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MANUFACTURING OF GLASS AND SAWDUST ASH CONCRETE

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Abstract: This paper examines the possibility of using the combination of waste Sheet Glass Powder (SGP) and Sawdust Ash (SDA) as fine aggregate replacement offers an economically viable technology for high value utilization of industrial waste. Using of SGP and SDA in concrete is an interesting possibility for economy on waste disposal sites and conservation of natural resources. Natural sand was partially replaced (10%, 20%, 30%, 40% and 50%) with SGP and 10% optimum replacement SDA. Compressive strength, Tensile strength (cubes and cylinders) and Flexural strength up 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 and SDA were also studied. The test results indicate that it is possible to manufacture low cost concrete containing Sheet glass powder (SGP) and Sawdust ash (SDA) with characteristics similar to those of natural sand aggregate concrete provided that the percentage of SGP as fine aggregate up to 30% along with Sawdust ash 10% can be used respectively.

Key Words: Saw dust ash(SDA), Portland, Pozzolanic, Sheet glass powder(SGP), Compressive Strength, Tensile Strength, Flexural Strength.

INTRODUCTION

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 nonscientific methods of mining from the riverbeds, lowering of water table, sinking of the bridge piers,etc. are becoming common treats. The present scenario demands identification of substitute materials for the river sand for making concrete. During the last decades it has been recognized with growing sawdust ash waste are of large volume and that this is increasing year by year in the household , mills and factory's. Now a days even in rice mills they are using sawdust for burning due to shortage of rice husk. In Chidambaram a huge quantity of sawdust ash waste is produced in the near by rice mills and households are dumped. On the other hand, one bucket of sawdust cost Rs 6.00 and we get sawdust ash with no cost. SGP (Sheet Glass Powder) is one of the solid wastes not being used for any applications other than dumping. 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. Surrounding Chidambaram most of the coloured sheet glasses from windows are packed as a waste and sent to landfill. The plain sheet glasses can be recycled but the coloured glasses are costlier to remove the colour and recycled again. This waste storage disposals 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. An attempt has been made in this paper to study for M_{20} concrete mixtures with different percentages of SGP with 10 percent SDA of replacement of fine aggregate was studied. Compressive strength, tensile strength of (cubes and cylinders) and flexural strength of beams are evaluated and compared up to 180 days of ages. Physical properties of concrete materials like Sheet Glass Powder and Sawdust Ash are also studied.

EXPERIMENTAL PROGRAMME

Six different mixes were made. First were control mix and the remaining five mixes were SGP with different percentage replacement and 10% Sawdust Ash in fine aggregate. Investigations were carried out in concrete mixtures with 5 levels of SGP (Sheet Glass Powder) replacement ranging from 10% to 50% and 10% Sawdust ash. The specimens were cast and tested to study the possibility of using SGP and SDA as a substitute material for sand in concrete and also making high strength concrete. For compressive, tensile and flexural strength tests 150 x 150mm cubes, 150 x 300mm cylinders and 100 x 100 x 500mm beam specimens were used respectively. A total of 450 specimens were cast and cured for 28, 45, 60, 90 and180 days. Three specimens for each mixture were tested for compressive strength; tensile strength and flexural strength were recorded.

MATERIALS USED

The raw materials, used for this study are ordinary portland (53 grades) cement was used. Natural river Sand(S) Sheet glass Powder (SGP) and Sawdust ash (SDA) as fine aggregate replacement material of size 1.18mm were used as per Indian standard Specification IS: 383-1970.The Fineness Modulus results of S, SGP, SDA (S + 10%SGP +10%SDA), (S + 20%SGP + 10%SDA), (S + 30%SGP + 10%SDA), (S + 40%SGP + 10%SDA) and (S +

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50%SGP + 10%SDA) shown in Table1.The Fine aggregate material of grading curve shown in Figure1. The sheet glass and Sawdust Ash used for this study was collected from Chidambaram at Cuddalore District. The coarse aggregate was a normal weight aggregate with a maximum size of 20mm.The workability ranges of concrete maintained 30 – 40 mm in terms of slump. The physical properties of SGP, SDA, fine aggregate and coarse aggregate are shown in Table 2. The concrete used with mix proportion of 1:1.66:3.61 with w/c 0.48.The 28 days compressive strength of concrete was 43.5 Mpa. Sheet glass collected from shops is shown in Figure 2(a), Sheet Glass Powder is shown in Figure 2(b) and sawdust ash is shown in Figure 3.

Material	Fineness Modulus
Sand (S)	2.21
Sawdust ash (SDA)	1.78
(90%S+10%SGP+10%SDA)(GPSA1)	2.25
(80%S+20%SGP+10%SDA)(GPSA2)	2.20
(70%S+30%SGP+10%SDA)(GPSA3)	2.07
(60%S+40%SGP+!0%SDA)(GPSA4)	1.84
(50%S+50%SGP+10%SDA)(GPSA5)	1.82
Sheet Glass Powder (GPSA6)	2.16

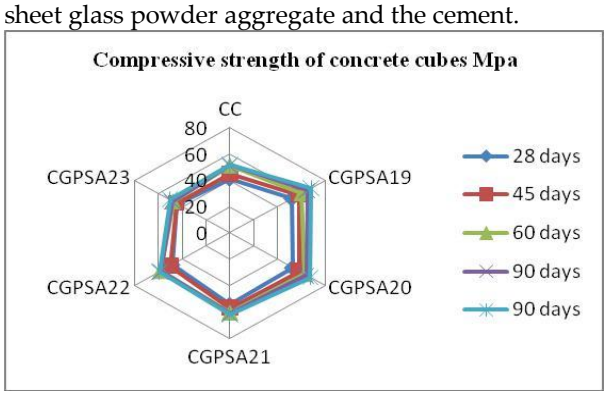
RESULTS AND DISCUSSION

Six different mixes were made. First were control mix and the remaining five mixes were SGP with different percentage with10% replacement sawdust ash

replacement in fine aggregate.. Investigations were carried out in concrete mixtures with 5 levels of SGP (Sheet Glass Powder) replacement ranging from 10% to 50% and sawdust replaced with 10%. The specimens were cast and tested to study the possibility of using SGP and sawdust as a substitute material for sand in concrete and also making high strength concrete. For compressive, tensile and flexural strength tests 150 x 150mm cubes, 150 x 300mm cylinders and 100x100x500mm beam specimens were used respectively. A total of 450 specimens were cast and cured for 28, 45, 60, 90 and180 days. Three specimens for each mixture were tested for compressive strength; tensile strength and flexural strength were recorded.

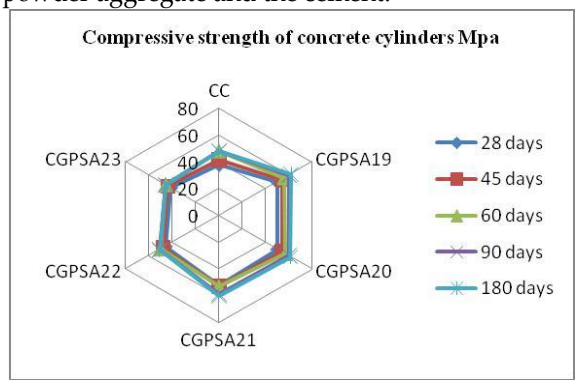
COMPRESSIVE STRENGTH OF CUBES

The compressive strength of concrete cubes made with Sheet Glass Powder and sawdust ash was determined at the ages of 28,45,60,90 and 180 days results shown Figure 4 with conventional concrete. From the test results it is observed that the compressive strength increased by 15% to 23.6% at 10%, 20% and 30% replacement SGP and sawdust ash. Similarly for 45, 60, 90, and 180 day's compressive strength is increased. When SGP and SDA replace sand, the strength is significantly greater than that of the control mix. These observations indicate the beneficial pozzolanic reaction of SGP and SDA in concrete. At mixing ratios of 40% and 50% at 45, 60, 90 and 180 days displayed a reduction in compressive strength. This inclination may be due to the decrease in adhesive strength between the surface of sheet glass powder aggregate strength between the surface of the sheet glass powder aggregate and the cement.



COMPRESSIVE STRENGTH OF CYLINDER

The compressive strength of concrete cylinder made with Sheet Glass Powder and Sawdust ash was determined at the ages of 28,45,60,90 and 180 days results shown Figure 5 with conventional concrete. From the test results it is observed that the compressive strength increased by 14.2% to 24% at 10%, 20% and 30% replacement SGP and SDA. Similarly for 45, 60, 90, and 180 day's compressive strength is increased. When SGP and SDA replace sand, the strength is significantly greater than that of the control mix. These observations indicate the beneficial pozzolanic reaction of SGP and SDA in concrete. At mixing ratios of 40% and 50% at 45, 60, 90 and 180 days displayed a reduction in compressive strength. This inclination may be due to the decrease in adhesive strength between the surface of sheet glass powder aggregate strength between the surface of the sheet glass powder aggregate and the cement.



TENSILE STRENGTH OF CUBES

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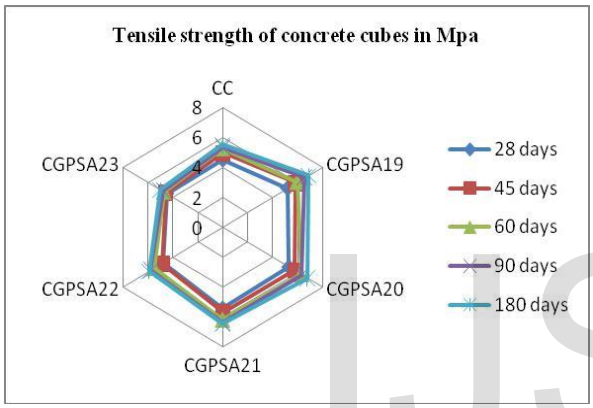
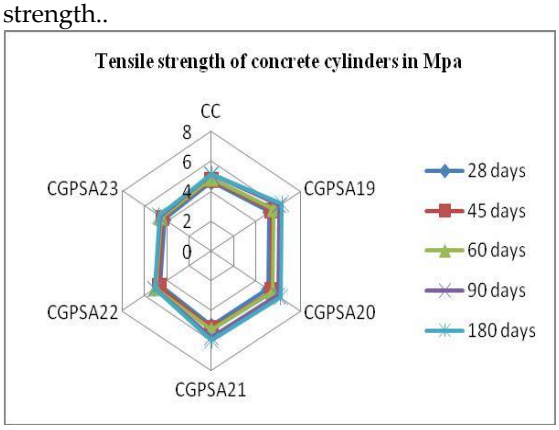
The tensile strength of concrete cubes made with Sheet Glass Powder and Sawdust ash was determined at the ages of 28,45,60,90 and 180 days results shown Figure 6 with conventional concrete. From the test results it is observed that the tensile strength increased by 12.5% to 20.2% at 10%, 20% and 30% replacement SGP and SDA. Similarly for 45, 60, 90, and 180 day's tensile strength is increased. When SGP and SDA replace sand, the strength is significantly greater than that of the control mix. These observations indicate the beneficial pozzolanic reaction of SGP and SDA in concrete. At mixing ratios of 40% and 50% at 45, 60, 90 and 180 days displayed a reduction in tensile strength. This inclination may be due to the decrease in adhesive strength between the surface of sheet glass powder aggregate strength between the surface of the sheet glass powder aggregate and the cement.



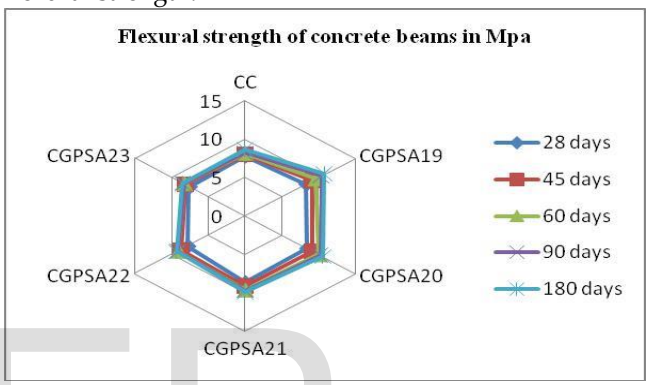
TENSILE STRENGTH OF CYLINDER

The tensile strength of concrete cylinder made with Sheet Glass Powder and Sawdust ash was determined at the ages of 28,45,60,90 and 180 days results shown Figure 7 with conventional concrete. From the test results it is observed that the tensile strength increased by 11.5% to 18.7% at 10%, 20% and 30% replacement SGP and SDA. Similarly for 45, 60, 90, and 180 day's tensile strength is increased. When SGP and SDA replace sand, the strength is significantly greater than that of the control mix. These observations indicate the beneficial pozzolanic reaction of SGP in concrete. At mixing ratios of 40% and 50% at 45, 60, 90 and 180 days displayed a reduction in tensile strength..



FLEXURAL STRENGTH OF BEAM

The flexural strength of concrete made with Sheet Glass Powder and Sawdust ash was determined at the ages of 28,45,60,90 and 180 days results shown Figure 8 with conventional concrete. From the test results it is observed that the flexural strength increased by 6% to 21.1% at 10%, 20% and 30% replacement SGP and SDA. Similarly for 45, 60, 90, and 180 day's tensile strength is increased. When SGP and SDA replace sand the strength is significantly greater than that of the control mix. These observations indicate the beneficial pozzolanic reaction of SGP and SDA in concrete. At mixing ratios of 40% and 50% at 45, 60, 90 and 180 days displayed a reduction in flexural strength.



CONCLUSION

The data presented in this paper show that there is great potential for the utilization of Sheet Glass Powder and Sawdust ash 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 and SDA in concrete would prevent expansive ASR in the presence of sawdust. Strength gain of SGP and SDA concrete is satisfactory. It has been concluded that 30% SGP and 10% SDA could be incorporated as fine aggregate replacement without any long-term detrimental effects. Up to 50% of fine aggregates could also be replaced in concrete of 44-MPa strength grade with acceptable strength.

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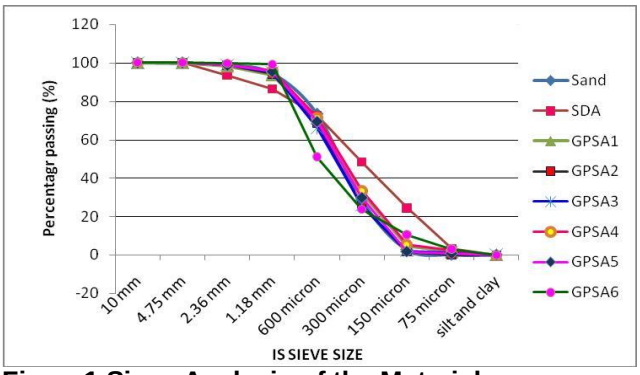

Figure1 Sieve Analysis of the Materials

Table 1 Fineness Modulus

Material	Fineness Modulus
Sand (S)	2.21
Sawdust ash (SDA)	1.78
(90%S+10%SGP+10%SDA)(GPSA1)	2.25
(80%S+20%SGP+10%SDA)(GPSA2)	2.20
(70%S+30%SGP+10%SDA)(GPSA3)	2.07
(60%S+40%SGP+!0%SDA)(GPSA4)	1.84
(50%S+50%SGP+10%SDA)(GPSA5)	1.82
Sheet Glass Powder (GPSA6)	2.16

Table 2 Physical properties of Materials.

Parameter	Sand	Coarse	SGP	SDA	GPSA1	GPSA2	GPSA3	GPSA4	GPSA5
Specific gravity	2.65	2.7	2.52	2.5	3.21	3.17	3.1	2.93	2.85
Water absorption %	8.3	0.45	0.1	0.56	7.5	7.3	7.25	7.2	7.0
Moisture content %	3.70	0	0	0	0.58	0.57	0.55	0.52	0.5
Bulk density (dry loose state) (kg/m^3)	1468	1450	1310	1250	1440	1440	1450	1460	1480
% Voids	40.8	39	57	64	54	54	53	52	48
% Porosity	28.9	27	36	41	35	35	34	33	31
Bulk density (dry compact state) (kg/m^3)	1512	1640	1530	1300	1600	1600	1590	1560	1520
% Voids	35.39	34	50	55	46	46	45	41	40
% Porosity	25.9	25	33	40	32	32	31	30	29

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Figure 2 (a)

Figure 2(b)

Figure 3

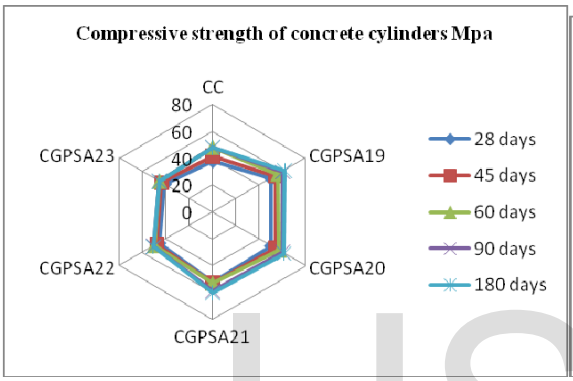

Figure 4 Compressive strength of cubes Cylinders

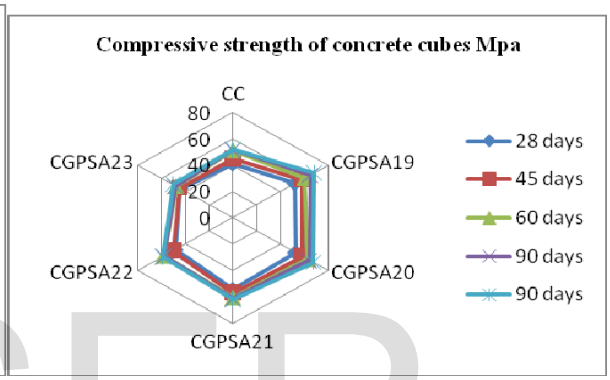

Figure 5 Compressive strength of

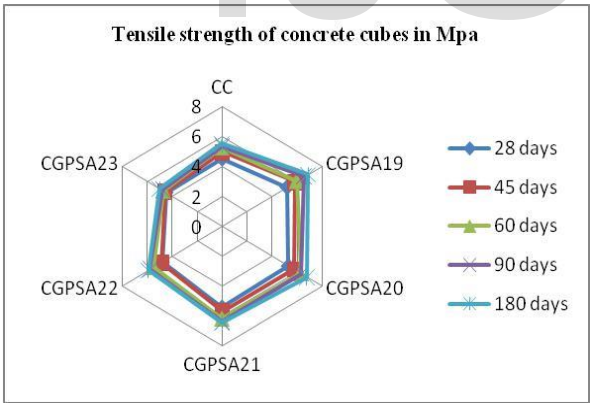

Figure 6 Tensile strength of Cubes

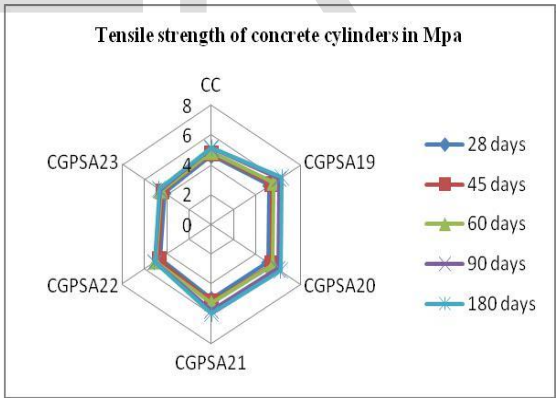

Figure 7 Tensile strength of Cylinder

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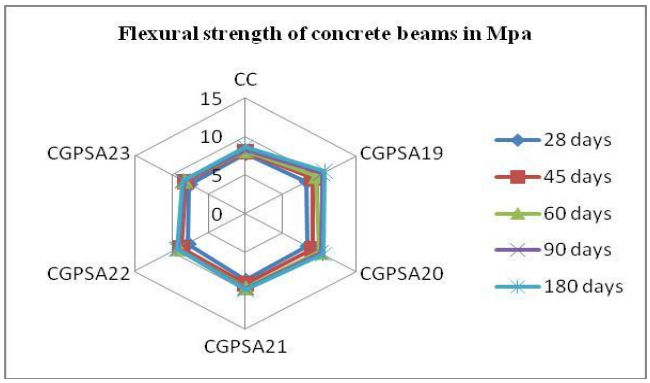

Figure 8 Flexural strength Vs curing days