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RESEARCH ARTICLE OPEN ACCESS

Compressive strength of Bagasse Ashbased M25 Grade Concrete.

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Abstract:
The world is focusing on many ways for utilizing either industrial or agricultural wastesas a source of raw material for construction industry. Using this waste is not economical which may also help us to create sustainable and pollution free environment. The usage of industrial and agricultural waste created by industrial process which has been focused for waste reduction for economic, environmental and technical reasons. sugarcane sorghum stalks is a fibrous waste product from the refining industry with the help of ethanol vapor. The sugarcane bagasse ash wastage causing toxic environmental pollution,which calls for immediate handling of the waste. This Bagasse ash contain silica and aluminum ion. In this research work, the Bagasse ash has been chemically and physically characterized, and partially replaced in the ratio of 0%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100% by the weight of cement in concrete. The bagasse ash was then ground until the particles passing the 90mm sieve size reach about 85% and the specific surface area about 4716 cm^2 /gm. At different percentage ratio sorghum stalks of sugar cane is being replaced by ordinary Portland cement.

The investigation of different mortars with bagasse ash were done by the compressive strengths. M25 concrete mixes with bagasse ash replacements of 0%, 10%, 20%, 30%, 40%, 50%,60%, 70%, 80%, 90% and 100% of the Ordinary Portland cement were prepared with water- cement ratio of 0.45 and cement content of 360 kg/m^3 for the control mix. we have tested fresh concrete tests like slump cone test were undertaken as well as hardened concrete test like compressive strength at the age of 7days, and 28 days was obtained. The test results indicated that up to 15% replacement of cement by bagasse ash results in better or similar concrete properties and further environmental and economic advantages can also be utilized by using bagasse ash as a partial cement substituted material.

Keywords: Cement, Slump-cone,Sugarcane Bagasse Ash (SBA)

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I. Introduction

In past decades,the industrial and Economic growth has been witnessed as the increase in generation of different types of waste (urban, Industrial, construction etc.,) regarding the waste management[1]. It represents an Economic cost.when waste is Controlled correctly then it can be convert-ed into a resource and Contribute to savings in raw materials, preservation of natural resources and the climate, encourages sustainable development. sugarcane is the most important agricultural plants.Bagasse is a byproduct of sugarcane Industry.when bagasse leaves are burned then bagasse ash is produced as a waste, which has a pozzolanic property that can be used as a cement replacement material. total worldwide production of sugarcane is over 1500 million ton[6].The usage of bagasse, for production of wood papers, animal food, Compost and thermal insulation, statistics show that about one million ton extra a bagasse ash remains in theCountry. Sugarcane Consists of 30% bagasse, then the sugar recovered is about 10% And the bagasse leaves about 8% bagasse Ash as the waste.As the sugar production is increased, le quantity of bagasse ash produced will also be large and the disposal will be problem. Bagasse is often used as a primary fuel source for sugar mills, when burn in quantity,it produces sufficient heat energy to supply all the needs of a typical sugar mill, with energy to spare

II. Experimental investigation:

In the present work, the concrete mixes with partial replacement of cement with bagasse ash were developed using OPC 53 grade cement. The same is the case with industrial waste–base concrete or bagasse ash replacement. The appropriate mix proportions can be involved in this major work. From previous experimental work,it was found that an optimal amount of 10% - 15% of cement can be replaced with bagasse ash. So, to carry-out further experimental studies, the cement was replaced by bagasse ash as 0%,10%,20%, 30%, 40%, 50%,60%, 70%, 80%, 90% and 100% by weight of cement the change in the properties of concrete mix are studied.

2.1 Materials: Raw materials required for the work are
2.1.1 Cement: Ordinary Portland cement is used.

Table:1 properties of cement composition

S.no	Property	Test results
1	Normal consistency	29%
2	Specific gravity	2.63
3	Initial setting time	92minutes
4	Final setting time	195minutes

2.1.2Coarse Aggregates: The particles retained on IS sieve of size4.75mm is termed as coarse aggregate and conforming IS: 383-1970 is used as coarse aggregate.

Table :2 properties of coarse aggregates

S.no	Property	Value
1	Specific gravity	2.67
2	Fineness modulus	5.314
3	Bulk density loose Compacted	14KN/m^3 16KN/m^3
4	Nominal maximum size	20mm

2.1.3 Fine aggregate: The magnitude of the fine aggregate is below 4.75mm. Fine aggregates can be natural or manufactured. The fine aggregates isnatural sand obtained from the river Godavari conforming to grading zone-Il of table 3 of IS: 10262-2009

Table:3physical properties of fine aggregate

s.no	Property	value
1	Specific gravity	2.52
2	Fineness modulus	4.36
3	Bulk density:loose Compacted	14KN/m^3 15KN/m^3
4	Grading zone	Zone-II

2.1.4 Water: All the properties of ingredients are exercised, but water quality control is ignored. Ph value of portable
wateris 7.1.portable water is used for the preparation of bagasse mix

Table: 4 properties of water

s.no	**Property**	**Value**
1	PH	7.1
2	Taste	Aggregable
3	Appearance	Clear

2.1.5Bagasse ash: The sugarcane bagasse ash consists of approximately 50% of cellulose, 25% of hemicelluloses and 25% of lignin. Each ton of sugarcane bring about around 26% of bagasse and 0.62% of residual ash. The residual ash after burning presents a chemical composition controlled by silicon dioxide (Si02). In this sugarcane bagasse ash was collected in Kakatiya Sugar Cement Industries, located in Kallur, Khammam district, India.

Table: 5Chemical Composition of BAGASSE ASH percentagebymass.

Components	**Mass%**
Silica as SIO_2	70.5
Calcium as CaO	4.75
Potassium K_2O	12.16
Iron as Fe_2O_3	1.89
Sodium as Na_2O	3.82
Aluminum Al_2O_3	1.36
Magnesium MgO	4.68
Titanium TiO_2	<0.06

Table :6 Physical properties of bagasse ash

Properties	**values**
Specific gravity	2.82
Color	Black
Density(gm/cm^3)	1.2
Moisture content	6.28%

2.2 Mixproportions:
Requirements of concrete mix design:
The basis of selection and proportioning of mix ingredients and their requirements:
1.The structural consideration for compressive strength required is minimum.
2.To get adequate durability for the particular site conditions maximum water-cement ratio must be given.
3.To avoid shrinkage cracking, maximum cement content is used by temperature cycle in concrete mass.

Factors to be considered for mix design
1.The grade designation, (the characteristic strength requirement of concrete).
2.The development of compressive strength of concrete depends on the type of cement.
3.Nominal size of aggregates used in concrete maybe large with the limits directed by IS:456-2000
4.Shrinkage, cracking and creep are limited by the cement content.
5.The workability of concrete for satisfactory placing and compaction is related to the size, shape, quantity and spacing of reinforcement and technique used for Transportation, placing and compaction.

Design of M25 grade concrete:
Stipulations for proportioning:
a) Grade designation: M25
b) Type of cement: OPC 53 grade confirming IS:12269
c) Minimum Cement content:360Kg/m^3[(13)]
d)Nominal size of aggregate: 20 mm[14]
e) Maximum water – cement:0.5[15]
D) Workability:100mm(slump)
g) Exposure condition:moderate
h) Method of concrete placing: non pumpable
i) Degree of supervision:Good
j)Type of aggregate:crushed angular aggregate

Test data for materials:
a) Cement used: 53 grade OPC confirming[16]
b) Specific gravity of cement:2.63
c) Specific gravity of
1) Coarse aggregate:2.67
2) Fine aggregate:2.52

3) Bagasse Ash:2.82
d) Water absorption
1) Coarse aggregate:0.5%
2) Fine aggregate:1.0%
e) Free (Surface) moisture
1) Coarse aggregate:NIL
2) Fine aggregate: NIL
f) Sieve analysis: Confirming to grading Zone II of **Table 4 of IS: 383**

2.3 Casting of specimens:
Before preparing the mix the test moulds were kept ready. All the surfaces of the Moulds were cleaned and oiled then fixed on vibrating table.The concrete is filled into moulds in three layers and then vibrated. The top surface of concrete is structed off to level with a trowel. The number and date of casting were put on the top surface of the cubes.

Curing:
The cast moulds are dried then the moulds are un moulded, then cubes were kept for curing in potable water

Workability:
Workability is a property of fresh concrete. It is, however, also a vital property as far as the finished product is concerned because concrete must have workability such that compaction to maximum density is possible with a reasonable amount of work or with the amount that we prepared to put in under given conditions.According to AC, workability is that property of the freshly mixed concrete or which regulates the ease and homogeneity with it can be mixed, placed, combined and concluded. Workability of the concrete can be measured in many ways. Here, workability in terms of slump was considered for the present study.

Slump cone test:
This test is used comprehensively in area all over the world. The workability of concrete does not measure the slump cone test, but the test is very useful in perceivingcontrast in the uniformity of a mix of give formal proportions.The slump test is done as directed byIS:516. Metallic mould is the essential apparatus for controlling slumptest the internal dimensions for slump is a frustum of a cone, 300 mm high. The smaller opening at the top is placed on the smooth surface, and filled by the three layers of concrete. Each layer is tamped twenty-five times with a standard 16 mm diameter steel rod, rounded at the end, and the top surface is struck off by means of sawing and rolling motion of the tamping rod. The mould must be rigidly fixed against its base during the entire action; this is smooth by handles or foot-rests bind to the mould. Immediately, the cone is slowly lifted perpendicularly up after stuffing, and the unfounded concrete will now sink. The highest point of concrete is measured.

Table 7:Slump values

SL.NO	SERIES	MIX ID	SLUMP(MM)
1	S1	NORMAL MIX	92
2	S2	10%	86
3	S3	20%	83
4	S4	30%	82
5	S5	40%	79
6	S6	50%	75
7	S7	60%	70
8	S8	70%	65
9	S9	80%	61
10	S10	90%	55
11	S11	100%	49

Hardened properties of concrete:
Compression test:
Compression test was conducted on 100mm*100mm*100mm cubes. concrete specimens were removed from curing tank and cleanedin the test machine, the cube is placed with the cast faces at right angle to that of compressive faces, then loaded load is applied at a constant rate of 1.4Kg/cm^2/min up to failure and ultimate load is noted. The load is incused until the specimen fails and maximum load is recorded. The compression tests were carried out at 7 days and 28 days. For strength computation,the average load of two specimens is considered for each mix.

Cube compressive strength = $\frac{load}{area\ of\ cross\ section}$

Density of cement =1440kg/m^3
Ratio of M25 Mix(C:S:A)=1:1:2
[C+S+A]=1+1+2=4
CEMENT (KGS)=$\frac{density\ of\ cement}{sum\ of\ ratio}$

$=\frac{1440}{4}$

=360kg/m^3

III. Results and Discussions

Table 8: Mix Proportions

MIX NUMBERS	MIX PROPORTION (M25)		CEMENT (KGS)	BAGASSE ASH (Kgs)
	CEMENT%	BAGASSE ASH %		
M1	100	0	2.16	0
M2	90	10	1.94	0.216
M3	80	20	1.728	0.432
M4	70	30	1.512	0.648
M5	60	40	1.296	0.864
M6	50	50	1.08	1.08
M7	40	60	0.864	1.296
M8	30	70	0.648	1.518
M9	20	80	0.432	1.728
M10	10	90	0.216	1.944
M11	0	100	0	2.16

The compressive strength test for all the mix proportion and the results are given in the table

Table 9: Compressive strength values

MIXES	CEMENTPROPORTION	BAGASSE ASH PROPORTION	AVERAGE COMPRESSIVE STRENGTH (N/MM^2)		7D/28D RATIO
			7 DAYS	28 DAYS	
M1	0	100	0.1	0	0
M2	10	90	4.0	5.52	0.72
M3	20	80	8.16	11.46	0.712
M4	30	70	10.6	14.72	0.720
M5	40	60	11.33	16.46	0.688
M6	50	50	12.46	18.6	0.669
M7	60	40	13.6	18.51	0.734
M8	70	30	18.23	21.02	0.867
M9	80	20	19.6	22.25	0.880
M10	90	10	19.14	23.97	0.798
M11	100	0	20.2	25.59	0.789

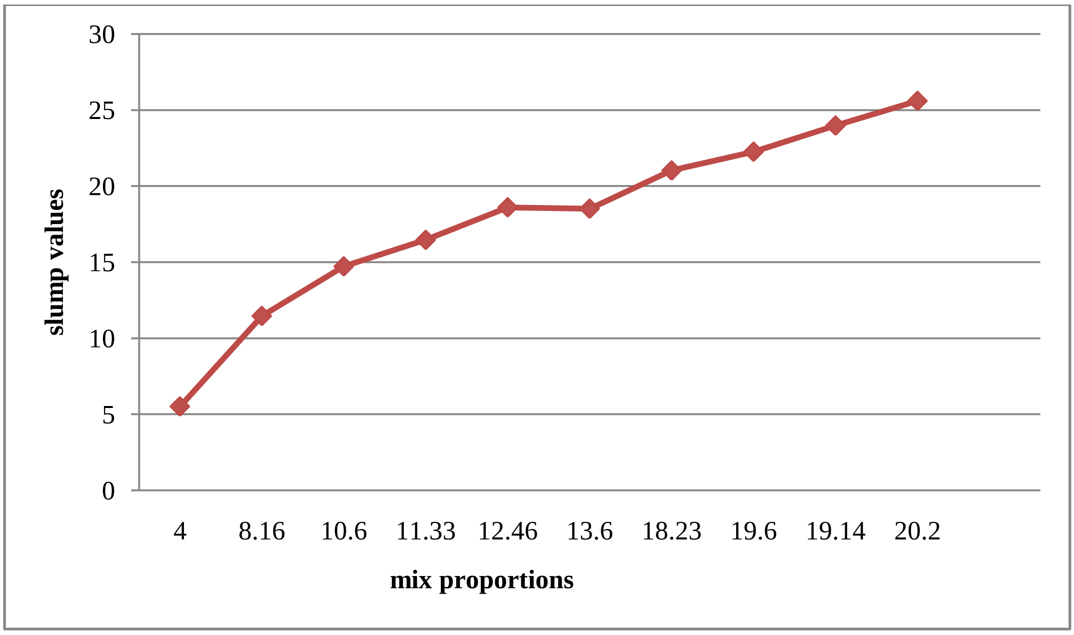

FIGURE:1 Variation of slump with various mix proportion

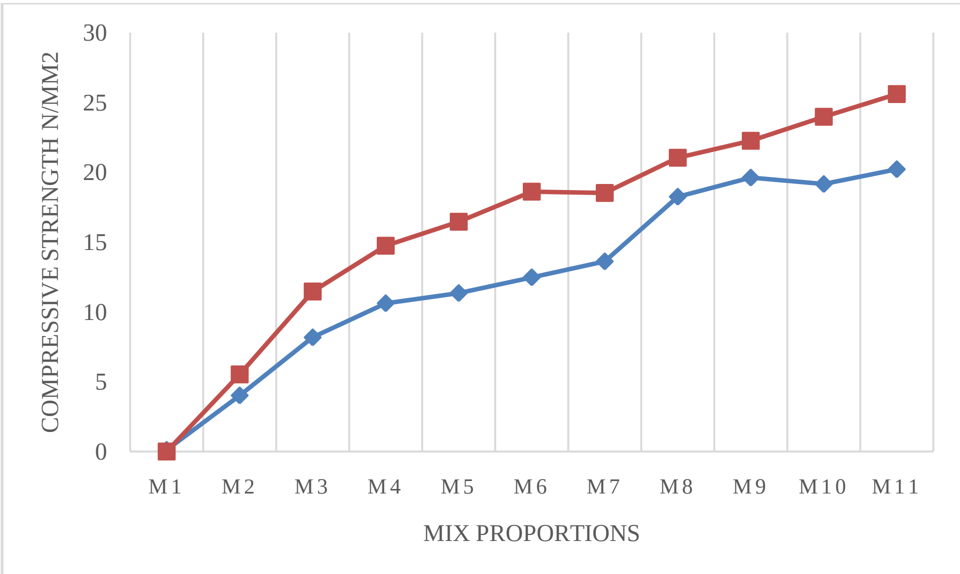

FIGURE 2: Variation of compressive strength of 7 days and 28 days

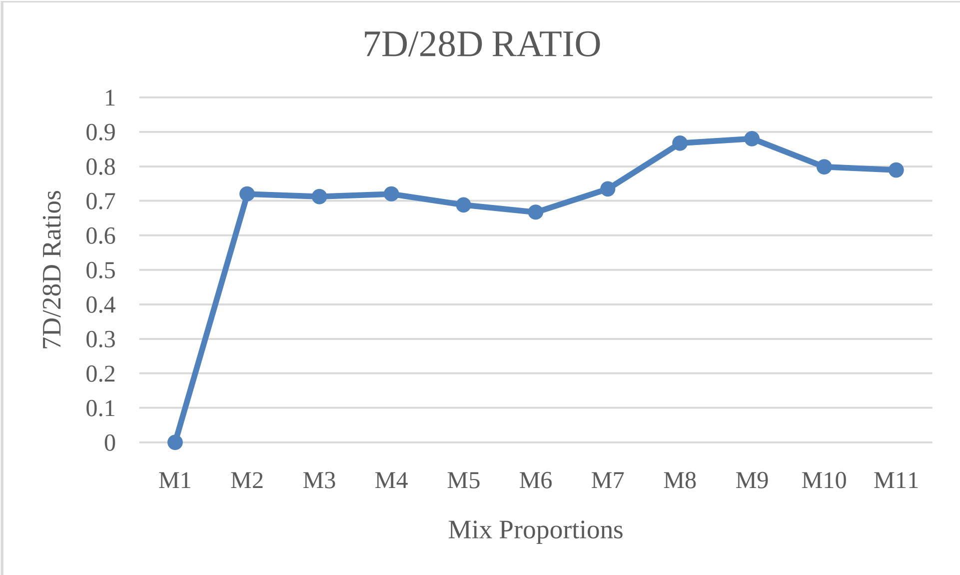

Figure 3:Variation of Compressive strength with different mix proportions

IV. CONCLUSIONS

Based on the research, following denouement can produce.

1.There is a change in slump for SCBA 10% has decreased 3.5% when compared with normal mix.

2.The slump for SCBA 10% and SCBA 20% has reduced by 4.7%, 8.2% and 14% respectively when compared with the normal mix

3. The SCBA mixes at the age of 7 days decreases its compressive strength balance with normal mix.

4. It was observed that the compressive strength of SCBA 10%, at the age of 28 days has increased its compressive strength by 16.8% when compared with the normal mix.

5. Cement can be replaced with bagasse ash up to 20% without much loss in compressive strength.

6. Considerable decrease in compressive strength was observed from 10% and 30% cement replacement.

7. It has been shown in this study that 10% sugarcane bagasse ash can be used as a partial cement replacement material with technical and environmental benefits. Concerned contributor, such as sugar fabrication, cement fabrication and pertinent government organization, should be sensible about this cement replacing material and promote its normalized manufacture and consumption.

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