Utilization of Sugarcane Bagasse ash in Concrete as Partial Replacement of Cement

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Abstract : This research addresses the suitability of sugarcane bagasse ash (SCBA) in concrete used as partial cement replacement. Two grades of concrete M45 and M50 were used for the experimental analysis. In this study, it represents the influence of (GGBS) and sugarcane ash. (GGBS) and sugarcane ash mixed in cement concrete for the workability and strength for concrete, adding few percentages of (GGBS) and sugarcane ash into ordinary Portland cement with removing that much percentage of ordinary Portland cement 5% to 25% by total weight of OPC.

Keywords- High strength concrete, compressive strength, mix design, (GGBS) and sugarcane ash workability, flexural strength, splitting tensile strength.

Introduction

Concrete is a combination of cement, sand, coarse aggregate and water. Their investigation depends on a reality that can be designed to resist hostile environments while adopting the most inspiring forms. Engineers and scientists are trying to increase their limits with the help of innovative chemical additives and additional SCMs.

Sugar cane is the main food crop in tropical and subtropical countries. This is the main supplier of sugar production. Cane sugar cane (SCB) is waste generated after extracting juice from sugar cane. Sugar Cane Ash Cane Sugar (SCBA) is obtained by burning cane sugar cane control. SCB causes environmental disturbance due to direct disposal of open land and the formation of piles of waste in that area [1]. According to Barroso [2], tons of cane sugar generates 280 kg of reed waste. Generates issues related to the economy and the environment. To solve these problems, enormous global efforts have been made to manage the remnants of bugs, namely, administration, justice and enforcement. To reduce the environmental burden, the use of waste materials in concrete is an important aspect. Sugar cane cane is a waste material for the sugar industry, which has good potential for concrete use as an alternative to cement.

Cement is the most heavily used material in infrastructure development. It is a permanent building material. However, the problem of environmental cement has become a growing concern, as cement industries account for about 2.5% of total global emissions from industrial waste [5, 6]. It takes some time to increase the use of concrete replacement materials in concrete, which can reduce a large amount of cement consumption, because cement production requires tremendous energy. When awarded to Asma [7], it also accounts for 5% of global production. CO2 emissions from human activities (each tonne of cement produces about 10 tonnes of carbon dioxide), and its use can also improve concrete properties. The burning of organic waste from the sugar industry known as bagasse results in a large amount of ash called ash cane cane sugar (SCBA). SCBA was recently identified as pozzolanic material; however, there are partial research statistics available for SCBA purposes on behavior.

Therefore, we strongly recommend an investigation into the trachea and its impact on concrete behavior. In general, reed residues are deposited in landfills or disposal sites where there is a presence in the country and rare studies are still being sent. Ashes can be used as a partial replacement of cement in concrete. Meanwhile, in the present era, there is a significant increase in sugar production worldwide, and approximately 1,500 million tons of sugar cane are produced annually worldwide, leaving between 40 to 45% of the sugar cane juice of the elimination . Therefore, the average annual production of the palace is expected to reach 600 million tons, which represents a huge waste for the sugar industry [8]. For the construction industry, concrete is one of the most important elements that are prepared for mixing cement, fine aggregates, rough aggregates and cement. The role of cement is very important. Without cement, building structures can not be enhanced. However, the high use of cement is a major concern for environmental professionals in the world. Taking into account the facts, one effective way to minimize environmental impact is the use of mineral additives, such as the partial replacement of cement in concrete, which will have the potential to reduce costs, save energy and reduce waste emissions.

Aim of This Study

- In this study to obtain the resistance of grades M45 and M50 with the replacement of cement by GGBS and sugarcane ash.

- Main aim of this study is to use of GGBS and sugarcane ash as mineral admixture which was partially replaced for effect on workability.
- In this work, the following concrete properties, such as compressive force, bending strength and tensile strength of concrete M45 and M50 were developed using GGBS and cane ash.
- To compare the engineering properties of improved concrete for M45 & M50 (partially replacement) samples with conventional concrete.
- To compare the engineering properties of improved concrete and find out its eco-friendly property and economic condition.
- The economic conditions required in concrete technology use waste materials as a metal additive and reduce carbon dioxide emissions by reducing cement productivity.

Methodology

Concrete is a combination of cement, sand, coarse aggregate and water. Evaluation of performance of concrete containing additional cement materials such as GGBS and cane ash. The need for high performance concrete is increasing because of requirements in the construction industry. Efforts to improve concrete performance in recent years indicate that cement substitutes, as well as mineral and chemical additives, can improve the properties of concrete strength and durability. The challenge for the civil engineering community in the near future is to implement projects consistent with the concept of sustainable development, including the use of high-performance waste materials manufactured at a reasonable cost.

In present concrete required economic & good blending material property. So, some industrial wastes use as blending material to improve property of concrete.

The coarse particle size is greater than 4.75 mm and contains only the most accurate materials as permitted in specifications. Thick and thick aggregates form the bulk of the concrete mix. Sand, natural gravel and crushed stone are mainly used for this purpose.

Figure 1 : Coarse aggregate (10mm & 20mm)

Table 1 : Properties of Coarse Aggregate 10mm & 20mm

Tests	Coarse Aggregate	
	10mm	**20mm**
Density (SSD)	1478 kg/m^3	1560 kg/m^3
Sp. Gravity (SSD)	2.66	2.66
Water Absorption	0.46%	0.46%

Fine aggregate (sand) particle size less than 4.75mm sieve and Sand shall be clean hard, durable, angular, sharp and gritty to touch and free from mica, silts, and alkalis, organic and vegetable matters. It should not contain more than 5% of clay or silt. Sand should be perfectly drying before measured.

Figure 2 : Fine aggregate (natural sand)

The fine aggregate is taken from Banas,Tonk,Rajashtan and designated IS- Sieve for the material passing through Zone-II is found.

Table 2 : Properties of Fine Aggregate

Tests	Natural fine aggregate
Density (SSD)	1675 kg/m^3
Bulk Density (SSD)	1675 kg/m^3
Sp. Gravity (SSD)	2.6
Water Absorption	1.15 %

Cement is binding material in the cement concrete. It is used for different engineering works where strength and durability are of Prime importance.Cement property depend dose of water in cement concrete.

Kind of Cement

- Portland pozzolana cement
- Ordinary Portland cement

Portland pozzolana cement give high strength in low contains compare to Ordinary portland cement &Ordinary portland cement economic but not give early time strength.

PPC give the 75% to 80%strength in 28 days and OPC give the 80% to 85% strength in 28 days. Researchers have used mostly Ordinary Portland Cement and then only few have used Portland pozzolana cement. Mostly this cement is used due to its economic condition.

Table 3 : Properties of Cement (OPC 43 grade)

Property	Value
CaO	3200 cm^2/gm
C_3S	20% - 25%
C_2S	52% - 54%
C_3A	7%
C_4AF	8%
SO_3	3%
Na_2O	0.5%
Gypusum ($CaSO_4.2H_2O$)	2.5%
Specific Gravity	3.15

Admixtures are ingredients in concrete other than Portland cement, water, and aggregates that are added to mixture immediately before or during mixing.Admixtureuseearly hardening and workability or provide additional cementing properties.

Type of admixture

- ❖ Mineral admixture
- ❖ Chemical admixture

(GGBS) and sugarcane ash is a mineral admixture.(GGBS) and sugarcane ash use for higher **M45** and **M50** of concrete and mineral admixture (GGBS) and sugarcane ash use for basically concrete.

(GGBS) is a specially processed product that relies on high vitreous content with high reaction obtained through the granulated process that is controlled. Raw materials consist of low calcium silicate. Processing with other specific components leads to a controlled particle size distribution (PSD). The calculated value of the base based on the PSD is about 12000 cm 2 / g and is really high resolution. (GGBS) provides a lower demand for water for a particular operability, up to a replacement level of up to 70% according to concrete performance requirements. (GGBS) can also be used as a high-pressure water dilution to improve pressure strength or as an aid to work easily to improve flow. (GGBS) is a pozzolanic material that can be used to produce long-lasting concrete compounds.

Table 4 : Physical Properties of (GGBS)

Physical Analysis	Range
Bulk Density	700-900 kg/m^3
Surface Area	12000cm^2/gm
Particle Shape	Irregular
Specific gravity	2.3
d10	<1.5 micron
d50	<5micron
d90	<9micron

Sugarcane ash

Sugar cane is one of the main crops in more than 110 countries and has a total production of more than 1500 million tons. In India, sugar cane production is more than 300 million tons / year, causing about 10 million tons of ashes of sugar cane bag as unused material and residues. In India, a large quantity of sugar cane bags is available from sugar mills. For every 10 tons of crushed sugar cane, the sugar mill produces about 3 tons of wet bag handle.

Table 5 : Chemical composition of SCA

Chemical compound	Abbreviation	%
Silica	SiO_2	68.42
Aluminum Oxide	Al_2O_3	5.812
Ferric Oxide	Fe_2O_3	0.218
Calcium Oxide	CaO	2.56
Phosphorous Oxide	P_2O_5	1.28
Magnesium Oxide	MgO	0.572
Sulphide Oxide	SO_3	4.33

Conclusion

In this study was successfully implemented, until the establishment of SCBA as an alternative to the replacement of cement in concrete. After the detailed investigation, the following conclusions were drawn:

- ❖ SCBA in concrete provides greater resistance to compression than natural resistance concrete, so the best results were found in replacing 5% of cement with SCBA.

- ❖ The usage of SCBA in concrete is not only a waste-minimizing technique, also it saves the amount of cement.
- ❖ The replacement of cement with SCBA increases the operability of fresh concrete; therefore, the use of super plasticizers is not necessary.

- ❖ Future research is recommended to evaluate the use of SCBA specifically for different properties of concrete, for example, elasticity factor, bending test, split tensile testing, drying shrinkage, etc.

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