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Effect of Sugarcane Bagasse Ash (SCBA) on Compressive Strengthof Concrete

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ABSTRACT: The main ingradient of Concrete is the Ordinary Portland Cement (OPC). The use of OPC in concrete is increases drastically with the development and growth. Ordinary Portland Cement (OPC) is the main ingredient of conventional concrete and is responsible for a major amount of greenhouse gases such as carbon-dioxide emission in the atmosphere which causes global warming and environmental pollution. The various forms of modern sustainable concrete use industrial waste, such as fly ash from blast furnaces, silica fume, slag, and rice husk ash, to reduce the amount of greenhouse gases released during the concrete-making process. Sugarcane is major crop grown in over 115 countries and its total production is over 1850 million tons. Sugarcane production in India is over 300 million tonnes per year. The processing of it in sugar-mill generates about 10 million tonnes of sugarcane bagasse ash (SCBA) as a waste material. One tonne of sugarcane can generate approximate 26% of bagasse and 0.62% of residual ash.This research addresses the suitability of sugarcane bagasse ash (SCBA) in concrete used as partial cement replacement. Four grade grades of concrete M15, M20, M25 were used for the experimental analysis. The cement was partially replaced by SCBA at 0%, 5%, and 10%, by weight in normal strength concrete (NSC). The outcome of this work indicates that maximum strength of concrete could be attained at 5% replacement of cement with SCBA. Furthermore, the SCBA also gives compatible slump values which increase the workability of concrete.

KEYWORDS: Workability, Compressive Strength, SCBA

I INTRODUCTION

Concrete is the widely used manmade material on earth. The exponential rise in its use has coincided with the world population's rapid growth.The concrete sector contributes 5% of all greenhouse gas emissions, which causes climate change worldwide.ased on statistical data, the yearly manufacturing of cement is associated with over 4 billion tons of carbon emissions. In addition, the manufacture of cement has raised the atmospheric concentration of carbon footprints to 380 parts per million, with an anticipated increase to 800 parts per million by the year 2100.These days, the construction industry uses a variety of supplemental cementing materials (SCMs) to minimize the amount of cement required and, in turn, carbon emissions. These SCMs include metakaolin, fly ash, slag, and silica fume, SCBA. Sugarcane is major crop grown in over 115 countries and its total production is over 1850 million tons. Sugarcane production in India is over 300 million tonnes per year. The processing of it in sugar-mill generates about 10 million tonnes of sugarcane bagasse ash (SCBA) as a waste material. One tonne of sugarcane can generate approximate 26% of bagasse and 0.62% of residual ash. The enormous volume of bagasse ash, the leftovers from the in-line sugar business, and the bagasse-biomass fuel have all been tried to be used in the electric generation sector. This garbage also produces ash with amorphous silica, which has pozzolanic qualities, when burned under controlled settings. A few studies have been conducted on ashes that are directly taken from the industries to investigate their potential as binders that can partially replace cement and their pozzolanic activity. It is also utilized in concrete without compromising the material's durability. As a result, it is feasible to replace cement with Sugarcane Bagasse Ash (SCBA) to increase concrete's qualities, lower its cost of building, and enhance its features.

II METHODOLOGY

In this study waste materials used are sugarcane bagasse ash. The sugarcane bagasse ash is used to replace ordinary Portland cement by 5%, 10%, 15% every mixes that are prepared. These concrete mixes are prepared for M15 to M25 grade of concrete. For each grade replacement of mix concrete samples are made and nominal Mix is also made to compare the results. The Samples are prepared and tested for 7 Days and 28 Days Compressive Strength Tests.

III. MATERIAL USED FOR THE RESEARCH

3.1.1 Cement. The ordinary Portland cement (Grade 43) was used in this research to prepare the control specimens.

3.1.2 Fine aggregate. Fine aggregate (commonly known as hill sand) free from debris were brought from nearby having 2.61 of specific gravity and size below 4.75 mm were used.

3.1.3 Coarse aggregate. Coarse aggregate commonly known as crushed aggregates were also bfrom nearby having 2.65 of specific gravity and nominal maximum size of 20 mm were used.

3.1.4 Water. Water (palatable liquid) accessible within the campus laboratory were utilized for the mixing and curing of concrete cubes .

3.1.5 Sugarcane bagasse ash. Sugarcane bagasse brought from vicinity of Pantnagar and was burnt in a closed drum (uncontrolled burning), SCBA was obtained after passing through 300µm standard sieve used for experimental study.

Table 1. Typical chemical composition of Sugarcane bagasse ash

S. No.	Component	Percentage
1	Sio_2	60-65
2	Al_2O_3	3-5
3	Fe_2O_3	6-10
4	CaO	9-12
5	MgO	1-3
6	SO_3	1-2
7	K_2O	2-6
8	LOI	3-5

IV EXPERIMENTAL PROGRAM

1. The Mix design was done for the M15-M30. The Cubes were casted for M15-M30 grade of concrete for
2. In a pan take the weighted materials i.e. fine aggregate (sand), coarse aggregate, cement and sugarcane bagasse ash as in ratio found for mix design.
3. Mix the materials in dry state thoroughly.
4. Dry mix all the materials. After thoroughly mixing the materials make a hollow as crater in the Centre.
5. Start adding water in the mix at small amount at a time and start mixing them, water should be added as per the water cement ration taken in mix design.
6. After concrete is mixed start placing it in oil polished Cube molds up to 1 / 3 of its part. Now after this start temping the placed mixture in mould for 25 times, fill the mould up to 2 / 3 and repeat the temping process.
7. Now completely fill the mould and temping it for 25 times in last portion, level it then put on Table Vibrator for compaction.
8. Then keep for 24 hours. After 24 hours take the specimen out of the moulds and keep for Curing in curing tanks.
9. After 7 & 28 Days take out the specimens of curing tanks and leave them for some time to surface dry them. After this perform the Compressive Strength tests.

V RESULTS & DISCUSSION

Workability :

The slump test was performed for the concrete with and without SCBA to check the consistency concrete and the observed result are reported in table 2.After the conducting slump test for concrete grade M15, M20 and M25 the continuous rise in the slump value were recorded, when cement replaced by SCBA. It is prominent that slump value represents the workability of fresh mix concrete and the observed values fall in the category of low and medium degree of workability.

Table 2. Slump values of different grades of concrete.

Mix	% Replacement SCBA	Average Slump Value (mm)
M15	0	32
	5	38
	10	45
	15	55
M20	0	30
	5	42
	10	51
	15	60
M25	0	70
	5	85
	10	90
	15	100

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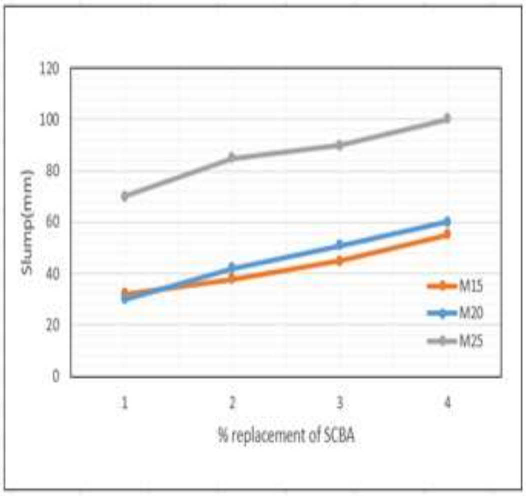

Fig1 Av. Slump values (in mm) for different grade corresponding to various % of SCBA

Compressive Strength:

The compressive testing machine was used to test the entire concrete cylinders for crushing strength at 7 and 28 days respectively. The compressive strength for concrete grade M15, M20 and M25 (1:2:4) were investigated for the control mix and while cement was partially replaced by SCBA. The results of compressive strength test at 7 days and 28 days curing periods are provided in table 3 and 4. Through the laboratory observations it was perceived that early age strength is lower than the later age strength, because concrete gain its strength with the passage of time.

It can be seen that the use of SGBA as partial replacement of cement increases the compressive strength of concrete by a significant amount. The compressive strength of concrete can be increased upto 10% of replacement of cement after which there is a fall in compressive strength with further increase in SGBA content. Thus, the optimum content of SGBA is 10%

Table 3 Compressive Strength at 7 days

Mix	Av. Comp. Strength (MPa) for M15	Av. Comp. Strength (MPa) for M20	Av. Comp. Strength (MPa) for M25
Cement + 0% SCBA	12.12	16.23	19.23
Cement + 5% SCBA	13.23	17.25	20.12
Cement + 10% SCBA	14.25	18.66	22.56
Cement + 15% SCBA	13.23	16.89	20.28

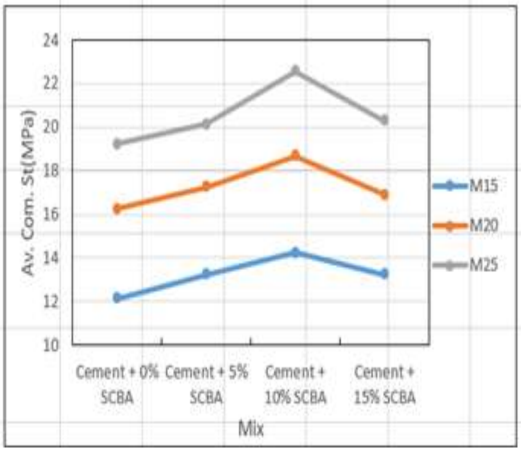

Fig 2 Av. Compressive strength (MPa) fordifferent grade corresponding to various % of SCBA for 7 days

Table 4 Compressive Strength at 28 days

Mix	Av. Comp. Strength (MPa) for M15	Av. Comp. Strength (MPa) for M20	Av. Comp. Strength (MPa) for M25
Cement + 0% SCBA	20.58	28.33	32.33
Cement + 5% SCBA	22.36	29.12	34.26
Cement + 10% SCBA	23.26	30.12	37.85
Cement + 15% SCBA	22.35	28.35	36.56

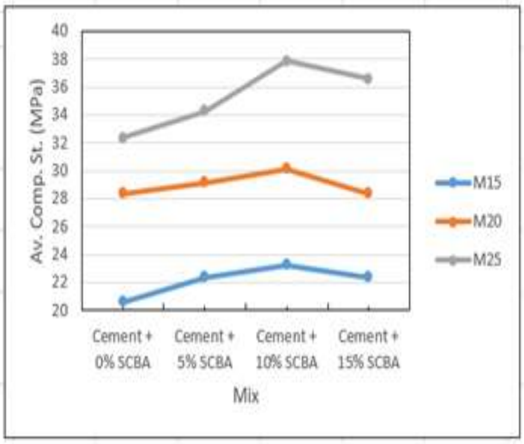

Fig 2 Av. Compressive strength (MPa) for different grade corresponding to various % of SCBA for 28 days

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VI. CONCLUSION

This work was 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:

- Partial replacement of cement by SCBA boosts workability of fresh concrete; therefore use of super plasticizer is not essential.
- The results showed that, the concrete with 10% SCBA replacement after 28 days of curing, showed maximum strength when compared to concrete with other percentage replacement mixes.
- In the economic point of view, the cement replaced by SCBA saves money
- The usage of SCBA in concrete is not only a waste-minimizing technique, also it saves the amount of cement.

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