Issue 9 vol 3 ISSN: 2321-8134

IJFEAT

INTERNATIONAL JOURNAL FOR ENGINEERING APPLICATIONS AND TECHNOLOGY

STUDY OF CONCRETE BY PARTIALLY REPLACING CEMENT WITH SUGARCANE BAGASSE ASH

Pallavi Kumbhare[1], Aishwarya B Gotekar[2], Apurva S Zende[3], Tejas N Chute[4]

[1]*Assistant Professor,Department of Civil Engineering , JDIET, Maharashtra, India,* **pallu15kumbhare@rediffmail.com**

[2]*Student,Department of Civil Engineering , JDIET, Maharashtra, India,* **aishwaryagotekar59@gmail.com**

[3]*Student,Department of Civil Engineering , JDIET, Maharashtra, India,* **tejaschute@gmail.com**

[4]*Student,Department of Civil Engineering , JDIET, Maharashtra, India,* **apurva26zende@gmail.com**

Abstract

India is one of the fast developing countries in the world and therefore agriculture and industrialization both needs a parallel growth. Industries growth is one of the biggest sign of growth of Indian economy but the saddest part is many of industries in view of its growth are neglecting our mother environment and thus polluting it by not taking proper care of waste management and Pollution. A modern lifestyle, alongside the advancement of technology has led to an increase in the amount and type of waste being generated, leading to a waste disposal crisis. In developing countries, accumulation of unmanaged (agricultural) waste has resulted in an increased environmental concern. Also increase in Pollution is leading to various Humans Problems such as respiration. Recycling such wastes is the viable solution not only to pollution problem, but also the problem of land filling. The problem of waste accumulation exists all over the world, specifically in the densely populated areas. Most of these waste materials left are as illegally dumped in selected areas or used as an landfill. Large quantities of this waste cannot be eliminated. However, these environmental wastes produced can be reduced by making more use of this waste and by recycling. Moreover we need to look for Solutions from Technical Aspect i.e. how we can bring these wastes into use in our Construction Sector. This paper focus on utilization of industrial and agricultural waste produced by industrial processes i.e. Use of Sugarcane bagasse ash (SCBA) for waste reduction research for economic, environmental, and technical reasons.

Index Terms: *Cement , Sugar Cane Bagasse Ash , Workability, Compressive Strength*

--- *** ---

1. INTRODUCTION

The use of industrial and unindustrialized (agricultural) waste produced by industrial process is a reason of concern in present scenario. For years, researches are carried out for possible solutions. Studies state that replacing raw materials with recycled and unused materials reduces our dependency on raw materials in the construction industry. A waste management plan helps us to direct the construction activities towards an environmentally friendly process by reducing the amount of waste materials and their discard in landfills. The environmental and economic advantages that occur when waste materials are diverted from landfills include:

a. Conservation of raw materials;
b. Reduction in waste disposal
c. Efficient use of the materials
d. Availability of land for public use

In view of utilization of agricultural waste in concrete and mortar, the present paper experiments the utilization of sugarcane bagasse ash (SCBA) in different compositions, which were added to the raw material at different levels to produce Concrete. Concrete being widely used construction material needs to undergo a lot of developments in terms of its per capita consumption. It is the second most consumed material in the country, next only to water. The important part of concrete is cement. Cement manufacturing is a highly energy intensive process, which involves intensive fuel consumption for clinker making and resulting in emission of Greenhouse gases like carbon dioxide (CO_2) in large amount which is very harmful for the environment.

Sugarcane is a tree-free renewable resource and one of the most important agricultural plants that grows in hot regions. Sugar cane is one of the major crops produced in over the world and its total production is over 1500 million tons. India is the second largest producer of sugarcane. In India sugar production is undertaken practically throughout the country and there are well-established large scale factories in 18 out of 29 States and its production is over 300 million tons/year that cause around 10 million tons of sugar cane bagasse ash as an un-utilized and waste material. In India, a large amount of sugar cane bagasse from sugar mills is available. For each 10 tons of sugar cane crushed in a factory, it produces nearly 3 tons of sugarcane bagasse. One ton of sugarcane can generate approximate 26% of bagasse and 0.62% of residual ash. After the extraction of all juice sugar from sugarcane, about 40-45 percent fibrous residue is obtained called bagasse, which is reused in the same industry as fuel in boilers for heat or power generation. When bagasse is burnt in the boiler of cogeneration plant under controlled conditions 8 -10 percent of ash as waste , known as Sugarcane Bagasse Ash. This amorphous silica content makes bagasse ash as a useful cement replacement material in concrete. For this reason sugarcane bagasse ash (SCBA) is one of the main byproduct can be used as binders, partially replacing cement.

The mix design of concrete was done according to Indian Standard Code IS: 10262-2009 for M20 grade. Adopted water cement ratio is 0.48. Sugarcane bagasse ash (SCBA) was partially replaced in the ratio of 0%, 5%, 10%, 15% and 20% by weight of cement in concrete for curing period of 7, 14, and 28 days.

1.1. Pozzolans:

A "Pozzolan" is defined as "a siliceous or siliceous and aluminous material, which in itself possesses little or no cementing property, but will in a finely divided form - and in the presence of moisture - chemically react with calcium hydroxide at ordinary temperatures to form compounds possessing cementitious properties.

1.2. Need of sugarcane bagasse ash (SCBA) usage :

a. Each ton of cement produces around about one ton of CO2 and cement industry is answerable for the release of about 5% of CO2 worldwide.
b. Has an effective impact in the economical point of view.
c. When used as replacement for cement in concrete, it reduces the problem associated with their clearance.
d. Decrease in the release of greenhouse gases.

2. MATERIALS

The materials used in the project are as follows:

2.1. Cement

The cement is used as a Binding material. In this Project, the cement used was OPC 43 grade cement available from UltraTech Cement Company and having specific gravity of 3.15, fineness modulus of 4.62% and normal consistency of 32% was used. As per IS 4031-1988, various tests were conducted to check the quality of cement and confirmed to specifications of IS 12269-1987.

2.2. Fine Aggregate

Aggregates for the concrete were obtained from approved suppliers conforming to the specifications of IS 383 - 1970 and were chemically inactive (inert), spotless and robust. The fine aggregate was tested as per the limits which is specified in IS: 2386 (Part-3):1963. In this study, fine aggregate having a fineness modulus of 2.46 which is carried out by using sieve analysis and it confirming to zone.

2.3. Coarse Aggregate

Coarse aggregates will be machine-crushed done of black trap or equivalent black tough stone and shall be stiff, robust, dense, durable, spotless or procured from quarries approved by the consultant. In this Project, crushed aggregate of size 20 mm in angular shape is used and it conforming to IS 383.

2.4. Water

Good potable water available in the Project is used for the construction purpose which conforming to the requirements of water for concreting and curing as per IS: 456-2009.

2.5. Sugarcane Bagasse Ash

It comprises high volume of SiO2. Therefore, it is classified as a good pozzolanic material. SCBA can be used as add-on for cementations material due to its pozzolanic property. Sugarcane bagasse ash was collected from Deccan Sugar Pvt. Ltd., Mangrul, Yavatmal district of Maharashtra State, India. Bagasse is a by-product during the manufacture of sugar and it has high calorific value.

The obtained Sugarcane Bagasse Ash becomes a big problem and causes a great disposal problem. Using waste SCBA as a pozzolanic material to replace cement can reduce the consumption of cement and reduce landfill area requirements. This helps to solve environmental issues caused due to cement production which in turn will decrease both energy based and CO_2 emissions. It is well known that cement production leads to CO_2 emisson which is a major contributor to the greenhouse effect and the global warming of the earth.

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%). The residue after combustion presents a chemical composition dominates by silicon dioxide (SiO_2).

2.6. Process To Obtain Ash From Bagasse:

a. The bagasse was packed in the graphite crucible air tight, and place inside electricontrol furnace and burnt at a temperature of 1200oC for 5 hours to obtain a black color ash which is the bagasse ash which was used in this project.
b. The Baggase Carbonization(BC) was collected and burned for 6 hours at 600ºC using a stove. After burning a layer of light colored ash was observed on the surface and then an ash of black colour and heterogeneous composition was observed.

c. The second burn of CBC lasted for 3 hours at 700ºC. After this, it was cooled naturally determining the C level of the ash using a ball mill for the grinding. Six samples of ash were collected and dried in the oven for 24 hours at 70ºC.

Fig. 1: Flow Chart of Sugar and Bagasse

3. CASE STUDY

In this experimental work carried out in Jaihind Polytechnic, Kuran, a total of 36 numbers of concrete specimens was casted. The specimens considered in this study consisted of 36.00 numbers of 150.00 mm side cubes, The mix design of concrete was done according to Indian Standard (IS) guidelines 6.00-9.00 for M20 grade for the granite stone aggregates and the water cement ratio are 0.480. Based upon the quantities of ingredient of the mixes, the quantities of Sugarcane Bagasse Ash (SCBA) for 0%, 5%, 10%, 15%, 20% & 25% replacement by weight were estimated. The ingredients of concrete such as cement, sand, aggregate & water were thoroughly mixed in tilting or non-tilting mixer machine till uniform thoroughly consistency was achieved. Before casting, machine oil was smeared on the inner surfaces of the Cast Iron (CI) mould. Concrete was poured into the mould and compacted thoroughly using table vibrator or other types of vibrators. The top surface was finished with the help of a trowel. The specimens were removed from the mould after 24.00 hrs. then cured under water for a period of 7, 14 and 28 days. The specimens were taken out from the curing tank just prior to the test. The tests for compressive, split tensile strength were conducted using a 2000.00 KN Compression Testing Machine. For modulus of rupture was conducted using 1000.00 KN Universal Testing Machine (UTM). These tests were conducted as per the relevant Indian Standard (IS) specifications.

4. RESULTS AND DISCUSSION

4.1. Compressive Strength Test:

Determination of compressive strength of concrete is very important, because the compressive strength is a criterion for judging the quality of concrete. This strength will help us to reach the optimal proportion for replacement of the content. The compressive strength was performed according to IS:516-1959.The compressive strength for 7 day, 14 day and 28 day of various mixes with w/c ratio (0.48) were determined and given in tables below.

Table 7: Average Compressive Strength

Replacement of cement by SCBA	Compressive strength (N/mm2)		
	7 days	14 days	28 days
0%	19.83	23.68	27.08
5%	18.11	20.70	23.28
10%	20.44	21.89	25.20
15%	22.50	24.96	28.27
20%	13.85	15.89	17.22

4.2. Graphical Representation

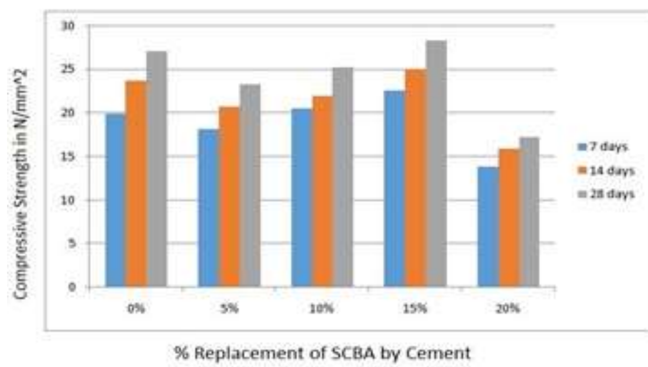

Fig 2: Graphical Representation of Compressive Strength

From above figure it is observed that maximum compressive strength shown in fig. M20 grade of concrete got compressive strength ranges from 23-29 N/mm2. The maximum compressive strength was obtained at 15% replacement of SCBA for cement.

5. ADVANTAGES

a. Like other pozolanic material i.e. fly ash, GGBS & slag, bagasse ash is also a valuable pozolonic material so it can definitely be used as a partial replacement of cement.

b. Predominantly the ash disposal problem from sugar industry is reduced since it is usually disposed off in open land area. This could reduce the ecological complications and minimize the requirement of land fill area to dispose SCBA.

c. Keeping in view the environmental consideration, energy conservation and economy, reactive ash production can lead to excellent technological benefits useful to the community at large.

d. Usage of bagasse ash in concrete helps in reduction of dead weight thereby producing light weight structures.

e. Sugarcane bagasse ash (SCBA) has similar composition as cement and by replacing cement with SCBA by weight of cement in concrete the cost is reduced without affecting its quality.
f. Replacement of cement by sugarcane bagasse ash reduces agro industrial waste and bring about efficient use of cement which results in conservation of cement. By saving cement, it reduces greenhouse gases emission and makes way for better and green environment.

6. CONCLUSIONS

a. It is concluded that finely grounded SCBA can be successfully replaced by cement and is responsible for higher compressive strengths than normal concrete.
b. The study reveals that the compressive strength of concrete increased up to 15% replacement whereas beyond 20% replacement the strength was found to be decreasing. Therefore it is possible to use bagasse (SCBA) as cement replacement material to improve quality control and reduction of cost.
c. From the study it is concluded that workability of concrete increases by increasing the percentage of replacement of SCBA in concrete. Therefore use of super plasticizer is not essential.
d. From the results, it is clearly seen that the 15% cost of cement can be save with better strength than control concrete.
e. Optimum percentages of replacement of cement by SCBA will vary from different grade of concrete which is a further scope of study.

REFERENCES

[1]. Bangar Sayali S "A Review Paper On Replacement Of Cement With Bagasse Ash", International Journal Of Engineering Sciences &Management, ISSN 2277 – 5528.

[2]. Lavanya M.R, Sugumaran. B & Pradeep.T. "An Experimental study on the compressive strength of concrete by partial replacement of cement with sugarcane bagasse ash". International Journal of Engineering Inventions, ISSN: 2278-7461, ISBN: 2319-6491,Volume 1, Issue 11 (December2012) PP: 01-04.

[3]. R. Srinivasan, K Sathiya, 2010. "Experimental study on bagasse ash in concrete", International Journal of Service Learning in Engineering 5(2), p. 60.