

Nano Micro structure Study Sheet Glass Concrete

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Abstract

Concrete is a universal construction material. Several new varieties of concrete are now available. Sheet Glass Powder (SGP) used in concrete making will lead to greener environment. In shops nearby Chidambaram many sheet glass cuttings go to wastes, which is not recycled at present is usually delivered to landfills for disposal. Using of SGP concrete is an interesting possibility for economy on waste disposal sites and conservation of natural resources. Natural sand was replaced 100% SGP. Compressive strength (cubes and cylinders) to 180 days of age were compared with those of concrete made with natural fine aggregates. Fineness modulus, specific gravity, moisture content, water absorption, Bulk density, % voids, % porosity (loose and compact) state for sand (S), SGP studied. Sheet glass is a material with a high Percentage of amorphous silica, favouring pozzolanic reactivity. The test results indicate that it is possible to manufacture low cost concrete containing sheet glass powder (SGP) with characteristics similar to those of natural sand aggregate concrete provided that the percentage of SGP as fine aggregate. The SEM and EDS presents the compact structure of the concrete due to which the strength increases.

INTRODUCTION

Concrete is one of the widely used common construction material. Every year, concrete consumes 12.6 billion tons of natural raw materials. The huge rate of consumption of the natural raw materials creates several ecological problems. During the last decades it has been recognized with growing Sheet Glass waste are of large volume and that this is increasing year by year in the Shops, construction areas and factory's. Waste sheet glasses from these areas can be recycled and reused to prevent the environmental problems resulting from solid waste disposal. In Chennai a place called Chidambaram most of the colored sheet glasses from windows are packed as a waste and sent to landfill. The plain sheet glasses can be recycled but the colored glasses are costlier to remove the color and recycled again. Traditional landfill method is not an environment friendly solution and the disposal process is also very difficult to meet. The need for housing are estimated more cost and some construction materials like natural sand are becoming rare. This waste storage and disposal are becoming a serious environmental problem especially for Chidambaram place disposal sites are lacking. Hence there is a need for recycling more and more waste materials.

The most widely used fine aggregate for the making of concrete is the natural sand mined from the riverbeds. However, the availability of river sand for the preparation of concrete is becoming scarce due to the excessive non-scientific methods of mining from the riverbeds, lowering of water table, sinking of the bridge piers, etc. are becoming common threats. This presents a scenario demanding identification of substitute materials for the river sand for making concrete. The choice of substitute materials for sand in concrete depends on several factors such as their availability, physical properties, chemical ingredients etc; SGP (Sheet glass powder) is one of the Solid wastes not being used for any application other than dumping. The objective of this paper is to present the results of experimental investigation on Physical and Mechanical properties of Conventional concrete and Sheet Glass powder concrete. Natural fine aggregate is substituted Sheet Glass Powder. Compressive, Tension, and flexural strength are evaluated and compared up to 180 days of ages.

II. MATERIALS AND METHODS

The raw materials, used for this study are natural coarse aggregate, fine aggregate, Sheet Glass Powder (SGP) aggregate and 53 grades Portland

cement. The Sheet glass used for this study was collected from the points in Chidambaram taluk at Cuddalore District. Sheet Glass collected from shops is shown in Fig. 1. Sheet Glass crushed is shown in Fig. 2. Fine aggregate material of grading curves sand and SGP is shown in Fig 3. The sand used

for the study was locally available river sand conforming to grading zone III of IS:383-

1970. The coarse aggregate was a normal weight aggregate with a maximum size of 20mm IS:456-2000. Table 1 shows the physical properties of SGP, Fine aggregate and coarse aggregate. The control mix of the concrete was designed with a mix ratio of cement /water /Sand /Coarse of 1:0.48:1.66:3.61 by weight. This mix design yielded an average 28 days compressive strength 41 Mpa.



Fig.1 Sheet glass



Fig.2 Sheet glass powder

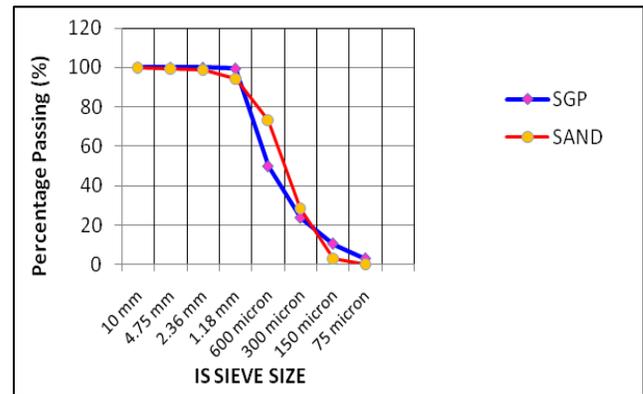


Fig.3 Sieve Analysis of the Materials

Parameter	Sand	Coarse	SGP
Fineness modulus	2.21	-	2.16
Specific gravity	2.65	2.7	3.01
Water absorption %	8.3	0.45	0
Moisture content %	3.70	0	0
Bulk density (dry loose state) (kg/m ³)	1468	1450	1310
% Voids	40.8	39	57
% Porosity	28.9	27	36
Bulk density (dry compact state) (kg/m ³)	1512	1640	1530
% Voids	35.39	34	50
% Porosity	25.9	25	33

Table.1 Physical Properties of Sand and SGP

III. EXPERIMENTAL PROGRAM

The SG (Sheet Glass) was collected from shops from Chidambaram and its properties were tested. Analysis was carried out in Concrete mixtures with conventional concrete and sheet glass concrete. These specimens were cast and tested to study the possibility of using SGP as a substitute material for sand in concrete. The control mix, Utilizing SG Replaced as the fine aggregate, was designed for the cube, cylinder and beam. Based on the laboratory

trials, the mix proportion of the control mix (M₂₀) was finalized and they were investigated to determine the effect on compressive and tensile strength in cubes and cylinder. It is also used to investigate the effect of SGP replacement on Flexural strength.

For compressive and tensile strength tests 150 x 150 mm cubes and 150 x 300 mm cylinders specimens were used. A total of 60 specimens were cast and cured in water at room temperature in the laboratory for 28, 45, 60, 90, 180 days. At the end of each curing period, three specimens for each Mixture were tested for Compressive and Tensile the average was recorded.

IV. RESULTS AND DISCUSSION

Workability of the concrete increased in SGP replacement but later it decreased as the curing days increase this is because of alkali silicate action. The Flexural strength was measured

using 100x100x500mm beam specimen in the centre of the beam load applied. A total of 15 beams were cast and cured in water for 28, 45, 60, 90, 180 days. For each mixture, three beams were loaded to failure, and the average strength was recorded in each case.

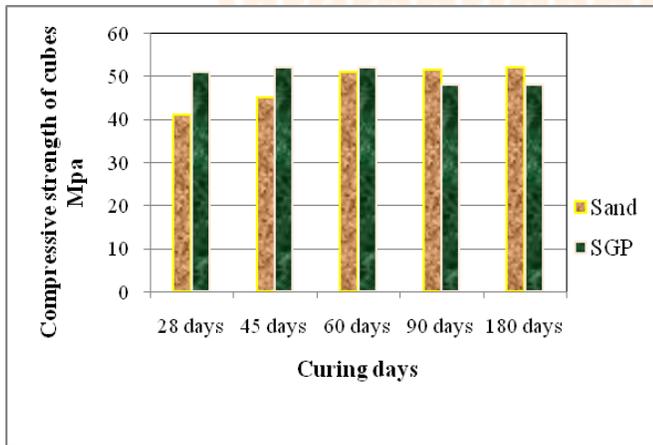


Fig. 3 Compressive strength of concrete cubes

density of the concrete 2531 at conventional concrete the density increased in SGP concrete to 2689 kg/m³ for cube at 28 days curing.

A. Compressive strength

The compressive strength test results for the concrete containing SGP fine aggregates of cubes and cylinders according to their age are very similar to each other. Thus, the results are represented in Fig. 4 and Fig. 5. Concrete containing SGP as fine aggregates, with a mixing ratio 100% displayed an increase in compressive strength in the beginning of curing days than that of plain concrete but decreases as the curing days increase respectively. This tendency towards a decrease in tensile strength with an increase in curing days was repeated for concrete up to 180 days of age.

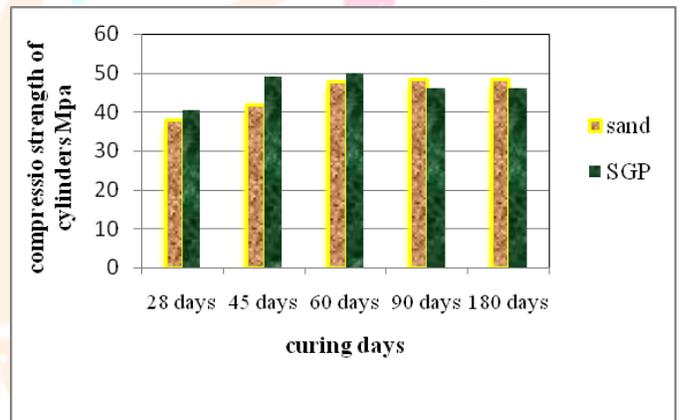


Fig. 5 Compressive strength of concrete cylinders

B. Tensile strength

The tensile strength test results for the concrete containing SGP fine aggregates of cubes and cylinders according to their age are very similar to each other. Thus, the results are presented in Fig. 6 and Fig. 7. Concrete containing SGP as fine aggregates, with a mixing ratio 100% displayed an increase in tensile strength at the beginning of curing days than that of plain concrete but

decreases as the curing days increase respectively. This tendency towards a decrease in tensile strength with an increase in curing days was repeated for concrete at 180 days of age. In any case, the SGP as fine aggregate in concrete did not have any notable effect on the Tensile strength of the concrete.

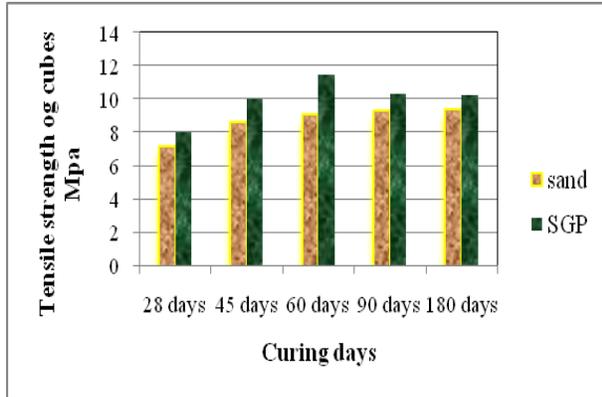


Fig. 6 Tensile strength of concrete cubes

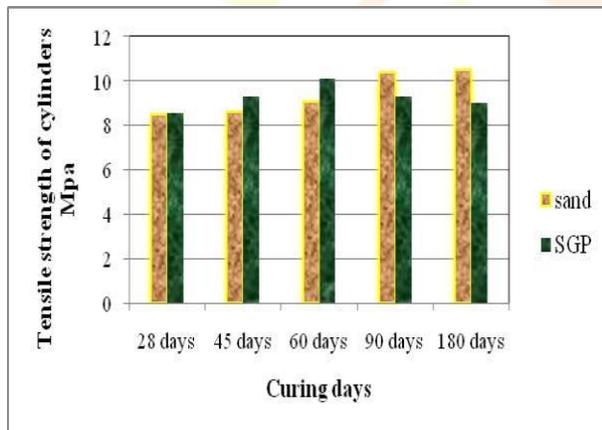


Fig. 7 Tensile strength of concrete cylinders

C. Flexural strength

The Flexural strength test results for the curing concrete with SGP of different percentage according to their age are represented in Fig. 8. The results were very similar to each other like compressive and tensile strength test results. The concrete containing SGP as fine aggregate at a 100%

mixing ratio showed an increase in the flexural strength at the beginning of curing days while that of plain concrete but there was a decrease in strength as curing days increase than that of plain concrete.

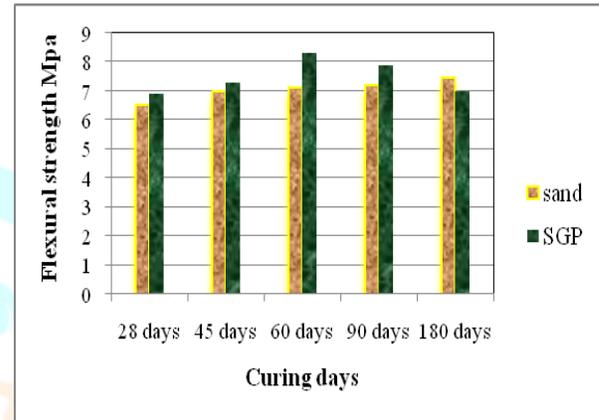


Fig. 8 Flexural strength of concrete beams

Microstructure of concrete phase containing 100% SGP

The concrete specimens containing SGP, which had 28 days curing, were examined by scanning electron microscopy (SEM). These concrete specimens would also represent similar concrete of the same history. Fig. 9 shows the dense microstructure that had developed in concrete incorporating 100% SGP than that of conventional concrete shown in Fig. 10. The EDS of 100% SGP concrete shown in Fig. 11 indicate high silica content than that of conventional concrete EDS shown in Fig. 12.

The fine sheet glass powder reacted as a filler particles and pozzolanic reaction in concrete. For comparison, the SEM and EDS view of the concrete with and without SGP is also shown.



Fig.9SEM analysis of100%SGPconcrete

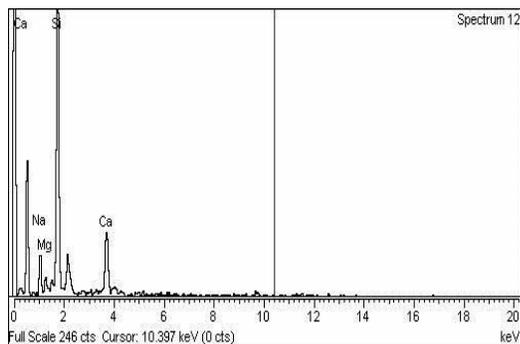


Fig.11EDSof100%SGPconcrete

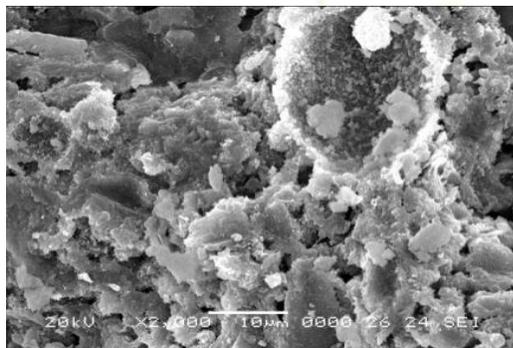


Fig.10SEM analysisofconventionalconcrete

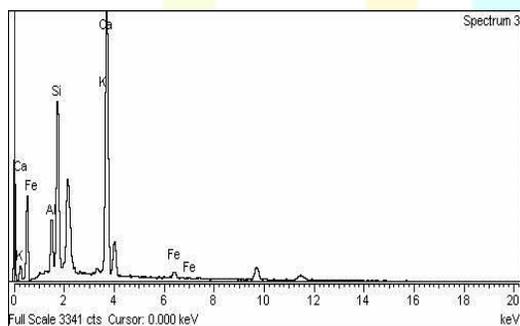


Fig.12EDSofConventionalconcrete

V. CONCLUSION

The data presented in this paper show that there is great potential for the utilization of Sheet Glass Powder in concrete as fine aggregate. It is considered that latter form would provide much greater opportunities for value adding and cost recovery as it could be used as a replacement for non available like sand. The use of SGP in concrete would cause ASR expansive. Strength gain of SGP concrete is satisfactory. It has been concluded that 100% SGP could be incorporated as fine aggregate replacement could be replaced in concrete of 47- MPa strength grade with acceptable strength. Microstructural examination has also shown that 100% SGP would produce a dense matrix and improve the durability of concrete incorporating.

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