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EXPERIMENTAL INVESTIGATION ON SUGARCANE BAGASSE ASH AND GGBS IN CONCRETE BY PARTIAL REPLACEMENT OF CEMENT

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Abstract *- Use of waste fabric in concrete is important for environmental aspect. Sugar cane bagasse ash is a waste by using product of sugar mill. This experimental study is to investigate impact of sugar cane bagasse ash and ground granulated blast furnaces slag in concrete. In this experimental work cement is partially replaced with Sugarcane bagasse ash (0%, 10%, 20%) and Ground granulated blast furnace slag (0%, 10%, 20%) by weight in concrete. The grade of concrete is M25 and w/c ratio is 0.45 taken as a reference. Cubes, cylinders and prisms are casted and tested for 7, 14 and 28days.The sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicelluloses and 25% of lignin. The ground granulated blast furnace slag have Fineness about 96% and Specific gravity 2.98. One effective way to reduce the environmental impact is to use mineral admixtures, as a partial cement replacement both in concrete and mortar, which will have the potential to reduce costs, conserve energy, and minimize waste emission. Also it requires checking various properties of concrete like compression test, Split tensile test, Flexure test with variation of SCBA and GGBS in concrete. Recycling of waste building substances saves natural resources, saves energy, reduces solid waste, reduces air and water pollutants and reduces greenhouse gases. Also the amount of sugarcane bagasse ash and Ground granulated blast furnace slag increase, workability of concrete increases.*

Key word: *Sugar Cane Bagasse Ash, Concrete Properties, Waste Recycling, Strength Tests*

1. INTRODUCTION

Large quantities of waste substances and by-products are generated from manufacturing processes, provider industries and municipal stable waste, and many others. As a result, solid waste management has become one of the major environment, scarcity of land-fill space and due to its ever increasing cost, waste materials and by-products utilization has become an attractive alternative to disposal. "Bagasse is a cellulose fiber closing after the extraction of the sugar-bearing juice from sugarcane. Biomass is an important source of energy in tropical countries like India Bagasse ash is one of the biomass sources and valuable byproduct in sugar milling that often uses bagasse as a primary fuel sources to supply all the needs of energy to move the plants.

Burning bagasse as an energy source yield its ash, considered as a waste causing disposal problems. Currently, sugarcane bagasse is burned in a boiler to produce steam which is utilized in the factory's procedures and additionally to energy turbines for the manufacturing of electrical energy. The objectives of this work were the unit cost of concrete can be reduced by partial replacement of cement with GGBS and SCBA. Concrete making with conventional material is becoming costlier day by day. More over concrete suffers little resistance to cracking. These problems may overcome by inclusion of GGBS and SCBA in concrete.

MATERIALS USED

1.1 SUGAR CANE BAGASSE ASH (SCBA)

In this project sugarcane bagasse ash was collected from Kabilarmalai in Namakkal district. The combustion yields ashes containing high amounts of unburned matter, silicon and aluminum oxides as essential elements. These sugar-cane bagasse ashes (SCBA) have been chemically, physically and mineralogical characterized, in order to evaluate the possibility of their use as a cement-replacing material in the concrete industry. SCBA mainly contains silica content, but it is lack in alkali content. But silica content of over 70% is a good pozzolanic material. The total amount of silica, aluminum oxide and ferrous oxide is over 70% . Specific gravity of SCBA was 1.79 and 1.92.

Composition of bagasse

Component	Proportion (%)
Sio_2	55.76
Al_2o_3	1.79
Fe_2o_3	0.72
Cao	1.68
Mgo	2.02

1.2 GROUND GRANULATED BLAST FURNACE SLAG (GGBS)

The GGBS was procured from Tirupur with information on both chemical and physical properties. Granulated Blast Furnace Slag is obtained by way of hastily chilling (quenching) the molten ash from the furnace with the help of water. All through this system, the slag gets fragmented and transformed into amorphous granules (glass), assembly the requirement of IS 12089:1987 (manufacturing specification for granulated slag utilized in Portland Slag Cement)The granulated slag is floor to favored fineness for producing GGBS.

Fineness of GGBS : 96%

Specific gravity : 2.98

Chemical properties of GGBS

Composition	Proportion (%)
Sio_2	35.34
Al_2o_3	11.59
Fe_2o_3	0.35
Cao	41.99
Mgo	8.04

1.3 CEMENT

OPC 43 Grade Ultra Tech cement confirming to IS: 12269:1987 be taken for use in this investigation.

1.4 FINE AGGREGATE (As per IS:383)

The Fine sand was taken from Thottumukkam crusher having a Specific gravity of 2.39 and fineness modulus of 1.75 was used. With conforming to IS specifications IS 383- 1970. Experiments on fine aggregate were performed from Government Engineering College Kozhikode.

1.5 COARSE AGGREGATE (As per IS :383)

The coarse aggregate 20mm nominal size was used. The total coarse was tested according to Indian standard detail Seems to be: 383-1970. The different test results are shown in the table below.

Sl.no	Content	Particulars
1	Specific gravity	2.80
2	fineness modulus	6.9
3	Free surface moisture	NIL
4	Size of crushed aggregate	20mm down size
5	Water absorption	1.34%
6	Aggregate crushing value	13

1.8 MIX DESIGN:

Concrete Mix Design is process by which determined the relative proportion of the various raw materials of concrete with an aim to achieve a certain strength and durability, as economically as possible. Basically, two factors are involved in concrete mix design. We have to consider two kinds of costs, are involved in making of concrete; namely cost of material and cost of labor. The labor cost, with comprises of formwork, batching, mixing, transporting and curing is nearly the same for good

The fresh paste is a suspension of cement in water. The dilution of the paste is determined by the water cement ratio. The ore ductile paste, greater will be the space between cement partial and weaker will be the paste structure.

1.7 STRENGTH TEST AND RESULTS

1.7.1 COMPRESSIVE STRENGTH

The compressive strength of concrete has been evaluated by testing three cubes of size 15cm 15cm 15cm. After 24 hours the cubes are removed from the mould and immersed in clean fresh water until taken for testing.

Compressive strength f_{ck} =P/A N/mm^2

1.9.1.2 COMPRESSIVE STRENGTH FOR CUBE WITH GGBS &SCBA

SL. NO	CURING DAYS	REPLACEMENT WITH GGBS& SCBA(%)	TRIAL I	TRIAL II	TRIAL III	MEAN VALUE (N/mm^2)
1	7	10%	24.4	23.11	26.66	24.72
		20%	35.11	34.22	33.77	34.36
2	28	10%	37.7	37.7	37.7	37.7
		20%	38.22	39.5	39.5	39.07

COMPARISON WITH CONVENTIONAL CONCRETE

CURING PERIOD	0%	10%	20%
7 DAYS	21.48	24.72	34.36
28 DAYS	38.46	37.7	39.07

1.7.2 SPLIT TENSILE STRENGTH

The break up tensile exams are done by means of putting a cylindrical specimen horizontally between the loading floor of a compression testing computing device and the load is applied till failure of cylinder, along the vertical side.

Split tensile strength $=2p/\pi dl$ N/mm^2

1.9.2.2SPLIT TENSILE STRENGTH FOR CYLINDERS WITH GGBS & SCBA

SL. NO	CURING DAYS	REPLACEMENT WITH GGBS &SCBA(%)	TRIAL I	TRIAL II	TRIAL III	MEAN VALUE (N/mm^2)
1	7	10%	2.40	2.26	2.26	2.30
		20%	2.546	1.98	1.98	2.48
2	28	10%	3.11	2.68	2.97	2.92
		20%	3.96	2.97	3.53	3.486

COMPARISION WITH CONVENTIONAL CONCRETE

CURING PERIOD	0%	10%	20%
7 DAYS	2.63	2.30	2.48
28 DAYS	3.25	2.92	3.48

1.7.3 FLEXURAL STRENGTH

The specimen is then placed in the machine, along two lines spaced 13.33cm apart. The axis of the specimen is carefully aligned with the axis of the loading device. The load is applied without shock and increasing continuously at a rate such that the extreme fiber stress increases at approximately $0.7kg/cm^2/min$

1.9.3.2 FLEXURAL STRENGTH FOR BEAM WITH GGBS $ SCBA

Sl. no	CURING DAYS	REPLACEMENT WITH GGBS&SCBA (%)	TRIAL I	TRIAL II	TRIAL III	MEAN VALUE (N/mm²)
1	7	10%	8	7.5	8	7.83
.		20%	7.5	7.5	8	7.66
2	28	10%	12	7.5	7	8.83
		20%	3.5	7.5	7	6

COMPARISON WITH CONVENTIONAL CONCRETE

CURING PERIOD	0%	10%	20%
7 DAYS	6.58	7.83	7.66
28 DAYS	8.25	8.83	6.00

3. CONCLUSIONS:

In this project we are partially replacing the cement with Sugarcane bagasse ash and Ground granulated blast furnace slag. It has been observed that by the incorporation of GGBS & SCBA as partial replacement to cement in fresh and plain concrete increases workability when compared to the workability with reference to concrete made without GGBS & SCBA. The highly silica content can be used for silica compound preparation and can minimize the environmental impact problems for bagasse ash disposal by using it in the economical construction practices.

The mix with 10% replacement of cement with GGBS (5%) and SCBA (5%) has shown good strength properties like compressive and tensile. This may be due to the fact that the CSH gel formed at this percentage is of good quality and have better composition.

The results show that the SCBA in blended concrete had significantly higher compressive strength, tensile strength, and flexural strength compared to that of the concrete without SCBA .It is observed that the cement should be advantageously changed with SCBA up to most restrict of 10%.Partial replacement of cement via SCBA will increase workability of fresh concrete; therefore use of incredible plasticizer is not substantial

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