Partial Replacement of Cement in Concrete with sugarcane bagasse ash

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***Abstract*—The strength and shrinkage of concrete that is combined with sugarcane bagasse ash particles are influenced by the size of the particles, as analyzed in this research article. A higher amount of water is required when utilizing Sugarcane Bagasse Ash (ScBA) in concrete. The strength of the mixture created with fine ScBA can be comparable to or greater than that of standard concrete. The ScBA waste produced from sugarcane contracts substantially as a consequence of the presence of minute components within it. In this study, the researchers utilized a material known as Sugarcane Bagasse Ash (ScBA) to substitute cement in concrete. The experiment involved testing the effectiveness of ScBA (at different percentages: 0%, 5%, 10%, 15%, and 20%) in strengthening M20 concrete over a period of 28 days. They compared it to regular concrete. The extent to which it could resist pressure and strain without snapping was measured. The reason behind burning Sugarcane waste (ScBA) for fuel is its ability to produce significant amounts of heat. Cement can be supplemented with the remaining ash after it has been burnt.**

Keywords: Compressive strength Concrete, cement, Fine Aggregate, Coarse Aggregate, Sugarcane bagasse ash.

I. INTRODUCTION

Cement is very important for making concrete. Creating this thing makes a lot of pollution called CO2. Many people know that having too much CO2 in the air can harm nature. People are trying to make less of a gas called CO2 come from factories. Using different materials instead of some parts of cement is the best way to cut down on the amount of CO2 that cement factories release. When we use things that weren't used before in farming and making things, it makes concrete better. Instead of buying new things, we should find ways to use things that have already been thrown away. To Rephrase wants to make really good concrete and protect the environment when getting rid of it. This info is about research done by a group of authors. Using pozzolans for making concrete is beneficial for the environment as they can replace a large amount of cement. Making new concrete better when it's still wet and when it's hard. Using pozzolans instead of cement to make concrete is more environmentally friendly.

When people burn the things left over after making sugar and bagasse plants in a special way, they create a type of ash that contains a substance called amorphous silica. Scientists checked how ash affects concrete in various regions worldwide. They discovered that adding some ash to concrete can make it stronger and stop water from getting inside. Bagasse ash has special properties that can help it become a type of cement called pozzolan. This is because it has a lot of a substance called silicate inside. This stuff makes concrete stronger by working together with cement to get rid of extra lime. The amount of silicate in ash varies depending on how it was burned and the kind of soil it was from. It is used to help sugarcane grow better.

A. Objectives

The investigation has been carried out with the following objectives.

1.To determine the compressive strength of concrete at normal 0 percent.
2. To determine the compressive strength at 5, 10, 15 percent.
3. To compare compressive strength for 0, 5, 10, and 15 percent.

II. RESEARCH SIGNIFICANCE

The most common material used to prepare concrete is natural sand. Due to excessive river sand mining and large-scale resource depletion, there have been major issues with its availability, cost, and impact on the environment related to its continuous consumption over the past ten years. The concrete industry currently

needs an alternative to river sand. The material's capacity to meet strength and durability standards demonstrates its suitability as a substitute for fine aggregates in concrete. One such substance that has been discovered to be suitable for use as a sand replacement in concrete is red soil. A percentage of red soil is used in an experiment to partially replace fine aggregate to investigate the qualities of concrete. In these mixed proportions, workability, and mechanical properties are further studied.

III. MATERIALS AND METHODOLOGY

A. Material required

1. Cement:

A binder, known as cement, is used to set, harden, and remain in other materials, binding them together. Cement, sand, and gravel combine to form concrete. OPC 53 grade cement was used throughout the project work.

2. Fine aggregate:

In this study, manufactured sand, which passes through a 4.75 mm sieve, is used as the fine aggregate. The samples are tested according to IS 2386.

3. Coarse aggregate:

The coarse aggregate, which has a maximum size of 12.5 mm and is retained on an IS 4.75 sieve, was chosen based on shape per IS 2386 (Part I) 1963. The aggregate's surface texture properties are classified using 383–1970. The nominal size of 20 mm coarse aggregate is used throughout the project work.

4. Sugarcane bagasse ash:

Sugarcane bagasse consists of approximately 52% of cellulose, 26% of hemicelluloses of ligin. Each ton of sugarcane generates approximately 28% of bagasse (at a moisture content of 52%) and 0.64% of residual ash. The residue after combustion presents a chemical composition dominates by silicon dioxide (sio2).

5. Water:

Water plays a crucial role in both the mixing and curing pocesses of concrete, ensuring its strength and durability.

B. Tests on materials

S. No	Materials	Name of Tests	Results
1.	Cement	Fineness Test	8%
		Consistency Test	31%
2.	Sugarcane bagasse ash	Fineness test	2.20
		Specific Gravity	2.35
		Liquid Limit Test	33.6
3.		Fineness test	2.65
	Fine aggregate	Specific Gravity	2.61
4.	Coarse aggregate	Water absorption	1%
		Specific Gravity	2.74

TABLE 1.1 Test results on different materials.

C. Methodology

An experimental study is conducted to investigate the characteristics of concrete by partially replacing cement with a specified percentage of sugarcane bagasse ash in the mix design of M-30 grade (IS 10262, 2009). To achieve an optimum mix, the mixture is made with varying amounts of cement. Once a suitable mix has been determined, proportions of sugarcane bagasse ash(0%, 5%, 10%, and 15%) are added to the weight of fine particles in the mix design. The experimental plan is executed in two phases.

• In the first phase, testing takes place on each mix to determine the fresh workability quality (slump flow) of the concrete.

In the second phase, cubes are cast with fresh concrete. The specimens are then cured in water for durations of 7, 14, or 28 days, after which they are tested for mechanical properties.

IV. EXPERIMENTAL INVESTIGATION

Sugarcane bagasse consists of approximately 52% of cellulose of hemicelluloses of ligin. Each ton of sugarcane generates approximately 28% of bagasse (at a moisture content of 52%) and 0.64% 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. In this sugarcane bagasse ash was collected during the cleaning operation of a boiler in the sugar factory, located in the town of Meerut, Uttar Pradesh.

Figure (a)sugarcane bagasse ash

Figure (b):cement

Figure(b): Fine Aggregate

A. Mix design

A concrete mix design was carried out to identify the correct amounts of cement, sand, and coarse particles required for casting concrete with a target compressive strength of 3000 psi. Table II displays the findings of the material proportions of cement (C), fine aggregate (FA), coarse aggregate (CA), and the water-cement ratio (W/C). The slump value was also considered satisfactory.

C: FA:CA	1:0.75:1.5
W/C	0.58

TABLE1.2 Mix design results.

B. Casting and curing

For the compressive strength test, 12 cubes were cast as shown in Fig. 3. Throughout the work, a suitable mix proportion was maintained. After 24 hours of casting, the cubes have been placed in water for the proper curing times

Figure(c): Curing the cubes for 7, 14, & 28 days.

Figure(d): Cubes tested under compressive testing

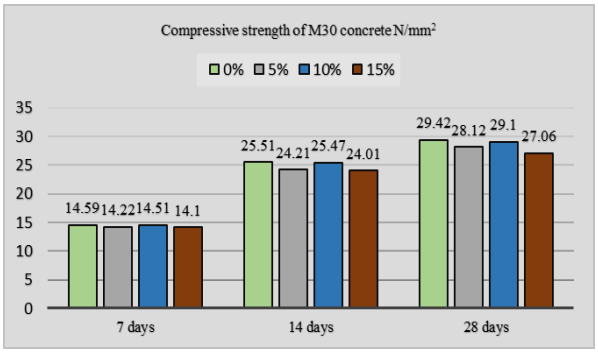
V. RESULTS AND DISCUSSION

A. Compressive strength of concrete cubes

A total of 150 mm-sized 12 specimens were cast. After curing period of 7, 14, and 28 days tested respectively, by using a calibrated compression testing machine of 2000 KN capacity. The obtained results are tabulated below.

Grade of concrete	% of red mud used	7 days	14 days	28 days
M-30	0%	14.59	25.51	29.42
	5%	14.22	24.21	28.12
	10%	14.51	25.47	29.10
	15%	14.10	24.01	27.06

TABLE 1.3Compressive strength of concrete cubesfor 7, 14, & 28 days



1.1: Comparing compressive strength for plain concrete and concrete with 5%, 10%, and 15% red soil with respect to curing time.

The compressive strength of concrete is increased by 10% by replacement fine aggregate with red soil, after which it is reduced.

VI. CONCLUSION

The experimental study seen that the compressive strength of concrete increases with help of SCBA, if use in partially replacement of cement in concrete, after that the compressive strength gets decreases it‘s also seen that HCL for curing of cube in place of normal water is also helpful in the enhancement of compressive strength.

Following conclusion is summarized as per experimental study.

By increasing the percentage of SCBA in mix design there is gradual decreases of compressive strength for 7 days.

VII. REFERENCES

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