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Experimental Study on Light Weight Concrete by Partical Replacement of Cement and Fine and Fine Aggeregates by Fly and Termocal

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ABSTRACT
Light weight concrete plays an important role in structural engineering and its use to steadily increasing light weight concrete using mix M25 and made by partial replacement of cement and fine aggregate by fly ash thermocol. It has many advantages of dead load reduction high thermal insulation, increase the process of building and lowers haulage cos. It is include an expanding agent in that it increase the volume of mixture.

KEYWORDS: *Agricultural Waste, SCBA, Concrete, Silica Content*

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INTRODUCTION

Light weight concrete is an important and versatile material in modern construction. It has many advantages of dead load reduction, high thermal insulation; increase the process of building and lowers haulage and handling cost. It also lowers power consumption for extreme climate condition due to possessing property of low thermal conductivity.

Nowadays lightweight concrete are commonly used in precast and prestressed components. Light weight concrete offers design flexibility and substantial cost savings by providing less dead load, improves seismic structural response, better fire rating, decreased storey height, smaller size structural members, lower foundation cost, and less reinforcing steel. The concrete made with light weight concrete exhibit lower thermal conductivity than of normal weight concrete. Therefore light weight concrete provide more efficient fire protection than dense aggregates as it is less liable to spalling and has a higher thermal insulation.

The LWC has been widely across other countries such as USA, UK and Sweden. Light weight concrete plays an important role in structural engineering and its use is steadily increasing. It is defined as a type of concrete which includes an expanding agent in that it increases the volume of mixture. It is lighter than conventional concrete with dry density of 300kg/m^3 up to 1840 kg/m^3. The reduction in weight by use of light weight concrete will be advantageous, especially for building structures.

OBJECTIVE OF THE STUDY

The important objectives the study of are as follows;

- To understand the light weight concrete and level of application in construction industry.
- To reduce the effect of pollutant in the environment
- To compare the strength & density of LWC with normal concrete
- To study the influence of partial replacement of fly ash & thermocol in concrete
- To ascertain the proper mix at which LWC can have low density with good compressive strength
- To study the properties of LWC with the incorporation of EPS and SCM.

TABLE I

Sample	SUGARCANE BAGASSE ASH	GLASS POWDER
A	**0**	**0**
B	**5**	**10**
C	10	10
D	15	10
E	20	10

DESCRIPTION OF THE MATERIALS USED:

The material used in the present study are cement, fine aggregate, coarse aggregate, sugar cane bagasse ash, glass powder and water.

CEMENT

Cement is a well known binding material which has occupied an indispensable place in the construction works. Cement is a finally powdered material which by itself is not a binder; it develops the binding property as a result of hydration. Cement is called a hydraulic product; the hydraulic products are stable in aqueous environment.

Fig: cement

Nowadays high strength Portland cement 53 grade is used for the construction works. It has confirmed to the requirements of Indian standard specifications IS 12269-1997. The tests on cement has been carried out as per IS 4031-1991.The chemical composition of cement is given in the table 1. And the physical properties that are obtained by conducting tests on cement is given in table 2.

Chemical composition of ordinary Portland cement

TABLE - 2

CaO	60-67
SiO2	17-25
Al2O3	3-8
Fe2O3	0.5-6
MgO	2.5
SO3	2-2.5
Other Oxides	5

Physical properties of ordinary Portland cement

TABLE - 3

SL. No	Properties	Results
1	Fineness (%)	2.35
2	Normal consistency (%)	34
3	Specific gravity	3.1
4	Initial setting time (min)	35

FINE AGGREGATE

Normally concrete is prepared by using the mix design. Concrete which has reported in this study is prepared with the different combination of the selected ingredients to suit the requirement has a concrete. The sand is one of the main ingredients use in the preparation of concrete. Fine aggregates are basically the sand that has been obtained from the land or marine environment.

Fig: fine aggregate

The fine aggregate generally consist of the natural sand or crushed stone. The sand used in this investigation is depending upon the proportion of ingredient selected for the concrete was made from an external source. The fine aggregates are the most largely mined material in the world in the account of the other mined materials.

The fine aggregates as per the guidelines of IS 383-1970 is defined as the particles, which will pass through the 4.75 mm IS sieve and the materials retained on 150 micron IS sieve. The natural sand is generally considered to have a lower size limit of 0.07 mm. The fine aggregates containing the materials between the range 0.06 mm and 0.02 mm is considered as silt material. The fine aggregates containing the materials still smaller than the ranger of the silt particles then it is considered as clay material. The natural sand as relatively high hydraulic conductivity value as compared to the different types of fine aggregate materials.

As per the guidelines confirming to IS 383-1970 zoning of fine aggregates, the fine aggregates used in the present experimental investigation belong to the zone. The physical properties of the fine aggregates are determined in the laboratory by conducting the tests confirming the guidelines of IS 2386-Part (3)-1963. The test results which are obtained in the laboratory during the present experimental investigation are shown in the table 4.

TABLE - 4

Sl. No	Properties	Results
1	Specific Gravity	2.60

COURSE AGGREGATE

The coarse aggregate is defined as an aggregate most of which is retained on 4.75 mm IS sieve. The coarse aggregate are formed by the natural disintegration of rocks. The coarse aggregate can also be obtained by the artificial crushing of the rock and gravel thus the coarse aggregates derive many of their properties from their parent rocks. The properties of coarse aggregates includes chemical composition, mineral composition, specific gravity, hardness, strength and pore structure

The coarse aggregates may be classified as rounded, partly rounded, flaky, angular and elongated based on its shape and surface texture. Generally angular aggregates are preferred and used for construction works. The angularity of the coarse aggregates also affects the workability or stability of the mix, which depends on the interlocking of the particles. The physical properties of the coarse aggregates are determined in the laboratory by conducting the tests

confirming to the guidelines of IS 2386-Part III and the test results which were obtained by the laboratory are shown in the table 5.

TABLE - 5

Sl. No	Properties	Results
1	Specific Gravity	2.67

WATER

Water is a very important ingredient in the preparation of concrete, as it actively participates in the chemical reaction with the cement during the mixing of concrete. In general the water fit for drinking is suitable for mixing concrete. Impurities in water may affect the initial and final setting time, strength and shrinkage of concrete. It may also have its effect in promoting the corrosion of the reinforcement. It has been estimated that or average water by the weight of cement is required for the chemical reaction in cement compounds. Portable water free from the impurity salts was used for mixing and curing of concrete blocks. Some water containing sugar would be suitable for drinking but it is not suitable fore mixing the concrete and conversely water suitable for making concrete may not be necessarily fit for drinking.

should have the following properties: The water to be used in the concrete work

- It should be free from adverse amount of soils, solids, alkalis, organic materials and inorganic impurities.
- It should be free from iron, vegetable matter and any other type of substances which are likely to have adverse effect on concrete or reinforcement.
- The water used should be fit for drinking.

SUGARCANE BAGASSE ASH

Sugarcane bagasse ash is a byproduct of sugar factory found after burning sugarcane bagasse which itself is found after the extraction of all economical sugar from sugarcane. In India, approximately about 2.5 Million tons of sugarcane bagasse ash produced every year. The sugarcane bagasse ash is a voluminous material and is an environmental waste sugarcane bagasse ash is non biodegradable waste. The disposal of this material is already causing environmental problems around the sugar factories. On the other hand, the boost in the construction activities in the country created shortage in most of concrete making materials especially cement, resulting in an increasing in price.

In this study, sugarcane bagasse ash was collected from and its chemical properties were investigated.

MAKAVALLY SUGAR FACTORY KR PETE:

The sugarcane collected from the factory was used as a partial replacement for cement in the preparation of M20 grade concrete before the use of bagasse ash, it was oven dried to remove the moisture content in the ash. After oven drying the sugarcane bagasse ash which is passing from 90 micron IS sieve was used in this experimental work. The sugarcane bagasse ash is rich in silica content and also possesses sufficient amount of calcium. The chemical composition of sugarcane bagasse ash is similar to that of cement and the physical properties are also in the comparable range.

In the present experimental work cement is partially replaced by the sugarcane bagasse ash in 0%. 5%, 10%, 15% & 20% followed by a constant percent of glass powder and the concrete blocks were made and the compressive strength of the concrete work determined for 7, 14 &28 days the split tensile strength were determined for 28 days.

Chemical composition of sugarcane bagasse ash is shown in the table 5.

Table - 6

Content	Percentage
SiO2	62.43
Al2O3	4.38
Fe2O3	6.98
CaO	11.8
MgO	2.51
SO3	1.48
K2O	3.53

Physical Properties of Sugarcane Bagasse Ash is shown in the table 7.

Table - 7

Sl. No	Properties	Results
1	Specific Gravity	2.20

GLASS POWDER

Million tons of waste glass is being generated annually all over the world. Once the glass becomes the waste it is disposed as landfills, which is unsustainable as this does not decomposes in the environment. Glass is principally composed of silica and it also possesses sufficient amount of calcium. The waste glass pieces are milled by using milling equipment and then the milled glass is used in concrete as a partial replacement of cement could be an important step towards the development of sustainable infrastructure systems. When the waste glass is milled down to micro size particles, it is expected to undergo pozzolonic reactions with the cement hydrates, forming secondary calcium silicate hydrate. In this present study the chemical properties of glass will be evaluated being non biodegradable in nature, glass disposal has landfilled has environmental impacts as the land filling will be expensive. The glass powder is sieved and the particles passing through 90 micron ARE sieve are collected. The glass powder increases the compressive strength of the concrete.

Chemical composition of glass powder is shown in the table 8.

Table - 8

Content	Percentage
SiO2	68.1
Al2O3	0.9
Fe2O3	0.6
CaO	14.5
MgO	1.8
Na2O	12.2
K2O	0.8

Physical Properties of Glass Powder is shown in the table 9.

Table - 9

Sl. No	Properties	Results
1	Specific Gravity	2.66

MIX DESIGN

A. Grade designation: M20
B. Type of cement: OPC 53 Grade
C. Maximum nominal size of aggregate: 20 mm
D. Minimum cement content: 300 Kg/m3
E. Maximum water cement ratio: 0.5
F. Workability: 100 mm (slump)
G. Exposure condition: Mild
H. Degree of supervision: Good
I. Type of aggregate: Crushed angular aggregate
J. Maximum cement content: 450 Kg/m3

➢ **CONCRETE MIXES**

MIX PROPORTION IS **1:1.7:2.7**

Quantity of materials required for 1 m³

TABLE - 10

SI. NO	Materials	Quantity (Kg/m3)
1	Cement (OPC)	394
2	Fine Aggregate	703
3	Coarse Aggregate	1082
4	Water	197

Mix Proportions per cubic meter in Kg

TABLE - 11

SI. No	Sample	Cement	Sand	CA	SCBA	GP	Water
1	A	394	703	1082	0	0	197
2	B	334.9	703	1082	19.7	39.4	197
3	C	315.2	703	1082	39.4	39.4	197
4	D	295.5	703	1082	59.1	39.4	197
5	E	275.8	703	1082	78.8	39.4	197

Mix Proportion for sample A-E (6 cubes per each sample) in Kg

TABLE - 12

SI. No	Sample	Cement	Sand	CA	SCBA	GP	Water
1	A	8.28	13.8	22.32	0	0	4.14
2	B	7.08	13.8	22.32	0.42	0.78	4.14
3	C	6.72	13.8	22.32	0.78	0.78	4.14
4	D	6.24	13.8	22.32	1.26	0.78	4.14
5	E	5.82	13.8	22.32	1.68	0.78	4.14

➢ **DEATAILS OF THE SPECIMENS**

TABLE - 13

SPECIMEN	CUBES			CYLINDERS
DIMENSION	(150*150*150) mm			150 mm Diameter & 300 mm height
SAMPLE/NO OF DAYS	7 DAYS	14 DAYS	28 DAYS	28 DAYS
A	2	2	2	1
B	2	2	2	1
C	2	2	2	1
D	2	2	2	1
E	2	2	2	1
TOTAL	10	10	10	5

➢ **CASTING, DEMOULDING, AND CURING**

Fig. 1

Fig .2

Fig .3

Fig .4

➢ **TESTS ON CONCRETE**

A. TESTS ON FRESH CONCRETE

1. STANDARD SLUMP TEST

Slump values of all the samples

TABLE - 14

SI. No	Items	A	B	C	D	E
1	Proportion	1:1.7:2.7				
2	Slump	100	97	94	89	85

B. TESTS ON HARDENED CONCRETE

1. COMPRESSIVE STRENGTH

Fig .5

C. SPLIT TENSILE STRENGTH OF CONCRETE

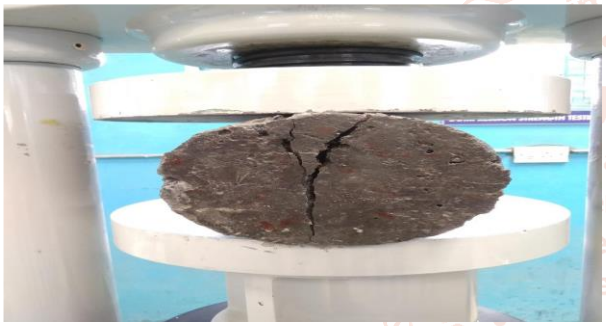

Fig .6

➢ RESULTS AND DISCUSSIONS

A. COMPRESSIVE STRENGTH OF CONCRETE

Compressive Strength of the concrete cubes at 7, 14, & 28 days is shown in table.

TABLE - 15

PERCENTAGE OF REPLACEMENT		COMPRESSIVE STRENGTH (Mpa)		
SCBA	GP	7 DAYS	14 DAYS	28 DAYS
0%	0%	13.99	23.77	26.21
5%	10%	16.22	25.10	26.88
10%	10%	17.55	25.55	27.33
15%	10%	13.10	21.77	24.44
20%	10%	12.24	20.66	23.10

B. **SPLIT TENSILE STRENGTH OF CONCRETE**

Split tensile strength results at 28 Days are shown in table.

TABLE - 16

PERCENTAGE OF REPLACEMENT		SPLITTENSILE STRENGTH (Mpa)
SCBA	GP	28 DAYS
0%	0%	2.90
5%	10%	3.15
10%	10%	3.50
15%	10%	2.85
20%	10%	2.24

CONCLUSION

Experimental investigation has been carried out to determine utilization of the sugarcane bagasse ash and glass powder as cement replacement materials by making the cement concrete. Based on the results obtained from the experimental work the following conclusions can be drawn:

1. The compressive strength of concrete was higher than the conventional concrete for 10% sugarcane bagasse ash and 10% glass powder replacement by the weight of cement at 7, 14, & 28 days of curing ages. However further increase in replacement percentages lowers the compressive strength of concrete.
2. The split tensile strength of concrete in which cement was replaced by 10% SCBA & 10 & GP was higher than conventional concrete. However further increase in replacement percentages lowers the split tensile strength of concrete.
3. Glass powder and SCBA can be used as partial replacement for cement in concrete which helps in reduction of construction cost.
4. The optimum replacement of cement by SCBA and Glass Powder is 10% and 10%, further increase in the replacement percentages results in reduction of concrete strength.

SCOPE FOR FUTURE WORK

1. Durability of concrete with partial replacement of cement by SCBA and glass powder can be studied.
2. Alkali aggregate reaction of concrete with partial replacement of cement by SCBA and Glass Powder can be studied.
3. Behavior due to acid attack of concrete with partial replacement of cement by SCBA and Glass Powder can be studied.

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