Experimental Study on Strength Behaviour of Concrete Using Bagasse Ash and Foundry Sand

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Abstract- *Concrete is the most indispensable construction material which composed of cement, fine aggregate, coarse aggregate. Now-a-days the increasing demand and scarcity of construction materials made the world to search for the alternate material to overcome the stress in supply of material. By utilizing the waste as the substitute will pave way for disposing of that material in a way which leads towards waste management as well create a sustainable and pollution less environment. Sugar cane bagasse ash created in sugar plant and foundry sand a result which is delivered in metal casting industries at the time of casting creating environment issue in view of its inappropriate disposal. Sugarcane bagasse ash is a by-product produced by consuming bagasse in boilers of sugar and ethanol plants and comprises predominantly of silica (SiO2) demonstrate its capability of for use as a supplementary cementitious material in bond based composites creation and pozzolanic properties. Foundry sand comprises fundamentally of silica sand, covered with a thin film of consumed carbon and residual binder, by halfway substituting for fine aggregates, it can address its transfer issues and enhance the quality that upgrade the sustainability. This paper takes sugarcane bagasse and foundry sand as a material for substitute. The experimental studies were done to find the strength of concrete by using sugarcane bagasse in various proportion (10%,20%,30%,40%,50%) and foundry sand (constant percentage 30%) as replacement material for cement and fine aggregate in M25 grade concrete. It is found that the compressive strength and split tensile strength of the concrete increases with increase in percentage of substitution material.*

Keywords- Concrete, Demand, Waste Management, Bagasse Ash, Foundry Sand, Strength Test.

I. INTRODUCTION

Concrete is a common construction material that is used all over the world because of its considerable durability nature than other construction materials. But the growing infrastructure development there is a situation of scarcity for the materials. So we have to look for different materials to reduce the quantity of basic materials in the concrete mix without changing any mix design procedure. We cannot replace the whole basic materials in the concrete, but we can replace with other materials to some extent. Sugarcane bagasse is the waste that comes after juice extraction from sugarcane. The Sugarcane bagasse ash is obtained through the control burning of sugarcane bagasse. The Sugarcane bagasse and the foundry sand from metal casting industries, millions of tons of waste materials are generated every year creates the environmental inconvenience due to direct disposal on the open lands that forms garbage heaps in the area. The use of those materials in construction could help to avoid the problems related to environment pollution. So this study was undertaken to explore the possibility of baggase ash and foundry sand as a replacement in concrete.

K.Ganesan.et.al (2007) said that the utilization of waste materials in concrete manufacture provides a satisfactory solution to some of the environmental concerns and problems associated with waste management. R.Srinivasan (2010) have studied the waste product (Sugar-cane Bagasse ash) is already causing serious environmental pollution, which calls for urgent ways of handling the waste. SCBA in blended concrete had significantly higher compressive strength, tensile strength, and flexural strength compare to that of the concrete without SCBA. T.S. Abdulkadir.et.al (2014) suggested SCBA has pozzolanic properties having met ASTM- 595 (1985) with total sum of silica, alumina and ferric composition of 80.55%. Jayachandra.et.al (2015) concluded in the paper that effects of concrete containing foundry sand is unique that Instead of using it for land filling it can be used more effectively and efficiently for construction.

S.Iswarya.et.al (2015) have done research and said that bagasse ash is a valuable pozzolanic material and it can potentially be sold at a price similar to that of slag and fly ash. Amrutha K.et.al (2017) suggested that to overcome the stress and demand of river sand, researchers and practitioners in the construction industry have identified some alternative. One of them is foundry sand, it is a high quality silica sand with uniform physical characteristics and by product of ferrous and non-ferrous metal casting industry. Chandrasekar R.et.al (2017).Partial replacement of sand with WFS (up to 10% and up to 20% in some cases) increases the strength properties (compressive strength, splitting tensile strength flexural strength

and modulus of elasticity) of concrete. Ankita P. Patel et.al(2017)carried out studies on behavior of concrete is assured by partially replacing the natural river sand with foundry sand which is a waste product from machine industries showed a nominal increasing strength property of concrete by the addition of waste foundry sand as a partial replacement of natural sand. Bangar Sayali S.et.al(2017) described that the consumption of cement is increasing day by day and to meet demand In this direction the industrial & agricultural waste play vital role. The agricultural waste product like Sugar Cane Bagasse Ash (SBCA) is used as alternate binding material.

The main aim of this experimental work is to compare the effect of using bagasse ash and foundry sand in concrete with the conventional concrete and to evaluate the properties like compressive strength and split tensile strength with this material inclusion in concrete.

II. MATERIALS AND METHODS

A. Cement

In this ordinary Portland cement (PPC) of 53 grade (chettinad cement) is used. Various tests were performed on the cement as per IS specifications and they are listed in Table 1.

Table 1 Properties of Cement

S.No	Physical Properties	Test Results
1	Specific Gravity	3.11
2	Initial Setting Time	Around 30 minutes
3	Normal Consistency	33%

B. Fine Aggregate

The locally available river sand is used as fine aggregate which was passed through 4.75 mm sieve. It was tested as per IS standard specification and the results are listed in Table.2

Table 2 Properties of Fine Aggregates

S.No	Physical Properties	Test Results
1	Specific Gravity	2.32
2	Density	980Kg/m^3
3	Fineness	2.08

C. Coarse Aggregate

The coarse aggregate was locally available quarry having maximum size of 20 mm, were used in this research investigation for the preparations of specimen and whose properties are shown in Table 3.

Table 3 Properties of Coarse Aggregates

S.No	Physical Properties	Test Results
1	Specific Gravity	2.60
2	Density	1120Kg/m^3
3	Fineness	3.43

D. Sugarcane bagasse ash

The bagasse ash utilized as a part of the examination is acquired from a Sugar Factory in the adjacent region. The sugarcane bagasse comprises of roughly half of cellulose, 25% of hemicelluloses and 25% of lignin. Every ton of sugarcane creates roughly 26% of bagasse (at a dampness substance of half) and 0.62% of lingering fiery remains.

The deposit after burning presents a compound arrangement overwhelms by silicon dioxide (SiO2).Table4.gives the chemical constituent of bagasse ash.

Table 4 Chemical Composition of Sugarcane Bagasse Ash

Chemical Properties	Sugarcane Bagasse Ash
Silica	73.63%
Calcium oxide	1.89%
Magnesium oxide	1.68%
Iron oxide	2.63%
Aluminium oxide	4.69%
Sodium oxide	1.00%
Potassium oxide	2.96%
Loss of ignition	6.18%

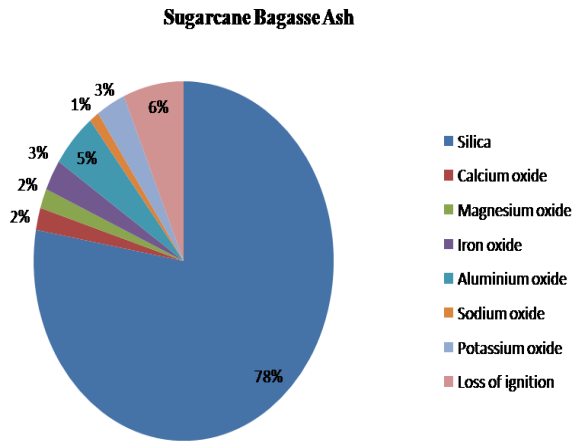


Fig. 1 Composition of Sugarcane Bagasse Ash

E. Foundry Sand

Foundry sand is a waste product from metal casting industry. In this work, foundry sand was used as fine aggregate

partially. The physical properties of foundry sand are given in Table.5. M20 concrete mix of 1:1.52:2.338 was designed and used during the investigation

Table 5 Properties of Foundry Sand

S.No	Physical Properties	Test Results
1	Specific Gravity	2.46
2	Density	1910Kg/m^3
3	Fineness	2.98

III. MIX DESIGN

Concrete mix design is a process of selecting suitable ingredient of concrete and determining the relative proportion with the object of producing economical concrete of certain properties like notable workability, strength and durability.

Table 6 Mix Design Specifications

Title	Specifications
Grade of Concrete	M25
Type	OPC
Grade of Cement	53 Grade
Size of Coarse Aggregate	20mm
Specific Gravity of Coarse Aggregate	2.60
Specific Gravity of Fine Aggregate	2.32
W/C Ratio	0.45

Mix proportion: 1:1.24:2.49

A. Mix Details

Table 7 Details of Mix Designation					
Mix Designation	Binder		Fine Aggregate		Coarse Aggregate
	OPC	SBA	River Sand	Foundry Sand	
M0	100	0	100	0	100
M1	90	10	70	30	100
M2	80	20	70	30	100
M3	70	30	70	30	100
M4	60	40	70	30	100
M5	50	50	70	30	100

IV. EXPERIMENTAL RESULTS

A.Casting of Concrete Specimen

The specimens were casted in 1:1.24:2.49 ratios. Compression test, cube of size 150 mm was used.

B. Slump Test

This is a test commonly adopted in construction site. It is very useful in detecting the variation in the uniformity of mix of given nominal proportion. It also gives an idea of water cement ratio need for concrete to be used for different works.

Table 8 Slump Value for Mix

Mix	M0	M1	M2	M3	M4	M5
Slump Value(mm)	55	63	68	71	84	90

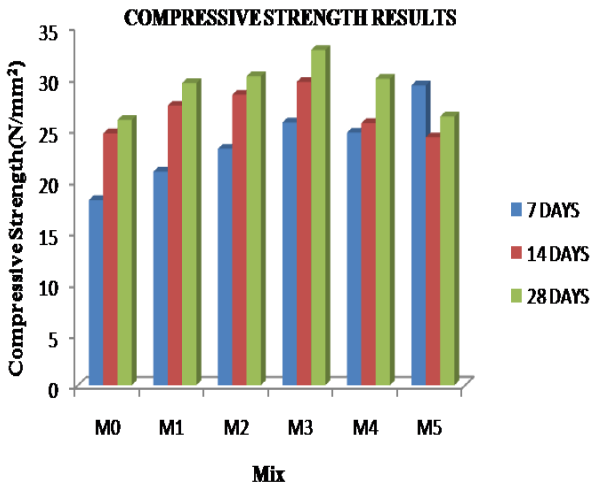
C. Compressive Strength

In this study, we found that the compressive strength of concrete incorporating bagasse ash and foundry sand. The results of compressive strength test at different curing periods are provided in table9.

Concrete specimen of size 150x150x150 mm was used for compression test. 3 specimens with each proportion were subjected to compressive strength test. This test is done as per IS 516:1959.

Table 9 Compressive Strength Results(N/mm^2)

Mix	7 Days	14 Days	28 Days
M0	18.08	24.60	25.93
M1	20.86	27.32	29.52
M2	23.10	28.38	30.19
M3	25.67	29.64	32.76
M4	27.78	25.61	29.95
M5	29.30	24.23	26.26



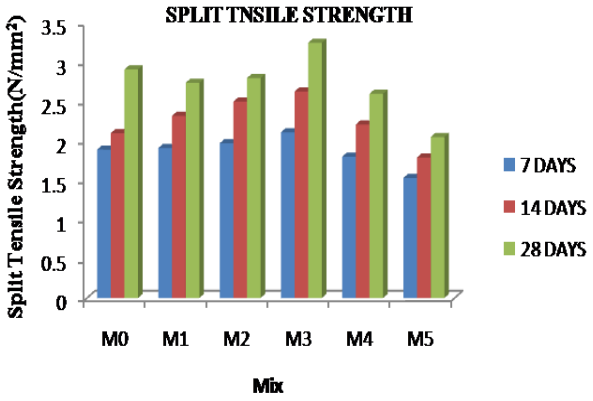
D. Split Tensile Test

Split tensile test was conducted as per IS 516:1959. A cylindrical concrete specimen of 150 mm diameter and 300 mm

height is used. The tensile strength of concrete specimen cured at 7, 14 and 28 days are shown in Table 10.

Table 10 Split Tensile Strength Results(N/mm^2)

Mix	7 Days	14 Days	28 Days
M0	1.89	2.10	2.91
M1	1.91	2.32	2.74
M2	1.97	2.50	2.80
M3	2.11	2.63	3.25
M4	1.80	2.21	2.60
M5	1.53	1.79	2.05



V.CONCLUSION

From our study it is concluded that,

- Bagasse ash is a valuable pozzolanic material that can increase the overall strength of the concrete when used up to a 30% cement replacement level. It can potentially be sold at a price similar to that of slag and fly ash

- Partial replacement of cement by SBA increases workability of fresh concrete; therefore use of super plasticizer is not essential.

- The cementitious material is incharge of early hydration. However pozzolanic action of bagasse cinder delivers more measure of CSH in the bio-bond thus quickens and improves the hydration with quality. Consequently bagasse ash is a potential trade material for concrete generation.

- The higher the percentage of bagasse ash and foundry sand gives higher strength until 30%.Hence maximum compressive strength, and split tensile strength is obtained for M3 mix is decided as optimal dosage.

In economic point of view the percentage of cement and sand replaced saves money, there is a cost reduction of 2.65% at the level of 30% replacement as compared to conventional concrete.

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