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Experimental Study on Bagasse Ash Concrete

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ABSTRACT: Bagasse ash is the waste produced by the sugar industries, recycling of this wastes in to a source of raw material in the production of cement, provides a satisfactory solution to environmental concern associated with waste management. These wastes become economical and also make a way to create a healthy environment. In this experimental work ,SBA replacement was done partially with 5%, 10%, 15%, and 20% by weight of cement, concrete cubes, cylinders and beams of M25 grade were casted and tested for workability, compression and split tensile strength for 7 days and 28 days. From the test results, indicate it is an effective admixture with replacement of 10% SBA by weight of cement.

KEYWORDS: SBA, partial replacement, strength, properties

I. INTRODUCTION

In today's era, India faces waste management crisis in every field, which is one of thje major issue for the developing country. To overcome this, researchers are focusing more on utilizing industrial agricultural waste as a source of raw material. India is an agricultural country and its main economy is dependent on agriculture. Next to Brazil , India is the second largest producer of sugarcane. In sugar industry after extracting sugar from the sugarcane, the left over called bagasse is burnt to produce heat to run boilers during the production of sugar.. The residue coming out after burning bagasse is called sugarcane bagasse ash (SBA).

SBA so produced will be in large amount and some part of it is used to treat agricultural land as fertilizer and the remaining is treated as waste which is of no use. Disposal of this waste is one of the major problem for sugar industries, nearly one ton of sugarcane generates approximately 26% of bagasse and 0.62% of residual ash and it has very high concentration of silica. With the increasing demand and consumption of cement day by day, researchers were finding a solution to overcome it and to develop a new alternate binder which is eco friendly and contribute for sustainable waste management. Since SBA is a huge by product of sugar industries and has a cementious property it can be effectively do partial replacement of cement to some extent.

The main objective of this experimental investigation is to evaluate bagasse ash as supplementary cementious material with reference to workability of fresh concrete and hard concrete and also to identify the optimal replacement of SBA in concrete , in addition to reducing environmental problems associated with manufacturing of cement and bagasse ash production

II. EXPERIMENTAL WORK

In this experimental work M25 grade concrete was used with water cement ratio 0.45 throughout work. SBA was air dried to remove moisture completely before use of SBA in cement replacement. Fresh and hard concrete tests are done as per Indian specifications. For hard concrete test, total 50 numbers of specimens were casted, in that 30 no's cubes of size 150*150*150mm and 20 no's cylinders of size 500*100*100mm were casted in cast iron moulds respectively. The specimens were removed carefully from the mould after 24 hours from the time of casting and placed for 7 days and 28 days curing. At certain 7 and 28 days of testing, specimen are taken out from curing and air dried and placed for testing. The specimens were tested in 2000kN capacity compression testing machine.

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A. Materials used in experimental work

The materials used in this study are:

Cement: OPC 53 grade cement - confirming to BIS 12600-1989(2009)

Table 1: properties of cement

S.No.	Property	Test results
1	Normal consistency	29.5%
2	Specific gravity	3.10
3	Initial setting time	190 mins
4	Final setting time	270 mins

Fine aggregate: In this experiment, locally available river bed sand is used, free from debris and it confirms to zone II as per BIS:383 and the physical properties of the fine aggregate used in the study are tested as per Indian standards and results are tabulated in the table below

Table 2: properties of fine aggregate

S.No	Property	Test results
1	Specific gravity	2.61
2	Water absorption	0.33
3	Bulk density: Loose Compacted	1526kg/m ³ 1686kg/m ³
4	Fineness modulus	3.55

Coarse aggregate: In this experiment, debris free coarse aggregates used are 20 mm and 10mm down size locally available crushed stone obtained from local quarries were tested as per BIS:383 and the results are tabulated in the table below and are within the permissible limits.

Table 3: properties of coarse aggregate

S.No	Property	Test results
1	Specific gravity	2.59
2	Bulk density: Loose Compacted	1366.37kgm ³ 1484kg/m ³
3	Nominal maximum size	20mm,10mm
4	Water absorption	0.28%

Water: Locally available water free from impurities was used in this experiment.

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Sugarcane bagasse ash: In this experimental investigation, SBA sample was brought from Davangere sugar factory near Kukwada, Karnataka ,during the time of disposal of ash from the boilers which was burned at 800°C and were collected in polythene bags and carried to laboratory. After that it was air dried to remove complete moisture from it and then finally sieved to remove hard and unburnt fibrous particles from it.

Table 4:Chemical composition of SBA

S.No.	Component	%
1	Silica(SiO ₂)	67.42
2	Alimina(Al ₂ O ₃)	0.22
3	Ferric oxide(Fe ₂ O ₃)	5.87
4	Calcium oxide(CaO)	2.6
5	Magnesium oxide(MgO)	0.58
6	Sulphur trioxide(SO ₃)	4.29
7	Loss of ignition	21.04

B. Experimental test and results

Workability of concrete:

The workability of concrete mixture is tested using slump cone apparatus, slump test is one of the method to determine the consistency of concrete and also it is the measurement of concrete workability. The results obtained from the test for different mix proportions are shown in the below figure, it was observed that slump value of plain cement concrete gives the maximum slump value of 90mm and as on adding SBA at 5%,10%,15% and 20% proportion in concrete, it was observed that slump value decreases slowly as compare to plain cement concrete .Which is the indication of good workability of concrete upon addition of SBA.



Fig 1 Slump cone test for M25 concrete

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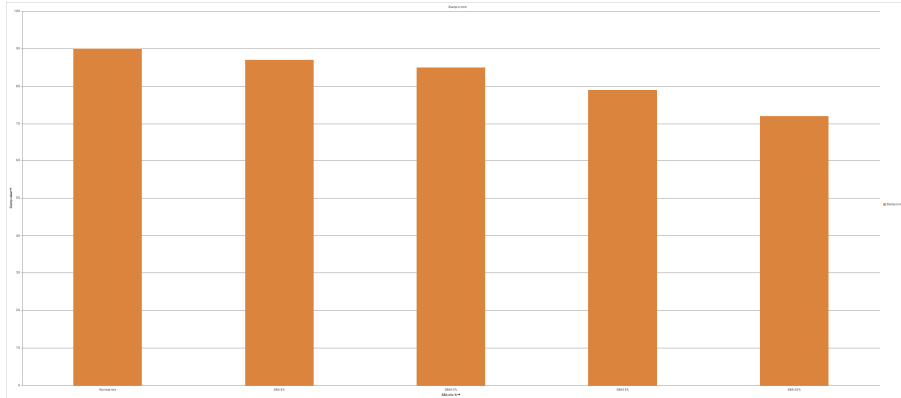


Fig 2 Slump of M25 concrete

Compression Testing:

Compression testing of cubes was done on compression testing machine having capacity of 2000kN. Compressive strength of concrete cube specimens was tested after the age of 7 and 28 days curing as per IS specifications. The test results, obtained of cube specimens indicated that at 10% replacement of SBA, compressive strength increases but further increase in SBA percentage, decreases the strength of concrete cubes.



Fig 3 Compression testing of concrete cubes specimen

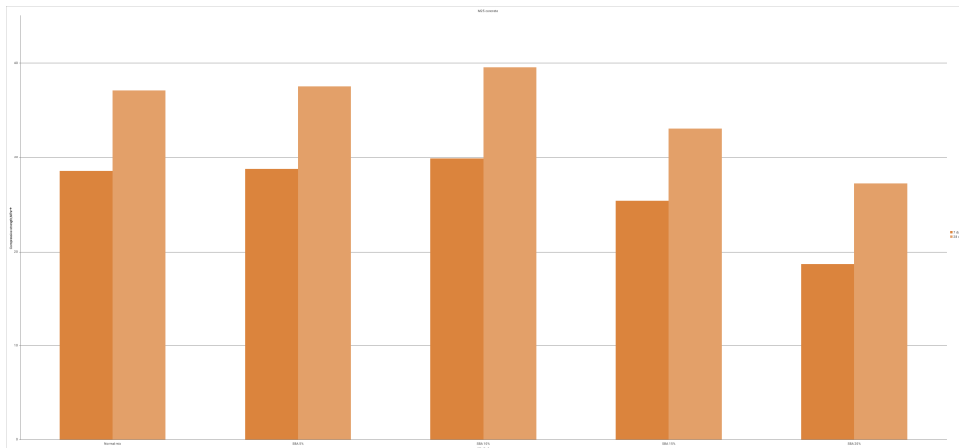


Fig 4 Compressive strength of M25 concrete

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Split tensile testing:

Testing for split tensile strength of concrete cylindrical specimen is done as per IS specifications. The test is conducted in compression testing machine of capacity 2000kN .The results of the test shows that the variation of split tensile strength parameter upon the addition of 10% replacement of SBA, it gives the maximum strength ,further addition of SBA i.e., 15% and 20% shows that there is a comparative decrease in strength of concrete cylindrical specimen because of more silica content present in SBA.



Fig 5 Split tensile testing of concrete cubes specimen

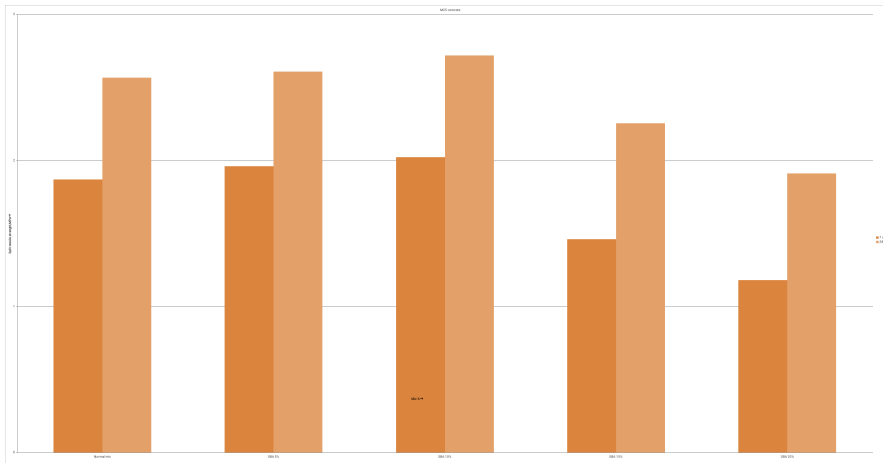


Fig. 6 Split tensile strength of M25 concrete

III. CONCLUSION

The experimental results show that the SBA in blended concrete had significantly higher compressive strength and tensile strength at partial replacement of 10% SBA by weight of cement, so up to 10% SBA can be replaced effectively. And also upto 20% it can be replaced since it can be observed that at 20% replacement also the strength is there and there is no sudden decrease observed. It is also indicated that the rate of increase of strength of mixes with SBA is higher at later days that may be due to pozzolanic properties of SBA.

And partial replacement of SBA also increases the workability of fresh state concrete, which results in zero addition of superplasticizer. Use of SBA in cement not only reduces the use of cement but also saves money. Effective utilization of SBA contributes to waste management.

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