon a lot of factors e.g. worth and amount of cement water and aggregates batching and mixing placing compaction and curing. The cost of concrete prepared by the cost of materials plant and labour the variation in the cost of material begin from the information that the cement is numerous times costly than the aggregates thus the intent is to produce a mix as feasible from the practical point of view the rich mixes may lead to high shrinkage and crack in the structural concrete and to development of high heat of hydration is mass concrete which may cause cracking. The genuine cost of concrete is related to cost of materials essential for produce a minimum mean strength called characteristic strength that is specific by designer of the structures. This depends on the quality control measures but there is no doubt that quality control add to the cost of concrete. The level of quality control is often an inexpensive cooperation and depends on the size and type of job nowadays engineers and scientists are trying to enhance the strength of concrete by adding the several other economical and waste material as a partial substitute of cement or as a admixture fly ash, Glass Powder, steel slag etc are the few examples of these types of materials. These materials are generally by-product from further industries for example fly ash is a waste product from power plants and Glass Powder is a by-product resulting from decrease of high purity quartz by coal or coke and wood chips in an electric arc furnace during production of silicon metal or ferrosilicon alloys but nowadays Glass Powder is used in large amount because it enhances the property of concrete.

2. MATERIAL

2.1 Cement: Ordinary Portland cement of 53 Grade satisfying the requirements of IS:8112-1939 is used. The specific gravity was found to be 3.

2.2 Fine Aggregates: Sand is the main component grading zone-II of IS:383-1978 was used with specific gravity of 2.6 and water absorption of 1.8% at 24 Hrs.

2.3 Coarse Aggregates: Mechanically crushed stone of 20mm maximum size, satisfying to IS:383-1978 was used.

The specific gravity was found to be 2.62 and 2.64 and water absorption is 0.16% and 0.18% at 24 Hrs. of 20mm aggregates respectively.

2.4 Glass Powder: Clear glass powder made from leaded crystal glass and ground into fine powder can be used in all media to give colors added luminosity or to create textural effects on the surface of paintings. Colored and clear glass powder can be used in all media, such as oil, acrylic dispersions, lime and all kinds of glues.

How glass is made from sand?

Believe it or not, glass is made from liquid sand. You can make glass by heating ordinary sand (which is mostly made of silicon dioxide) until it melts and turns into a liquid. You won't find that happening on your local beach: sand melts at the incredibly high temperature of 1700°C (3090°F).

What is glass and how is it made?

Glass is made by melting together several minerals at very high temperatures. Silica in the form of sand is the main ingredient and this is combined with soda ash and limestone and melted in a furnace at temperatures of 1700째C. Other materials can be added to produce different colours or properties.

3. METHODOLOGY

The methodology adopted to accomplish the objective of the experimental investigation and excavation of work was done in step by step as follows:

1) Weighing: The quantity of all ingredients of the concrete i.e. Cement, Glass Powder, Fine aggregate, Coarse aggregate and water for each batch was determined as per the mix design ratio and weighed using weighing machine available in laboratory.

2) Mixing: Process of mixing of various ingredients adopted was as per IS:516-1959 and hand mixing process was adopted for mixing the concrete

3) Preparation of moulds: Before casting the specimens, all cube and cylinder moulds were cleaned, screwed tightly and oil was applied to all surfaces to prevent adhesion of concrete during casting.

4) Compaction: Placing of concrete in oiled mould was done in three layers and each layer tamped 25 times with the tamping rod. After tamping the moulds, they work compacted using vibratory machine.

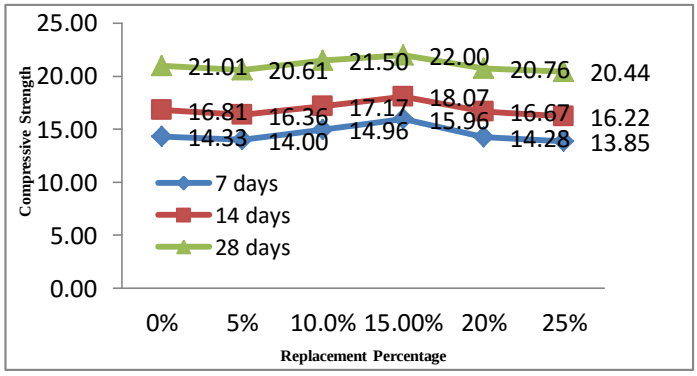
5) Curing: After 24 hours, all the casted specimen were demoulded from the moulds and marked (To identify the casting batch) and immediately put into the curing tank for a period of 7, 14 and 28 days for different specimens. The specimens were not allowed to become dry during the curing period.

6) Testing: Specimen were taken out from the curing tank after 7, 14 and 28 days to perform various test. Three numbers of specimens is each sample were tested and average value was calculated. Fresh concrete properly like workability was examined during casting by slump cone test. Hardened properties are found out by carrying out the investigational work on cubes and cylinder which were casted in laboratory and their behaviour Under test were observed at 7, 14 and 28 days for compressive strength and split tensile strength.

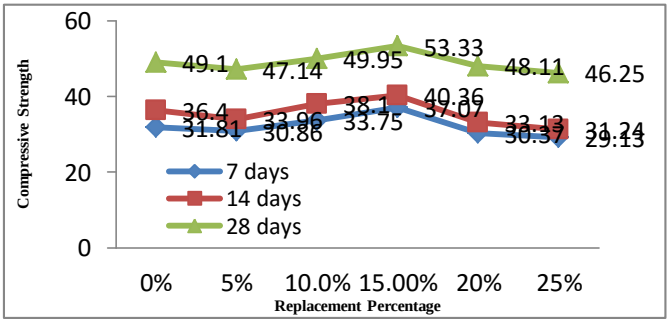
4. RESULT AND DISCUSSION

All work is carried out in single stages, result of all stages is presented by graphs. Test are perform on cubes and cylinders on 7 days, 14 days and 28 days have been determined.

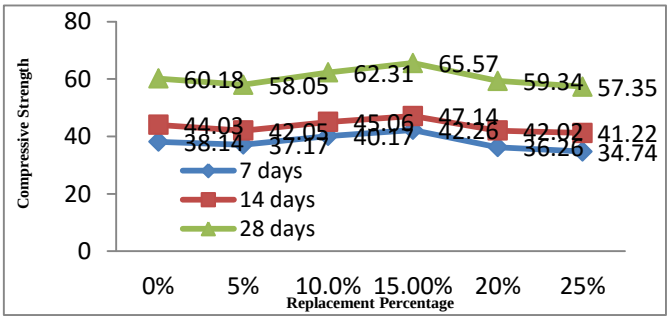
4.1 Compressive Strength: The results of the compressive strength test conducted on concrete specimen of different mixes cured at different ages are presented and discussed in this section. The compressive strength test were conducted at 7, 14 and 28 days. Variation of compressive strength of all the mixtures at 7, 14 and 28 days are shown in graphs.



Graph: 1 Compressive Strength in N/mm2 at various ages for M-20



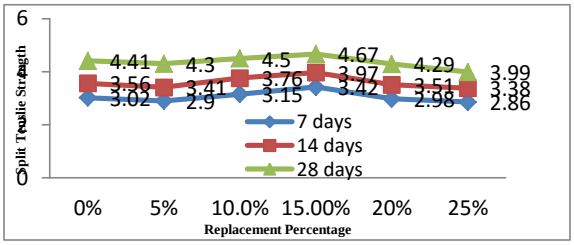
Graph: 1 Compressive Strength in N/mm2 at various ages for M-40



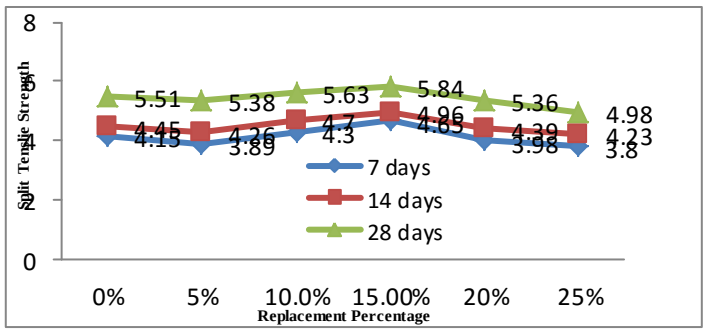
Graph: 1 Compressive Strength in N/mm2 at various ages for M-50

Graph 1, 2 and 3 are shows that there is an increase in compressive strength with increase in Glass powder percentage up to 15%, thereafter there is a decrease in compressive strength with further increase in glass powder. The result of compressive strength for M20, M40 and M50 grade concrete are given in the above graphs.

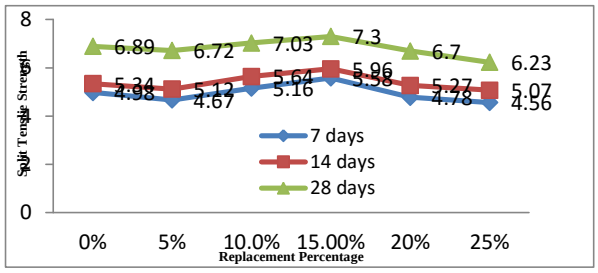
4.2 Split Tensile Strength: The results of the Split Tensile strength test conducted on concrete specimen of different mixes cured at different ages are presented and discussed in this section. The split tensile strength test were conducted at 7, 14 and 28 days. Variation of split tensile strength of all the mixtures at 7, 14 and 28 days are shown in graphs.



Graph: 4 Split Tensile Strength in N/mm2 at various ages for M-20



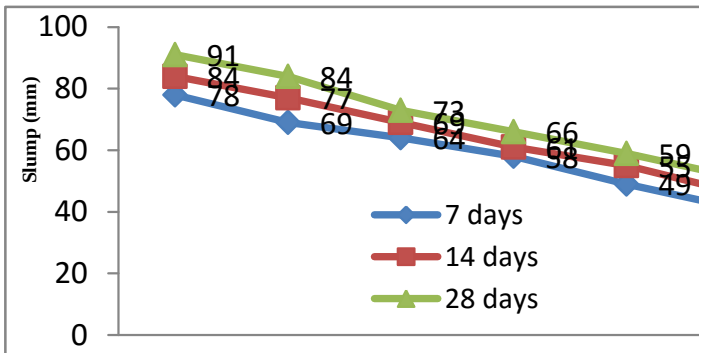
Graph: 5 Split Tensile Strength in N/mm2 at various ages for M-40



Graph: 6 Split Tensile Strength in N/mm2 at various ages for M-50

Graph 4, 5 and 6 are shows that there is an increase in split tensile strength with increase in Glass powder percentage up to 15%, thereafter there is a decrease in split tensile strength with further increase in glass powder. The result of compressive strength for M20, M40 and M50 grade concrete are given in the above graphs.

4.3 Workability of Concrete: The workability of concrete mixes was found put by slump test as per procedure is given in previous chapter. Water cement ratio (W/C) was kept constant 0.5 for all the concrete mixes. The workability results of different concrete mixes were shows in graph-7.



Graph: 7 Slump (mm) at 28 days

5. CONCLUSION

Compressive strength and Split tensile strength test of concrete Mixes made with and without Glass Powder has been determined at 7, 14, & 28 days of curing. The strength gained has been determined of Glass Powder added concrete with addition of 0%, 5%, 10%, 15%, 20% & 25% for M20, M40 and M50 grade as a partial replacement of cement in conventional concrete. From the results it is conclude that the Glass Powder is a superior replacement of cement. The rate of strength increase in Glass Powder concrete is high. After performing all the tests and analyzing their result, the following conclusions have been derived-

1. The results achieved from the existing study shows that Glass Powder is great potential for the utilization in concrete as replacement of cement.

2. Workability of concrete decreases as proportion of Glass Powders increases.

3. Maximum compressive strength was observed when Glass Powder replacement is about 15%.

4. Maximum split tensile strength was observed when Glass Powder replacement is about 15%.

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