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EVALUATION OF SUGARCANE BAGASSE ASH AS A PARTIAL REPLACEMENT OF CEMENT IN CONCRETE

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ABSTRACT:- Due to increasing demand and consumption of cement, researchers and scientist are in search of developing alternate binders that are recyclable and contribute towards waste management. The exploitation of industrial and agricultural waste produced is mainly focus on waste reduction. Sugar cane bagasse ash (SCBA) is one of the agro waste which is a fibrous waste product comes out from sugar mills as byproduct. The burning yields ashes containing high amounts of unburned matter, silicon and aluminium oxides as main components .The main intention of this research was to characterize the compressive strengths of concrete by varying the SCBA and (Portland Pozzolanic Cement) PPC contents. Concrete is strength and hard material but it is permeable material also which interacts with the surrounding environment. The durability of concrete depends largely on the progress of water and gas enters and moves through it. Bagasse ash has been chemically and physically characterized, and will be partially replaced in the ratio of 0%, 10%, 15% and 20% by weight of cement in concrete. Hardened concrete tests like compressive strength & split tensile strength at the age of seven and 28 days will be conducted. Concrete strength and property of concrete will be conducted and comparison chart will be arrived.

KEYWORDS: By-product, Cement, Concrete, Bagasse ash, Hardened tests.

I. INTRODUCTION:

The exploitation of industrial and farming waste produced by industrial processes has been the focus of waste reduction research for efficient, environmental, and scientific reasons. Sugar-cane bagasse is a fibrous waste-product of the sugar cleansing industry along with ethanol vapor. Bagasse ash generally contains aluminum ion and silica. Portland Pozzolanic cement is accepted as a major construction material throughout the world. This waste, consumption would not only be economical, but may also result in distant exchange earning and environmental contamination control . Industrial wastes such as blast kiln slag, fly cinders and silica smoke are being used as auxiliary cement replacement materials. They are currently exploited as pozzolanic materials and supplements to get better compressive force in terms of microstructures of cement. One of their advantages is to decline CO_2 gas emission from decreasing utilization of cement in either mortar or concrete production. Currently, there has been an challenge to utilize the large amount of bagasse ash, the deposit from an in-line sugar industry and the bagasse-biomass energy in electric generation industry. When this waste is burned under certain conditions, it also gives ash having formless silica, which has pozzolanic properties. Therefore it is probable to use sugarcane bagasse ash (SCBA) as cement substitute material to improve quality and diminish the cost of building materials such as

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mortar, concrete pavers, concrete cover tiles and soil cement interlocking slab.

OBJECTIVES

This research aims at,

1. To study the physical properties of concrete materials.
2. To arrive a mix design review for concrete using IS code method.
3. To study the workability of fresh concrete such as slump.
4. To study the different strength of hardened concrete such as compressive strength of concrete cubes at 28 days and Split tensile strength of cylinder at 28 days .
5. To compare the workability and various strength for different percentage of partial substitute of cement with sugarcane baggase ash.

II. LITERATURE REVIEW:

A. EFFECT OF USE OF BAGASSE ASH ON STRENGTH OF CONCRETE By

Mrs.U.R.Kawade, Mr.V.R.Rathi, Miss.Vaishali D. Girge , Associate Professor, P.D.V.V.P, Engineering college, Maharashtra, Ahmednagar -" Effect of use of Bagasse Ash on Strength of Concrete Vol.2, Issue-7, July(2013).

The utilization of industrial and farming waste created by industrial processes has been the focus on waste reduction. In this paper SCBA has been physically and chemically characterized and partially replaced in the ratio of 0%,10%,15%, 20%, 25% and 30% by mass of cement in concrete.The properties for fresh concrete are tested like slump cone test and for toughened concrete compressive strength at the age of 7,28,56 and 90 days. The test result indicate that the strength of concrete boost upto 15% SCBA replacement with cement. The results show that the compressive strength of SCBA concrete is higher compare to conventional concrete.

It is found that the cement could be advantageously replaced with SCBA up to utmost limit of 15%. Although, the optimal level of SCBA content was achieved with 15.0% replacement. Partial substitution of cement by SCBA increases workability of fresh concrete; therefore use of super plasticizer is not essential.

B. CHARACTERIZATION OF COMPRESSIVE STRENGTH OF CONCRETE BLENDED WITH SUGARCANE BAGASSE ASH By

Mr.KennedyAburili,Dr.R.O.Onchiri,Dr.G.W.Waswa PhD Candidate, Department of Disaster Preparedness and Engineering Management, Masinde Muliro University of Science and Technology(MMUST) Lecturer, Department of Structural Engineering & Civil Engineering, Masinde Muliro University of Science and Technology, Oct 2014 – Mar 2015.

Presence of silica in Sugarcane Bagasse Ash (SCBA) contribute to enhanced Pozzolanic activity, but the silicate content may differ from ash to ash depending on the burning circumstances of bagasse and the properties of soil on which the sugarcane is grown. The research concluded that SCBA grain size of < 0.075mm and finest SCBA content of 10% would offer the highest workability and compressive strength in SCBA blended concrete, higher than a similar mix with 0% SCBA content. It was generally observed that a trend characterized the7,14 and 28days curing periods, hence compressive strength of blended SCBA concrete models can be developed.

III. TESTING PROGRAMME

In the present study different test on materials such as cement, fine aggregate, coarse aggregate and the waste material (Sugarcane Bagasse Ash) from Udumpium Dhanalakshmi Sugar Mills Pvt.Ltd were performed as per the Indian Standards.

MATERIALS USED:

1. FINE AGGREGATE

a) Sand: Sand is used as fine aggregate from the day of introduction of concrete which makes the

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quality of concrete higher when it consists of round shaped grains rather than angular shaped. Only river sand is used as fine aggregate in concrete.. The size of the sand is used 4.75mm and down size. The properties of fine aggregate investigated are existing in table 1.

Table-1: Properties of Fine aggregate

Sl.No	Property	Value
1	Specific Gravity	2.8
2	Fineness Modulus	3.1
3	Water Absorption	0.5%
4	Surface Texture	Smooth

2. COARSE AGGREGATE

Coarse aggregate of size 20mm has been procured nearby quarry. They are verified to be clean & free from impurities. The properties of the coarse aggregate are shown in table 2.

Table- 2: Coarse Aggregate Properties :

Sl.No	Property	Value
1	Specific Gravity	2.8
2	Fineness Modulus	7.5
3	Water Absorption	0.5%
4	Particle shape	Angular
5	Impact Value	15.2
6	Crushing value	18.6

3.WATER

Water available in the college site conforming to the necessities of water for concreting and curing as per IS: 456-2000

4.CEMENT

Cement is one of the binding materials used especially in concrete to bind all materials used in concrete and form a single substance .Generally now a days PPC is used for all engineering works. The specific gravity of PPC is 3.18. Portland Pozzolanic Cement of 15 grade was purchased from the local supplier and used throughout this project. The properties of cement used in the research are presented in table 3.

Table- 3: Properties of Cement

Sl.No	Property	Value
1	Specific Gravity	3.18
2	Fineness	97.8m2/kg
3	Initial setting time	Not less than 30 min
4	Final setting time	Not less than 600 min
5	Standard consistency	30%
6	Fineness modulus	6

SUGARCANE BAGASSE ASH

Sugar-cane bagasse is a fibrous waste-product of the sugar cleansing industry, along with ethanol vapor. The combustion yields ashes containing high amounts of unburned material, silicon and aluminium oxides as major components. The properties of concrete using sugarcane bagasse ash as cement were investigated in an experimental study. Sugarcane is one of the most gifted unindustrialized sources of biomass energy in the world.

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The composition of Bagasse depends on the variety and ripeness of Sugarcane as well as harvesting techniques applied and efficiency of the Sugar processing. Bagasse is a cellulose fiber remaining after the removal of the sugar-bearing juice from sugarcane. The burning of bagasse leaves solid black particles known as sugarcane bagasse ash (SCBA). Bagasse is usually combusted in furnaces to produce steam for power generation. Sugar Cane Bagasse is partly used as fuel. Though, bagasse ash (SCBA) is considered waste, which creates a disposal trouble.

As well as, if sugar cane bagasse is burned beneath controlled circumstances, the SCBA can be potentially reused. This paper considers the industrial feasibility of using SCBA as a partial replacement for cement. The results point out that SCBA formed in the production of commercial cements can be recycled for use as pozzolanic substance. This complementary material can partly replaced for cement and therefore it reduces CO_2 emissions.

Table-4. Physical Characteristics of SCBA-based PPC cements:

CHARACTERISTICS	OPC	SCBA	10% PPC	15% PPC	20% PPC
Specific gravity	3.16	2.12	3.02	2.97	2.86
Fineness (m^2 /kg)	310	300	306	313	317
Soundness expansion(mm)	0.73	1.21	1.30	1.10	1.36
Consistency(%)	30	40	35	40	40
Initial setting time(min)	125	190	135	180	190
Final setting time(min)	165	285	205	280	285

III Preparation of Specimens :

Based on the above results the cement, fine aggregate coarse aggregate and water quantity required for design mix of M_{15} were calculated based on the procedure given in IS code method in IS :2009. The final mix ratio was 1:2:4 with water cement ratio of 0.48. The measurement of materials was done by weight in electronic weighing machine is used. Water was measured in litres.

Concrete was placed in mould in layers. The cast specimen were removed from moulds after 24 hours and the specimens were kept for water curing. The details of specimens and mix designation used in experimental program are given in table 5.

Sl. No	Mix Design	Cement	Sand	Sugarcane Bagasse Ash	Coarse Aggregates
1	M0	100%	100%	0%	100%
2	M1	90%	90%	10%	100%
3	M2	85%	80%	15%	100%
4	M3	80%	70%	20%	100%

Table-5:

IV. TESTING OF THE SPECIMEN:

For each batch of concrete, 3 cubes of 150mm x 150mm x 150mm size were tested to determine compressive strength of concrete, 3 cylinders of 150mm diameter and 300 mm length were tested to determine split tensile strength of concrete .

V. RESULTS COMPARASION & DISCUSSION:

Table 5(i) Comparison of compressive strength results for conventional concrete & replaced concrete:

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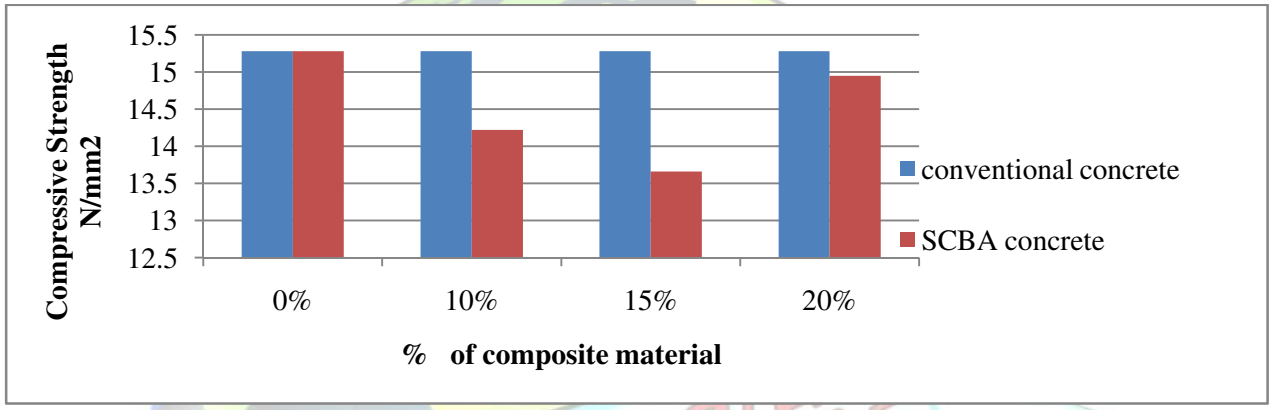
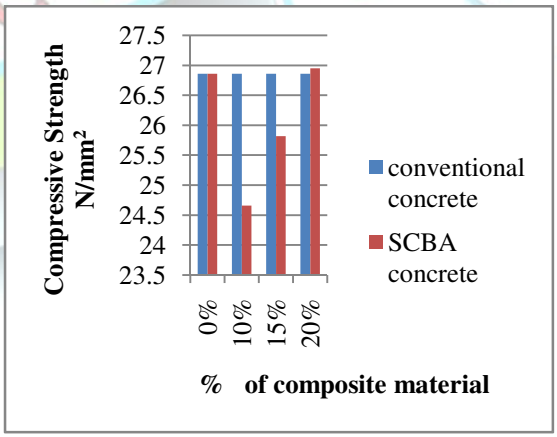
M_{15} Mix / No.Of.Days	Conventional Concrete (N/mm^2)	10% Bagasse Ash Concrete (N/mm^2)	15% Bagasse Ash Concrete (N/mm^2)	20% Bagasse Ash Concrete (N/mm^2)
7	15.28	14.22	13.66	14.95
28	26.86	24.66	26.72	26.98

After 7 days curing for compressive strength:



After 28 days curing for compressive strength:



M_{15} Mix / No.Of.Days	Conventional Concrete (N/mm^2)	10% Bagasse Ash Concrete (N/mm^2)	15% Bagasse Ash Concrete (N/mm^2)	20% Bagasse Ash Concrete (N/mm^2)
7	2.32	2.45	2.59	2.7
28	2.58	2.62	2.75	2.84

Table-5(ii) Comparison of Split tensile strength results for conventional concrete & replaced concrete:

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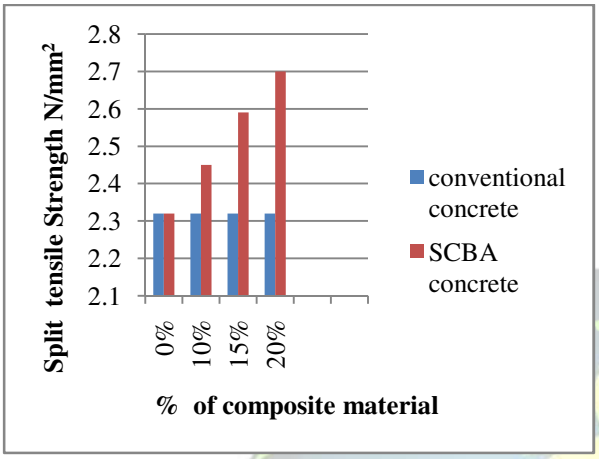
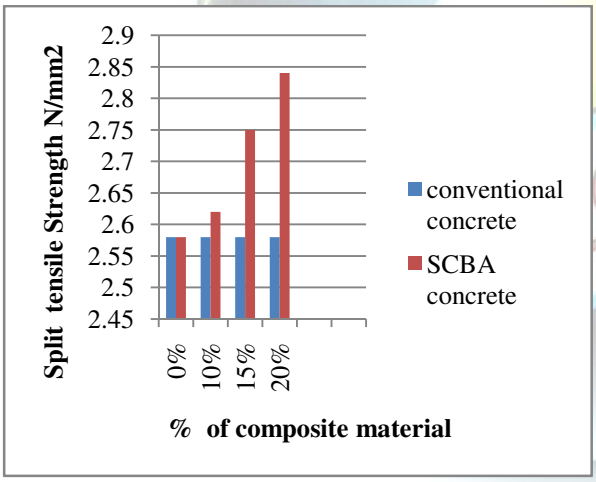
After 7 days curing for split tensile strength :



After 28 days curing for split tensile strength:



VI. CONCLUSION

The results show that the SCBA concrete had significantly higher compressive strength split tensile strength compare to that of the concrete without SCBA. It is found that the cement could be advantageously replaced with SCBA up to maximum limit of 20%. Although, the optimal level of SCBA content was achieved with 20% replacement. It is found that 20% replacement of cement by industrial waste give maximum result in strength and quality aspects than the conventional concrete. Thus the environmental effects from the industrial waste can be significantly reduced and also the cost of cement can be reduced lot by this replacement of material.

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