ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

An Experimental Aproch on Strength Improvement of Concrete by Partial Replacement of Cement with Bagasse Ash

S.Komalidevi
Department of Civil Engineering,
Baba Institute of Technology and Sciences,
Visakhapatnam-530041, A.P, India.

M.Chiranjeevi
Department of Civil Engineering,
Baba Institute of Technology and Sciences,
Visakhapatnam-530041, A.P, India.

ABSTRACT:
Today researches all over the world are focusing on ways of utilizing either industrial or agricultural wastes as a source of raw materials for the construction industry. The tilization of industrial and agricultural waste produced by industrial processes has been the focus of waste reduction research for economic, environmental and technical reasons. Sugar-cane bagasse is a fibrous waste-product of the sugar refining industry, along with ethanol vapor. Bagasse has mainly contained silica and aluminum ion. In this project, ordinary Portland cement(OPC) is partially replaced by the bagasse ash. The bagasse ash is replaced by the different percentages 0%,5%,10%,15%,20% and 25%. Laboratory tests are conducted by the concrete like workability, compressive strength, split tensile strength, flexural strength. These are tests conducted by the age of 7days,28days and 90days and used M_{25} Grade of concrete mix with 0.45 water cement ratio.

INTRODUCTION:
The industrial and economic growth witnessed in recent decades have brought with an increase in the generation of different types of wastes (urban, industrial, construction etc.) despite the waste management policies which have been adopted nationally and internationally, the practice of dumping of waste from the various manufacturing sectors have had a notable impact on the receiving environment. At the same time, these practices represent an economic cost. However if waste is managed correctly it can be converted into a resource which contributes to savings in raw materials, conservation of natural resources and the climate, that promotes sustainable development.

Development of new concrete additives could produce a stronger, more workable material while reducing the amount of cement required and the resulting CO2 emissions. Concrete is used in such large amounts because it is, simply, a remarkably good building material not just for basic road construction but also for rather more glamorous projects. Concrete production is responsible for so much CO2 because making Portland cement not only requires significant amounts of energy to reach reaction temperatures up to 1500oC, but also for the key reaction of breakdown of calcium carbonate into calcium oxide and CO2. Of those 800kg of CO2 around 530kg is released by the limestone decomposition reaction itself.

Objective of the Work:
The main objective of the work is studying the effect on the strength on partial replacement of cement with bagasse ash. In this work, we study the comparison between strength variation on NCC and bagasse ash replaced concrete. From the study we can find out how much economy can be attained on using bagasse ash as partial replacement for cement. The objectives of the work are as follows:

i. To improve the strength properties of eco-efficient concretes in order to utilize them in major construction projects involving high strength requirements.
ii. Develop systems to mitigate and ultimately avoid industrial waste material.

Cite this article as: S.Komalidevi & M.Chiranjeevi, "An Experimental Aproch on Strength Improvement of Concrete by Partial Replacement of Cement with Bagasse", International Journal & Magazine of Engineering, Technology, Management and Research, Volume 5, Issue 8, 2018, Page 23-31.

iii. Develop industrial waste management systems.
iv. Develop ways to use industrial wastes as raw material for making construction material.
v. To develop environmental friendly methods of construction.
vi. To make the best use of industrial waste.
vii. To establish strategies to find economical means of construction.
viii. To overcome the problem of waste disposal crisis caused due to industries.
ix. Determine the ways to utilize industrial waste in most effective, ecological, environmental, social and financially responsible manner.

Scope of the Work

The scope of present study includes the following aspects:

Laboratory tests on cement, fine aggregate, coarse aggregate, bagasse ash and water. Mix design for normal concrete for M25 grade as per IS 10262:2009 was done by bagasse ash replacement of cement in the ratio of 0%, 5%, 10%, 15%, 20% and 25%. Conducting the trail mixes as per designed workability and target mean compressive strength of concrete. Specimens were tested at the age of 7 days, 28 days and 90 days of curing in portable water. Fresh properties of concrete were tested by slump cone test. For hardened properties of concrete specimens were tested at the age of 7 days, 28 days and 90 days. Casting cubes of dimensions 150mm×150mm×150 mm, for determination of compressive strength of concrete. Casting cylinders of dimensions 150mm×300 mm, for determination of split tensile strength of concrete. Casting beams of dimensions 100mm×100mm×150mm, for determination of flexural strength of concrete.

LITERAURE REVIEW

T. S. Abdulkadir, D.O.Oyejobi, A.A. Lawal (2014) has examined. “Evaluation of Sugarcane Bagasse Ash as a Replacement for Cement in Concrete Works”. SCBA was passing the residual through 45µm sieve, standard size of ordinary Portland cement (OPC). It was then used to replace OPC by weight in ratio of 0%, 10%, 20% and 30%.The cubes were tested at 7, 14, 21 and 28days of curing ages for density and compressive strength. The results showed a decrease in concrete density with increase in % replacement of SCBA. Average compressive strength of 26.8N/mm2 was obtained for control specimens at 28days (i.e. 0% SCBA) while 22.3, 20.1 and 17.3N/mm2 compressive strength at 28days were obtained for 10%, 20% and 30% replacement respectively. This showed that only 10% and 20% replacement of cement by weight of SCBA satisfied ASTM-595(1985) specification. It was concluded that SCBA is a low weight material and 10% replacement of SCBA has the highest strength [1].

Prashant O Modania, M.R Vyawahareb, (2013), has examined “Utilization of bagasse ash as a partial replacement of fine aggregate in concrete”. In this paper, untreated bagasse ash has been partially replaced in the ratio of 0%, 10%, 20%, 30% and 40% by volume of fine aggregate in concrete. Fresh concrete tests like compaction factor test and slump cone test were undertaken along with hardened concrete tests like compressive strength, split tensile strength and sorptivity at the age of 7 days and 28 days. The result shows that bagasse ash can be a suitable replacement to fine aggregate up to 20% [2].

V.R Rathi, VaishaliD.Girge Examined (2013) has studied “Effect of use of bagasse ash on strength of concrete”. The utilization of industrial and agricultural waste produced by industrial processes has been the focus on waste reduction. One of the agro waste sugar cane bagasse ash (SCBA) which is a fibrous waste product obtained from sugar mills as byproduct. Juice is extracted from sugar cane then ash produced by burning bagasse in uncontrolled condition and at very high temperature. In this paper SCBA has been chemically and physically characterized and partially replaced in the ratio of 0%, 10%, 15%, 20%, 25% and

30% by weight of cement in concrete. The properties for fresh concrete are tested like slump cone test and for hardened concrete compressive strength at the age of 7 and 28 days. The test result indicate that the strength of concrete increase up to 15% SCBA replacement with cement [3].

Lavanya M.R, Sugumaran.B, Pradeep.T (2012) have studied on "Experimental study on the compressive strength of concrete by partial replacement of cement with sugarcane bagasse ash". In this paper the feasibility of using sugarcane Bagasse Ash (SBA), a finely ground waste product from the sugarcane industry, as partial replacement for cement in conventional concrete is examined. The tests were conducted as per Bureau of Indian Standards (BIS) codes to evaluate the suitability of SBA for partial replacements up to 30% of cement with varying water cement (w/c) ratio.The physical properties of SBA were studied. Compressive strengths (7, 14 and 28 days) were determined. The results showed that the addition of sugarcane bagasse ash improves the strengths in all cases. The maximum strength increase happens at 15% with 0.35 w/c ratio [4].

Materials and their Properties

Raw materials required for the concrete use in the present work are

- Cement
- Coarse Aggregates
- Bagasse ash
- Fine aggregate
- Water

Testing on Cement

The following tests as per IS: 4031-1988 is done to ascertain the physical properties of the cement. The results of the tests are compared to the specified values of IS: 4031-1988 [5].

Table 3.1 Physical Properties of Cement

S. No	Property	Test results
1	Normal consistency	27%
2	Specific gravity	3.09
3	Initial setting time	33 minutes
4	Final setting time	600 minutes

Fine aggregate

The tests are conducted by the fine aggregate
1. Specific gravity
2. Finennes modulus
3. Water absorption
4. Grading

Table 3.2 Physical Properties of Fine Aggregate

S. No	Property	Value
1	Specific gravity	2.62
2	Fineness modulus	2.102
3	Water absorption	0.8%
4	Grading	Zone-II

Table: Physical Properties of Coarse Aggregate

S. No	Property	Value
1	Specific gravity	2.706
2	Fineness modulus	6.65
3	Water absorption	0.2%
4	Nominal maximum size	20 mm

Water:

This is the least expensive but most important ingredient of concrete. The quantity and quality of water is required to be looked in to very carefully. In practice very often great control on the properties of all other ingredients is exercised, but the control on the quality of the water is often neglected.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Since quality of the water effects strength, it is necessary for us to go in to the purity and quality of water. The water, which is used for making solution, should be clean and free from harmful impurities such as oil, alkali, acid, etc. in general, the distilled water should be used for making solution in laboratories. Water containing less than 2000 milligrams per litre of total dissolved solids can generally be used satisfactorily for making concrete. Although higher concentration is not always harmful they may affect certain cements adversely and should be avoided where possible. A good thumb rule to follow is, if water is pure enough for drinking it is suitable for mixing concrete.

S. No	Property	Value
1	pH	7.1
2	Taste	Agreeable
3	Appearance	Clear
4	Turbidity(NT units)	1.75

Chemical Composition of Bagasse Ash

Components	Mass %
Silica as SiO_2	78.35
Calcium as CaO	2.16
Potassium as k_2O	3.45
Iron as Fe_2O_3	3.6
Sodium as Na_2O	0.13
Aluminum as Al_2O_3	8.55
Magnesium as MgO	1.66
Titanium as TiO_2	<0.51
Loss of ignition	0.41

Physical Properties of Bagasse Ash

Properties	Values
Specific Gravity	2.21
Colour	Black
Moisture content	6.28%
Fineness Modulus	2.28

MIX DESIGN

Requirements of Concrete Mix Design

The requirements which form the basis of selection and proportioning of mix ingredients are:

- The minimum compressive strength required from structural consideration
- The adequate workability necessary for full compaction with the compacting equipment available.
- Maximum water-cement ratio to give adequate durability for the particular site conditions.
- Maximum cement content to avoid shrinkage cracking due to temperature cycle in mass concrete.

Factors to be considered for mix design

- The grade designation, (the characteristic strength requirement of concrete).
- The type of cement influences the rate of development of compressive strength of concrete.
- Maximum nominal size of aggregates to be used in concrete may be as large as possible within the limits prescribed by IS: 456-2000
- The cement content is to be limited from shrinkage, cracking and creep.

Design of M25Grade Concrete

Stipulations for Proportioning

a) Grade designation:M25
b) Type of cement: OPC 53grade confirming IS: 12269
c) Minimum Cement content: 300 kg/m³
d) Maximum nominal size of aggregate: 20 mm
e) Maximum water – cement ratio : 0.5
f) Workability: 100 mm (slump)
g) Exposure condition: Moderate
h) Method of concrete placing: Non Pump able
i) Degree of supervision: Good
j) Type of aggregate: Crushed angular aggregate
k) Maximum cement content: 438kg/m3

Test Data for Materials

a) Cement used: OPC 53 grade confirming IS:12269
b) Specific gravity of cement: 3.09
c) Mineral admixture: -----------
d) Specific gravity of
1) Coarse aggregate : 2.706
2) Fine aggregate : 2.62
3) Bagasse Ash : 2.21
e) Water absorption
1) Coarse aggregate : 0.2%
2) Fine aggregate : 0.8%
f) Free (Surface) moisture
1) Coarse aggregate: NIL
2) Fine aggregate: NIL
g) Sieve analysis
Coarse aggregate : 3.64
Fine aggregate : 2.102

Target Strength for Mix Proportioning

$f'_{ck} = f_{ck} + 1.65S = 25 + 1.65 \times 4 = 31.60$ N/mm²
Where
f'_{ck} =target average compressive strength at 28 days
f'_{ck} = characteristic compressive strength at 28 days
S = standard deviation
From Table 1of IS 10269:2009, standard deviation(s) = 4 N/mm²
Target strength = 31.60 N/mm²

Selection of Water-Cement Ratio

From Table 5 of IS 456, maximum water cement ratio = 0.50
Based on experience, adopt w/c=0.45
0.45< 0.50 hence O.K

Selection of Water Content

From Table 2 of IS 10262:2009 maximum water= 186 litres (for 25 to 50 mm Slump range) for 20mm aggregate
Estimated water content for 100mm slump

$$= 196 + \frac{6}{100} \times 196 = 197 \text{litres.}$$

Calculation of Cement Content

Water-cement ratio= 0.45

Cement content = $\frac{197}{0.45}$=438kg/m³
From Table 5 of IS 456 minimum cement content
For 'Moderate' exposure condition = 300kg/m³
438kg/m³> 300 kg/m³, hence, O.K

Proportion of Volume of Coarse Aggregate and Fine Aggregate Content

From Table 3 of IS: 10262-2009
Volume of coarse aggregate corresponding to 20mm size aggregate &fine aggregate (ZoneII)
For water-cement ratio of 0.50 = 0.62
But our water content is 0.45. Therefore water cement ratio lovers by 0.08, the proportion of Volume of coarse aggregate is increased by 0.02 (@ of -/+ 0.01 for every 0.05 change in w/c ratio)
Volume of Coarse aggregate for the water - cement ratio 0.45 = 0.63
Volume of fine aggregate = 1-0.63 = 0.37

Mix Calculations

The mix calculations per unit volume of concrete shall be as follows:
a) Volume of concrete = 1 m³
b) Volume of cement =

$$\frac{\text{Mass of cement}}{\text{Specific gravity of cement}} \times \frac{1}{1000} = \frac{438}{3.09} \times \frac{1}{1000} = 0.1417\text{m3}$$

c) Volume of water =

$$\frac{\text{Mass of water}}{\text{Specific gravity of water}} \times \frac{1}{1000} = \frac{167}{1} \times \frac{1}{1000} = 0.197\text{m3}$$

d) Volume of admixture = Nil
e) Volume of all in aggregate= [a – (b + c + d)]
= 1-(0.1417+0.197)= 0.661m3
f) Mass of coarse aggregate= e × Volume of CA × Specific gravity of CA x1000
= 0.661 × 0.63 × 2.706 × 1000= 1127 kg
g) Mass of fine aggregate = e × Volume of FA× Specific gravity of FA × 1000= 0.661 × 0.37 × 2.62 × 1000 = 641 kg

Water absorption

Water absorption due to Coarse aggregate =1127 x (0.2/100) =2.25 L
Water absorption due to Fine aggregate =641 x (0.8/100) =5.12 L

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Mix Proportions 1 m3 Concrete for Trail

Cement= 438kg/ m³
Water= 197litre
Fine aggregate= 641kg
Coarse aggregate= 1127kg
Water Cement ratio= 0.45

Cement	Fine aggregate	Coarse aggregate
1	1.46	2.56

Table 5.1 No. of specimens prepared for determining hardened properties.

Specimen	No. of specimen cured in water					
	NOR MAL MIX	SCB A 5%	SC BA 10 %	SC BA 15 %	SC BA 20 %	SC BA 25 %
Cubes	9	9	9	9	9	9
Cylinders	9	9	9	9	9	9
Beams	9	9	9	9	9	9
Total	27	27	27	27	27	27

Mixing

The object of mixing is to coat the surface of all aggregate particles with Cement paste and to blend all the ingredients of concrete into a uniform mass. Though mixing of the materials is essential for the production of uniform concrete. The mixing should ensure that the mass becomes homogeneous, uniform in colour and consistency. In this study the process of machine mixing was adopted.

Slump Cone Test

The slump test is done as prescribed by IS: 516.The apparatus for conducting the slump test essential consists of a metallic mould in the form of a cone having the internal dimensions as under

Bottom diameter : 200 mm
Top diameter : 100 mm

The mould for slump is a frustum of a cone, 300 mm high. It is placed on a smooth surface with the smaller opening at the top, and filled with concrete in three layers. Each layer is tamped twenty five times with a standard 16 mm diameter steel rod, rounded at the end, and the top surface is strucked off by means of sawing and rolling motion of the tamping rod. The mould must be firmly fixed against its base during the entire operation; this is facilitated by handles or foot-rests brazed to the mould. Immediately after filling, the cone is slowly lifted vertically up, and the unsupported concrete will now slump – hence the name of the test. The difference in level between the height of the mould and that of highest point of subsided concrete is measured. This difference in height in mm is taken as slump of concrete.

Compression Test

Compression test was conducted on 150mm×150mm×150mm cubes. Concrete specimens were removed from curing tank and cleaned. In the testing machine, the cube is placed with the cast faces at right angles to that of compressive faces, then load is applied at a constant rate of 1.4 kg/cm2/minute up to failure and the ultimate load is noted. The load is increased until the specimen fails and the maximum load is recorded. The compression tests were carried out at 7 days, 28 days and 90 days. For strength computation, the average load of three specimens is considered for each mix. The average of three specimens was reported as the cube compressive of strength. Cube compressive strength=$\frac{\text{Load}}{\text{Area of cross section}}$

Split Tensile Strength Test

The cylinder specimen is of the size 150 mm diameters and 300mm length. The test is carried out by placing a

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

cylindrical specimen horizontally between the loading surfaces of compression testing machine and the load is applied until failure of cylinder, along its longitudinal direction. The cylinder specimens are tested at 7 days, 28 days and 90 days. The average of three specimens was reported as the split tensile strength.

Split tensile strength $= \frac{2 \times P}{\pi \times D \times L}$

Where

P = compressive load on the cylinder.

L=length of the cylinder.

D=diameter of the cylinder.

Flexural Strength Test

The flexural strength of the specimen is expressed as the modulus of rupture ‘fb’ which, if ‘a’ equals the distance between the line of fracture and the nearest support measured on the centre line of the tensile side of the specimen, in cm, is calculated to the nearest 0.05Mpa as follows.

$$f_b = \frac{PL}{bd^2}$$

$$f = \frac{M}{Z} = \frac{(PL/6)}{(bd^2/6)}$$

When ‘a’ greater than 20 cm for 15cm specimen

$$f_b = \frac{3Pa}{bd^2}$$

when ‘a’ is less than 20cm but greater than 17cm for 15cm specimen or less than13.30 But greater than 11.00cm for a 10cm specimen.

Where,

P = ultimate load in N

L = span of the beam in mm

b = width of the specimen in mm

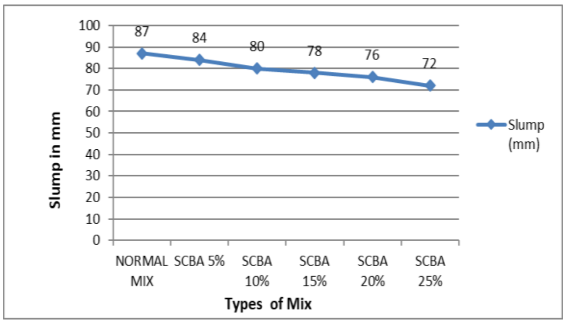
d = depth of the specimen in m

The flexural beam specimens are tested at 7 days, 28 days and 90 days. The average of three specimens was reported as the flexural tensile strength.

OBSERVATIONS AND DISCUSSIONS

S.No	Mix Id	Slump (mm)
1	NORMAL MIX	87
2	SCBA 5%	84
3	SCBA 10%	80
4	SCBA 15%	78
5	SCBA 20%	76
6	SCBA 25%	72

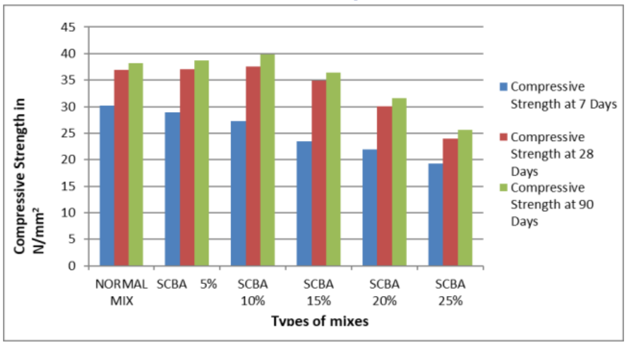
Table 6.1 Slump Cone Test Results



Graph 6.1 Slump test vs mixes

S.No	Mix id	Compressive Strength (N/mm²)		
		7 Days	28 Days	90 Days
1	NORMAL MIX	30.14	36.91	38.23
2	SCBA 5%	28.95	37.01	38.76
3	SCBA 10%	27.26	37.52	39.85
4	SCBA 15%	23.41	34.93	36.43
5	SCBA 20%	21.9	30.07	31.56
6	SCBA 25%	19.26	23.95	25.62

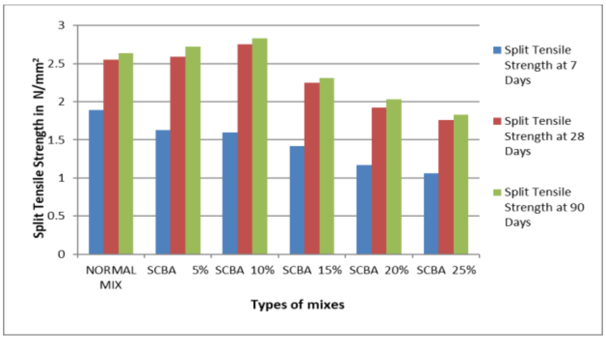
Table 6.2 Compressive Strength Test Results



Graph 6.2 Compressive Strength vs Age in days

S.No	Mix id	Split Tensile Strength (N/mm²)		
		7 Days	28 Days	90 Days
1	NORMAL MIX	1.89	2.55	2.64
2	SCBA 5%	1.63	2.59	2.72
3	SCBA 10%	1.60	2.75	2.83
4	SCBA 15%	1.42	2.25	2.31
5	SCBA 20%	1.17	1.92	2.03
6	SCBA 25%	1.06	1.76	1.83

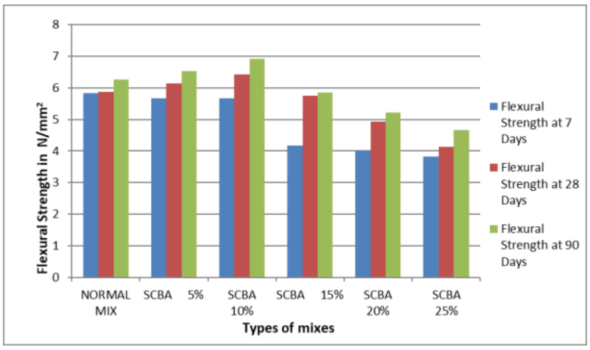
Table: Split Tensile Strength Test Results.



Graph: Split Tensile Strength graph vs age

S.No	Mix id	Flexural Strength (N/mm²)		
		7 Days	28 Days	90 Days
1	NORMAL MIX	4.67	5.87	6.25
2	SCBA 5%	4.53	6.13	6.52
3	SCBA 10%	4.51	6.43	6.92
4	SCBA 15%	3.33	5.75	5.85
5	SCBA 20%	3.20	4.93	5.22
6	SCBA 25%	3.07	4.13	4.66

Table 6.4 Flexural Strength Test Results



Graph 6.4 Flexural Strength graph vs Age

Conclusions

Based on the study, following conclusions can draw.

i. There is a change in slump for SCBA 5% has decreased 84mm when compared with normal mix the slump 87mm.

ii. The slump for SCBA 10%, SCBA 15%, SCBA 20% and SCBA 25% has reduced by 81mm, 79mm, 76mm and 73mm respectively when compared with the normal mix.

iii. To get the required slump use the admixtures.

iv. The compressive strengths of SCBA mixes at the age of 7 days was gradually decreases its strength when compared with normal mix due to pozzolanic activity.

v. It was observed that the compressive strength of SCBA 5% and SCBA 10% at the age of 28 days has reached its target mean strength; however the compressive strength was increased by 37.01 N/mm^2 and 37.52 $N/mm^2$when compared with normal mix.

vi. It was observed that the compressive strength of SCBA 15%, SCBA 20% and SCBA 25% at the age of 28 days has decreases its compressive strength by 34.93 N/mm^2, 30.07 $N/mm^2$and 23.95 N/mm^2respectively when compared with the normal mix.

vii. The split tensile strength of mixes SCBA 5% and SCBA 10% at the age of 28 days has increases its strengths by 2.59 $N/mm^2$and 2.75 N/mm^2respectively when compared with the normal mix.

viii. The split tensile strength of mix SCBA 15%, SCBA 20%, SCBA 25% at the age of 28 days has decreases it strengths by 2.25 N/mm^2, 1.92$N/mm^2$and 1.76$N/mm^2$when compared with the normal mix.

ix. The flexural strength of SCBA 5%, SCBA 10% at the age of 28 days has increases its strength by 6.13$N/mm^2$and 6.43$N/mm^2$when compared with the normal mix.

x. The flexural strength of SCBA 15%, SCBA 20% and SCBA 25% at the age of 28 days has decreases it strength by 5.75N/mm^2, 4.93N/mm^2 and 4.13$N/mm^2$when compared with normal mix.

ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

xi. The strengths of SCBA 5% and SCBA 10% at the age of 90 days increases its compressive, split tensile and flexural strengths when compared with normal mix.
xii. Similarly the strengths of SCBA 15%, SCBA 20% and SCBA 25% at the age of 90 days decreases its compressive, split tensile and flexural strengths when compared with normal mix.
xiii. Finally I conclude that cement can be replaced with bagasse ash up to 10% without much loss its compressive strength.
xiv. Considerable decrease in compressive strength was observed from 15% cement replacement.
xv. 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 stakeholder, such as sugar industries, cement industries and relevant government institutions, should be made aware about this potential cement replacement material and promote its standardized production and usage.
xvi. To improve the strengths of SCBA 15%, SCBA 20% using chemical admixtures like micro silica and super plasticizers for improving the strength.

Scope of Further Research

The experimental study can be carried out for higher strength concretes like M40, M50 and above. This work was carried out on replacement of cement in concrete without adding any admixtures. The same work has carried out as using admixtures like Super plasticizers. This work was carried out on replacement of cement in concrete, the same work done by replacement of fine aggregate also.

REFERENCES:

[1] T. S. Abdulkadir, D.O.Oyejobi, A.A. Lawal (2014) has Examined. “Evaluation of Sugarcane Bagasse Ash as a Replacement for Cement in Concrete Works”.Ecta technical conviniesis- buletion of engineering vol 7, issue 3, p 71-76.

[2] Shruthi H R, H Eramma, Yashwanth M K, B.S Keerthi Gowda (2014) are studied “A Study on bagasse ash replaced plain cement concrete” international journal of advanced technology in engineering and science.

[3] D.Neeraja, S.Jagan, P.G.Mohan (2014) has examined the “Experimental study on strength properties of concrete by partial replacement of cement with sugarcane bagasse ash” an international quarterly scientific journal.

[4] Prashant O Modania, M.R Vyawahareb, (2013), has examined “Utilization of bagasse ash as a partial replacement of fine aggregate in concrete” research article IJESC volume 8, Issue no.6.

[5] V.R Rathi, VaishaliD.Girge Examined (2013) has studied “Effect of use of bagasse ash on strength of concrete” International journal of innovative research in science, engineering and technology.