STRENGTH OF CONCRETE GRADE M45 & M50 BY PARTIAL REPLACEMENT OF CEMENT WITH SUGERCANE BAGASSE ASH

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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. Its realization lies in a reality that can be designed to resist hostile environments while taking the most inspiring forms. Engineers and scientists are trying to increase their limits with the help of innovative chemical additives and several additional SCMs.

Sugarcane is main food crop in tropical and subtropical countries. It is the major resource for the sugar production. Sugarcane bagasse (SCB) is the waste created after juice extraction from sugarcane. The Sugarcane bagasse ash (SCBA) is acquired through the control burning of sugarcane bagasse. The SCB creates the environmental nuisance due to direct disposal on the open lands and forms garbage heaps in that area [1]. According to Barroso [2] that one ton sugarcane generates the 280 kg of bagasse waste. It generates economics as well as environmental related issues, to solving this issues, enormous efforts have been global towards the bagasse waste management i.e. handling, disposed-off and application. To reduce the environmental burden, the usage of waste materials in concrete is a significant aspect, the sugarcane bagasse ash (SCBA) is a waste material of sugar industry, which has a good potential to utilize in concrete as cement replacement.

Cement is the most widely consumable material in the infrastructure development works. It is considered as a durable material of construction. However, the environmental issue of cement has become a rising concern, as cement industries are accountable around 2.5% of total worldwide waste emissions from industrial sources [5, 6]. It is need of time to rise the use of cement replacement materials in the concrete which can reduce the significant amount of cement consumption, because the production of cement required huge energy and conferring to Asma [7] it is also accountable for 5% of global anthropogenic CO2 release (every ton of cement produces around 01 ton of CO2), and their usage can also improve the properties of concrete. The burning of organic waste of sugar industry known as bagasse, produces the considerable amount of ash named as sugarcane bagasse ash (SCBA). SCBA is freshly acknowledged as a pozzolanic material; though, there is partial research statistics accessible to the effects of SCBA on the behavior of concrete.

Therefore, it was highly recommended to conducting research on the bagasse and their impact on concrete behavior. Generally, the bagasse waste is disposed to the landfills or disposal sites where ever present in the country and rare studies has been conveyed yet. The bagasse ash can be used as partial cement replacement in concrete. Meanwhile, in the present era there is a huge rise in the production of sugar worldwide, and almost 1500 Million tons of sugarcane are yearly produced in all over the world, which leaves around 40 - 45% bagasse afterward juice removal. So, a normal yearly production of bagasse is projected as 600Million tons, which is a bulky waste from sugar industry [8]. For the construction industry the concrete is one of the most important item which is prepared for mixing of cement, fine aggregates and coarse aggregates and within the concrete the role of cement is very vital. Without cement, one cannot build reinforced structures. However, the high used of cement are an important concern of world environmental professionals. Considering the facts, one of the effective way to reduce the environmental impact is to use mineral admixtures, as a partial cement replacement in concrete, which will have the possible to cost reduction, energy conservation, and waste emission minimization.

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 properties of concrete were worked out such as Compressive strength, Flexural strength and Split tensile strength for M45 & M50 grade of concrete by using (GGBS) and sugarcane 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.
- Requirement economic conditions in concrete technology use waste material as mineral admixture and reduce the emission of CO2 by decreasing productivity of cement.

Methodology

Concrete is a mixture of cement, sand, coarse aggregate and water. Evaluate the performance of concrete containing supplementary cementitious materials such (GGBS) and sugarcane ash. The necessity of high performance concrete is increasing because of demands in the construction industry. Efforts for improving the performance of concrete over the past few years suggest that cement replacement materials along with Mineral & chemical admixtures can improve the strength and durability characteristics of concrete. The challenge for civil engineering community in the near future is to realize projects in harmony with the concept of sustainable development and involves the use of high performing waste material manufactured at reasonable cost.
In present concrete required economic & good blending material property. So, some industrial wastes use as blending material to improve property of concrete.

Coarse aggregate Particle size more than 4.75mm and contains only so much finer material as is permitted by specification.

Fine and coarse aggregates make up the bulk of a concrete mixture. Sand, natural gravel and crushed stone are used mainly 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 based on high glass content with high reactivity obtained through the process of controlled granulation. The raw materials are composed primary of low calcium silicates. The processing with other select ingredients results in controlled particle size distribution (PSD).The computed blain value based on PSD is around 12000cm2/gm and is truly ultrafine. (GGBS) provides reduced water demand for a given workability, even up to 70% replacement level as per requirement of concrete performance. (GGBS) can also be used as a high range water reducer to improve compressive strength or as a super workability aid to improve flow. (GGBS) is pozzolanic materials that can be utilized to produce highly durable concrete composites.

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 major crops grown in over 110 countries and its total production is over 1500million tons. In India sugar cane production is over 300million tons/year that cause around 10 million tons of sugar cane bag asse ash as an un-utilized and waste material. In India, a large amount of sugar cane bag asse from sugar mills is available. For each 10 tonnes of sugar cane crushed, a sugar factory produces nearly 3tonnes of wet bag asse.

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 successfully carried out, to the establishment of SCBA as an alternative cement replacement material in concrete. After the detailed investigation the following conclusions have been drawn:

- ❖ SCBA in concrete gives the higher compressive strength as compared to the normal strength concrete, hence optimal results were found at the 5% replacement 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 workability of fresh concrete; therefore, use of super-plasticizer is not essential.
- ❖ It is recommended that future research should be performed to assess the use of SCBA in concrete for several properties of concrete for example

modulus of elasticity, flexure test, split tensile test, drying shrinkage etc.

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