An Experimental Analysis of Sugarcane Bagasse Ash Concrete by Partial Replacement of Cement

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Abstract— With increasing demand and consumption of cement, researchers and scientist are in search of developing alternate binders that are eco-friendly and contribute towards waste management. Cement industry creating environmental problem by emission of CO2 during manufacturing of cement. Sugar-cane bagasse is a fibrous waste-product of the sugar refining industry, along with ethanol vapour. This waste product (Sugar-cane Bagasse ash) is already causing serious environmental pollution, which calls for urgent ways of handling the waste. Bagasse ash mainly contains aluminium ion and silica. This experimental and analytical study investigates the strength performance of concrete using Ordinary Portland cement and Sugarcane Bagasse Ash. Bagasse ash has been chemically and physically characterized, and partially replaced in the various percentages by weight of cement in concrete. The result shows that the strength of concrete increased as percentage of bagasse ash replacement increased up to certain percentage. Beyond that optimum level the strength of concrete begins to decrease drastically. India produces around 24-25 MEGATON of sugar these days and also same is approximately the estimated sugar cane bagasse ash (SCBA) produce of India. Therefore it is essential that a useful method of utilization of this sugr factory waste should be found and gainfully used. As the demand and consumption of cement raising, researchers and scientist are in search of developing alternates binders that are eco friendly and contribute towards waste management It has limited life span and after use it s either stock piled or sent to landfills. In these project bagasse ash has been chemically and physically characterized and partially replaced in the ratio of 0%,7%,14% and 21% by weight of cement fresh concrete that is slump cone test were undertaken as well as hardened concrete test is compressive strength and Flexural Strength at the age of 7 and 28 days was obtained.

Keywords: Cement, CO2, Sugar-cane Bagasse ash

I. INTRODUCTION

It used the waste of material to forming the environmental pollution and the material are reused by the waste at include the concrete. The control of the environmental pollution, land waste to the controlled, the reusing mater many studies were carried out on the utilization of sugarcane bagasse ash obtained from the controlled burning of raw husk as per the procedure laid down in the literature and most of the studies are focused on the improvement of physical and chemical properties of sugarcane bagasse ash in concrete. Only a few studies have been reported on the use of sugarcane bagasse ash partial replacement in cement. Very little information is available on the chloride impermeability and corrosion resistant properties of concrete blended with these ash. In this research work, an experimental investigation for the evaluation of sugarcane bagasse ash and prepared from the mill residues as cement replacement materials and assessment of optimal level of replacement to the blended cement concrete system for the strength and resistance against chloride penetration and corrosion of steel are considered. . Researchers all over the world today are focusing on ways of utilizing either industrial or agricultural waste, as a source of raw materials for industry. This waste, utilization would not only be economical, but may also result in foreign exchange earnings and environmental pollution control.

A. Sugarcane Bagasse Ash (SCBA)

The sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicellulose and 25% of lignin. Each ton of sugarcane generates approximately 26% of bagasse (at a moisture content of 50%) and 0.62% of residual ash. The residue after combustion presents a chemical composition dominates by silicon dioxide (SiO2). In spite of being a material of hard degradation and that presents few nutrients, the ash is used on the farms as a fertilizer in the sugarcane harvests.

Components	Mass in Percentage
Silica (sio2)	66.89 %
Alumina (Al2O3)	29.18 %
Ferric Oxide(Fe2 O3)	
Calcium oxide (Cao)	1.92 %
Magnesium oxide (Mgo)	0.83 %
Sulphur trioxide (SO3)	0.56 %
Loss of Ignition	

Table 1: Chemical Composition of SCBA

B. Objectives of Project

- Investigate the strength of concrete by using Sugarcane Bagasse Ash as partial replacement of cement by using V.S.I. sand.
- Find the percentage of Sugarcane Bagasse Ash replaced to cement that makes the strength of concrete maximum using V.S.I. sand.
- Determine the suitability of Sugarcane Ash as partial replacement of cement in concrete.
- Manage industrial waste. (such as Sugarcane Bagasse Ash)
- Compare the mechanical properties of Sugarcane Bagasse Ash in concrete with control concrete.
- To determine the effectiveness of sugar cane bagasse ash (SCBA) as a cement replacement material in concrete.
- Perform the cost analysis between conventional concrete and concrete made with partial replacement of cement with sugarcane bagasse ash using V.S.I sand.

C. Scope of Project

- To reduce the waste for economical, environmental and technical reasons.

– SCB can be utilized for the production of lightweight, durable and cheap concrete. Since it is available in significant quantities across the country.

II. MATERIAL USED

A. Cement

Cement is a well-known building material and has occupied an indispensable place in construction work. There is a variety of cement available in market and each type is used under certain condition due to its special properties such as colour and composition of cement. The function of cement is first to bind the sand and coarse aggregates together and second to fill the voids. Although cement constitutes only about 10 percentage of the volume of the concrete mix, it is the active portion of the binding medium and the only scientifically controlled ingredient of concrete. Locally available cement is used. Like PPC (PARASAKTI- Cement).

B. Aggregate

1) Fine Aggregate:

Vertical Shaft Impactor (V.S.I.) Sand is also known as Artificial Sand or Crushed Sand. Only sand manufactured by V.S.I. Crusher is cubical and angular in shape. There is standard specification for Fine Aggregates (Sand). It is divided in four gradations Zone-I, Zone-II, Zone-III & Zone-IV. Generally the size of the aggregate lesser than 4.75 mm is considered as Fine Aggregate.

2) Coarse Aggregate:

The broken stone is generally used as a coarse aggregate. Aggregate occupies most of the volume of the concrete. The aggregates were washed to remove dust and dirt and were dried to surface dry condition. Locally available Coarse Aggregate used of 20 mm and down size. Testing is done as per Indian Standard Specification IS: 383-1970. The size of the aggregate bigger than 4.75 mm is considered as Coarse Aggregate. The coarse aggregate passing through 20 mm sieve and retained on 4.75 mm sieve & specific gravity 2.68

C. Water:

Water fit for drinking is generally considered fit for making concrete. Water should be free from acids, oils, alkalies, vegetable or other organic impurities. Water is used for mixing, curing purpose should be clean and portable, fresh and free from any bacteria and desire matter confirming to IS 3025-1964 is used for mixing. Soft water also produces weaker concrete. Water has two functions in concrete mix. Firstly, it reacts with the cement to form a cement paste; secondly it serves as a vehicle or lubricant in the mixture of fine aggregate and cement. Water is a key ingredient in the manufacturer of concrete. Ordinary tap water is used for concrete mix.

D. Sugarcane Bagasse Ash:

The Sugarcane Bagasse Ash consists of approximately 50% of cellulose, 25% of hemicellulose and 25% of lignin. Each ton of sugarcane generates approximately 26% of bagasse 0.620% of residual ash. The residue after incineration presents a chemical composition dominates by Silicon Dioxide (SiO2). In spite of being a material of hard degradation and that presents few nutrients, the ash is used on the farms as a fertilizer in the Sugarcane Baggage Ash harvests.

Components	Mass in Percentage
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III. CASTING SPECIMEN

Test specimens of Cubes of size 150mm x 150mm x 150mm, beam with 700mm x 150mm x 150mm will prepared using the standard moulds. The samples are cast. The samples are remoulded after 24hrs of casting and kept in a water tank for 7 and 28 days curing. A total of 36 specimens cast for testing the properties such as compressive strength, and flexural strength.

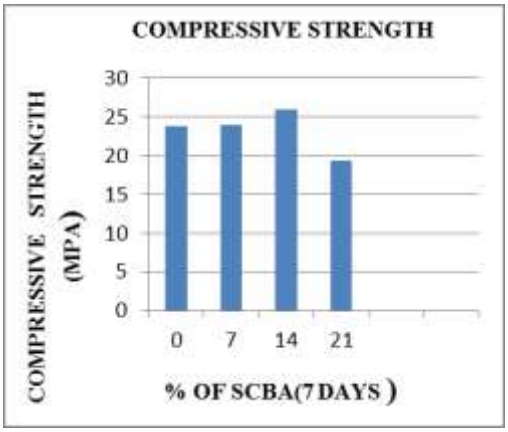
24 cube samples of size 150mmx150mmx150mm for different percentages of sugarcane bagasse ash in partial replacement of cement will casted. The concrete mixes are 0%,7%,14% & 21% sugarcane bagasse ash with partial replacement of cement. All cubes will casted in one lift and consolidated using machine vibrator. After final setting of cubes, the cube moulds will be removed and cubes will kept in water tank for curing up to 7 and 28 days.

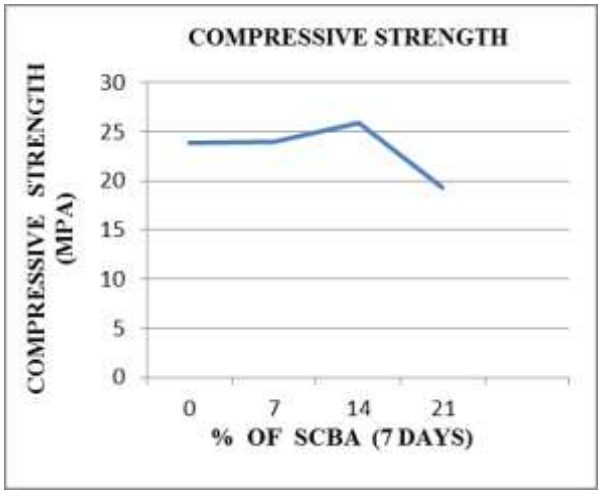
All specimen beams size 700mm × 150mm × 150mm will casted with optimum compressive strength for the specific mix in single lift and consolidated using tamping rods. After setting, the beams will covered with wet gunny bags. The burlap will be kept for 3days. At the end of the third day, the forms will stripped and beams will kept for curing up to 28 days.

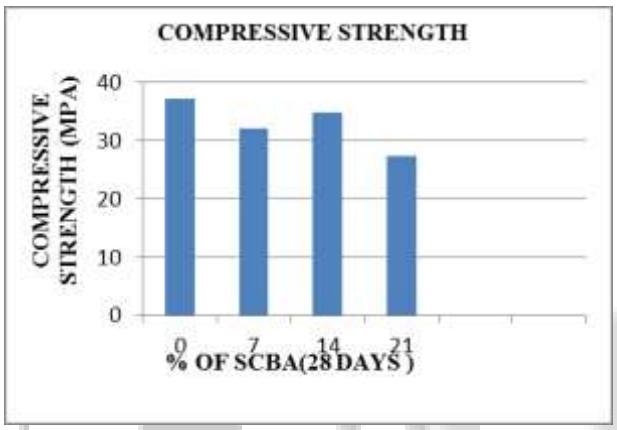
IV. EXPERIMENTAL METHODOLOGY

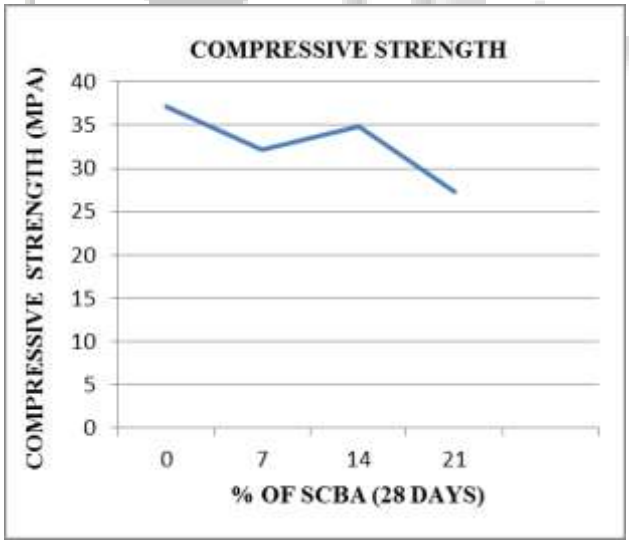
A. Compressive Strength Test

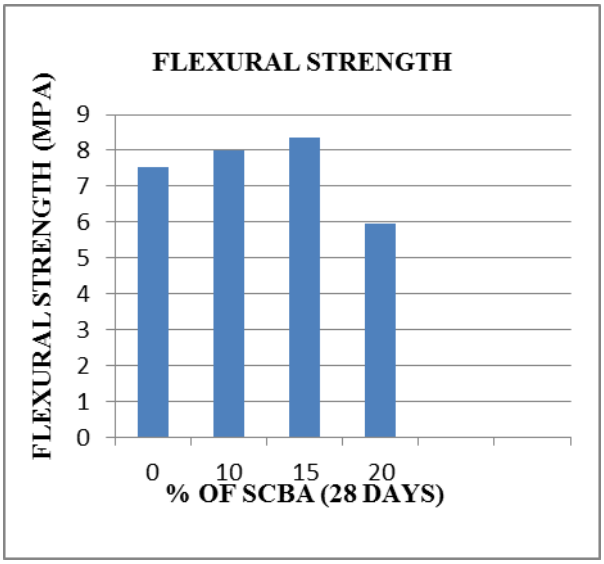
The result of compressive strength After 7 days and 28 days are recorded. Result indicate that as we increase percentage of sugarcane bagasse ash from 0% to 21% it's compressive strength increases after further increment in percentage of sugarcane bagasse ash there is loss in compressive strength. That means we can replace up to 14% cement by sugarcane bagasse ash.

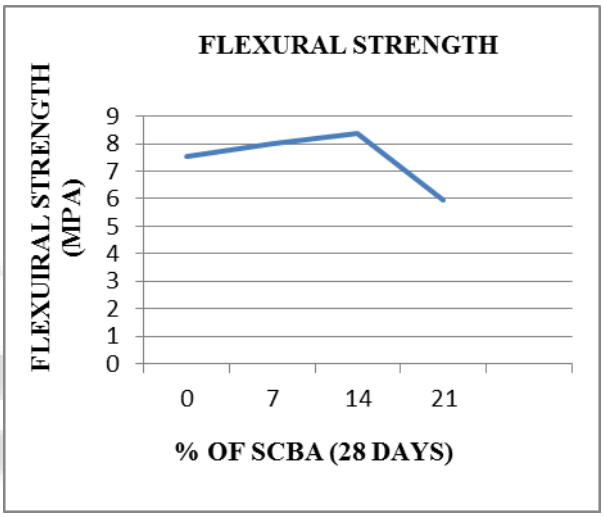












B. Flexural Strength Test

Testing of all beam specimens with two points loading for flexural strength. Result indicate that if we increase percentage of sugarcane bagasse ash from 0 to14% will give us good results and help to increase flexural strength of concrete.

V. Conclusion

From the experimental study following conclusions are made

- The results from above tests show that Sugarcane Bagasse Ash can be utilized for partial replacement of cement up to 14% by weight of cement without any major loss of strength.
- The results showed that the concrete with 5% of SCBA after 28 days of curing had higher strength when compared to concrete with other replacement percentages.
- Greenhouse gasses emissions can be reduced by replacement of cement with PPC.
- Mechanical properties of concrete are developed in later ages due to slow pozzolanic reactions.
- The SCBA in blended concrete had significantly higher compressive strength compared to that of the concrete without SCBA.
- It is found that the cement could be advantageously replaced with SCBA up the maximum limit of 14%.
- Partial replacement of cement by SCBA increases workability of fresh concrete, therefore use of super plasticizer is not sustainable.

- The 14% of replacement of bagasse ash gives maximum compressive strength at 28 days as compared to 7% and 21% replacement of SCBA.

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