International Journal of Advanced Technology in Civil Engineering

Volume 2 | Issue 2 Article 15

April 2013

# Experimental Study on Partial Replacement of Cement by Bagasse Ash and M-Sand in Concrete

S. Sundararaman
*Mailam Engineering College, Mailam, Villupuram District, Tamil Nadu 604 304*, hodcivil@mailamengg.com

S. Azhagarsamy
*Mailam Engineering College, Mailam, Villupuram District, Tamil Nadu 604 304*, azhagarsamy@ymail.com



Recommended Citation
Sundararaman, S. and Azhagarsamy, S. (2013) "Experimental Study on Partial Replacement of Cement by Bagasse Ash and M-Sand in Concrete," *International Journal of Advanced Technology in Civil Engineering*: Vol. 2: Iss. 2, Article 15.
DOI: 10.47893/IJATCE.2013.1079
Available at: https://www.interscience.in/ijatce/vol2/iss2/15

# Experimental Study on Partial Replacement of Cement by Bagasse Ash and M-Sand in Concrete

Dr.S.Sundararaman[1], S.Azhagarsamy[2],
[1]Professor, [2]Assistant Professor, Department of Civil Engineering
Mailam Engineering College, Mailam, Villupuram District, Tamil Nadu 604 304
hodcivil@mailamengg.com[1], azhagarsamy@ymail.com[2]

***ABSTRACT***

***The present study investigates the effect of pozzolanic material in concrete and hence improving the strength of concrete. This work evaluates the performance of Sugarcane Bagasse Ash (BA) as a mineral admixture in concrete having the w/c ratio of 0.39. Concrete was produced with 5% of BA and also replaced with M-Sand for fine aggregate with 10%, 20% and 30%. Similarly the BA percentage is increase to 10% and 15% with different replacement of M-sand. The strength properties are compared with the above varying percentage and found that the mix of 10% BA and 20% M-Sand was comparably shown a better performance than the conventional concrete.***

***Keywords: Compressive Strength, split tensile strength, Sugarcane Bagasse Ash and M-Sand.***

## I. INTRODUCTION

Ordinary Portland cement is recognized as the major construction material throughout the world. Industrial wastes, such as blast furnace slag, fly ash and silica fume are being used as supplementary cement replacement materials. In addition to these, agricultural wastes such as rice husk ash, wheat straw ash, and sugarcane bagasse ash are also being used as pozzolanic materials and hazel nutshell used as cement replacement material [1]. India being one of the largest producers of sugarcane in the world, produces 300 million tons per year [2] and large quantity of sugarcane bagasse is available from sugar mills. Sugarcane bagasse is partly used as fuel at the sugar mill. Only a few studies have been reported on the use of bagasse ash (BA) as pozzolanic material in respect of cement paste [5]. Bagasse is a by-product from the sugar industry and it is usually burnt at the mill to provide process power or steam. The resultant ash is a pozzolanic material that would otherwise require disposal [4, 5, 7]. The sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicellulose and 25% of lignin. Each ton of sugarcane generates approximately 26% of bagasse (at a moisture content of 50%) and 0.62% 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. Report shown that the strength of concrete is reduced when the percentage of BA is increased beyond 10% [1, 5]. Researches have also been carried out for different percentage of BA as replacement of OPC. Further replacement of cement by bagasse ash results in better or similar concrete properties and further environmental and economical advantages can also be exploited by using bagasse ash as a partial cement replacement material [3]. The present study involves the combination of BA and M-Sand which gives a better perspective on the strength behavior of concrete.

## II. MATERIALS

The Ordinary Portland cement of 53-grade was used in this study conforming to IS: 12269-1987 [9].The river sand is used as fine aggregate conforming to the requirements of IS: 383-1970 [10]. Coarse aggregate obtained from local quarry units has been used for this study, conforming to IS: 383-1970 [10]. The water used for experiments was potable water conforming as per IS: 456-2000 [11].

### A. Manufactured sand

The manufactured sand is used as fine aggregate in accordance with BIS 2386-1963 and the Physical Properties are given in Table 1.

Table 1. Physical Properties of Manufactured sand

| Property | Value |
|---|---|
| Specific gravity | 2.6 |
| fineness modulus | 2.82 |
| Water absorption | 1.5% |

### B. Bagasse ash

Sugarcane bagasse ash was collected from the Ponni Sugars Limited, Erode. Bagasse ash used in this study was obtained by burning BA at 600$^{o}$C for 5 hours under controlled conditions and its physical characterization was done to evaluate the possibility of its use as binder partially replacing cement in the mortar applications and physical properties are given in Table 2.

Table 2. Physical Properties of Bagasse Ash

| Property | Value |
|---|---|
| Specific gravity | 2.47 |
| Mean grain size in (µm) | 11.6 |
| Density Kg/m$^3$) | 2530 |
| Particle shape | Spherical |

## III. EXPERIMENTAL PROCEDURE

Concrete was produced with 5, 10, and 15% of the BA as cement replacement (by weight) and sand is replaced by M-Sand with 10, 20, and 30% (by weight) with w/c ratio of 0.39. Ratio for M45 Grade as per IS 10262:2009 (1:1.48:1.90) the mixes were designated in accordance with IS: 10262-2009 [10]. Initially BA was replacement for cement (5%, 10%, 15%) and the compressive strength was found out. From the study it was found that BA with 10% replacement showed a better performance. Hence having 10% of BA as common the M-Sand % was varied with 10%, 20% and 30% for fine aggregate. The compressive strength of the same was observed for 7days and 28 days. A total of 36 cubes and 36 cylinders were casted during the experimental program. Ordinary water curing was done through the experimental study.

Table 3.Strength properties of concrete with varying percentage of Bagasse ash:

| % Replacement of (BA and MS) | Compressive strength in N/mm$^2$ | | Split Tensile Strength in N/mm$^2$ | |
|---|---|---|---|---|
| | 7 Days | 28 Days | 7 Days | 28 Days |
| Conventional concrete (CC) | 32.35 | 46.23 | 3.74 | 4.23 |
| 5% BA | 31.55 | 46.58 | 2.83 | 4.27 |
| 10% BA | 33.33 | 47.52 | 2.93 | 4.77 |
| 15% BA | 26 | 44.07 | 2.37 | 3.18 |

Table 4. Strength properties of concrete with Bagasse ash and M-Sand

| % Replacement of (BA and MS) | Compressive strength in N/mm$^2$ | | Split Tensile Strength in N/mm$^2$ | |
|---|---|---|---|---|
| | 7 Days | 28 Days | 7 Days | 28 Days |
| Conventional concrete (CC) | 32.35 | 46.23 | 3.74 | 4.23 |
| 10% BA + 10% MS | 32.65 | 51.25 | 3.67 | 4.65 |
| 10% BA + 20% MS | 34.33 | 55.4 | 3.94 | 4.93 |
| 10% BA + 30% MS | 30.6 | 48.18 | 3.2 | 4.23 |

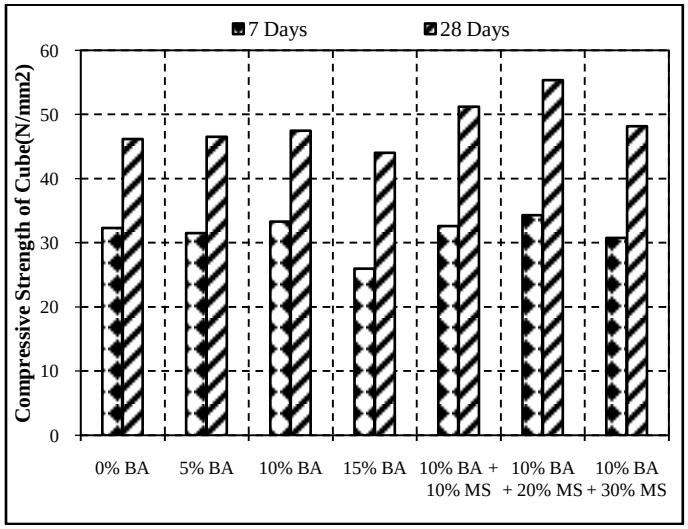


Fig 1. Comparison of Compressive Strength of Cubes on 7 and 28 Days

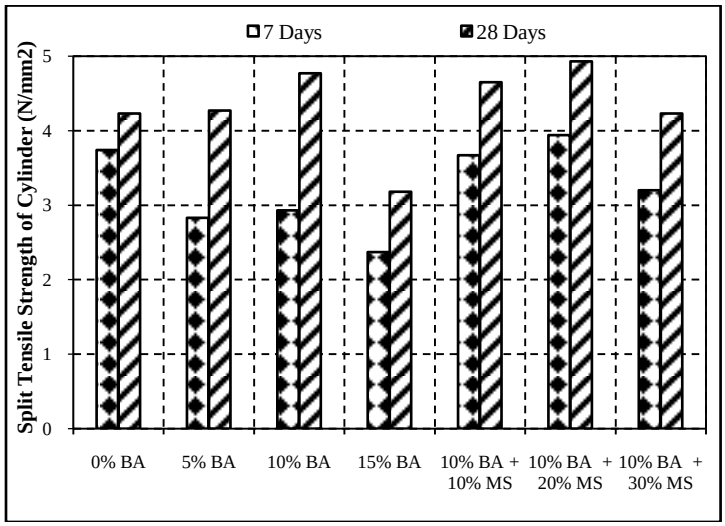


Fig 2. Comparison of Split Tensile Strength of Cylinders on 7 and 28 Days

## IV. RESULTS AND DISCUSSION

For 10% of BA and vary % of M-Sand the following result are observed.

1. The compressive strength was found to increase by 5% when M-Sand was increase from 10% to 20% and decrease by 10% beyond 20% at the end of 7 days.
2. The compressive strength was found to increase by 7.5% when M-Sand was increase from 10% to 20% and decrease by 13% beyond 20% at the end of 28 days.
3. The split tensile strength was found to increase by 7% when M-Sand was increase from 10% to 20% and decrease by 18.7% beyond 20% at the end of 7 days.

4. The split tensile strength was found to increase by 5.7% when M-Sand was increase from 10% to 20% and decrease by 14% beyond 20% at the end of 28 days.

## V. CONCLUSIONS

From the above results for 10% of BA and the combination of M-Sand following conclusion.

1. The compressive strength decrease when the M-Sand is increased beyond 20% at the end of 7 and 28 days.
2. The split tensile strength decrease when the M-Sand is increased beyond 20% at the end of 7 and 28 days.
3. Even though there is a decrease in strength parameters at the end of 28 days there is a considerable increase of compressive strength for 30% of M-Sand with 10% BA. This was comparably better than the conventional concrete obtained at the end of 28 days.

## REFERENCES

1. Amrita Kumari, Sheo Kumar, "Experimental Study on Partial Replacement of Cement by Sugaracne Bagasse Ash" International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Issue 7, July 2015.
2. Balasubramanian SV, Ratnavelu KN. Budget performance of sugar industry: 2000–2001. In: Proceeding of South India sugar mills association 2001, India.
3. BirukHailu and AbebeDinku, Application of Sugarcane Bagasse Ash as a partial cement replacement material, 1-21.
4. Ganesan, K., Rajagopal, K., & Thangavel, K. 2007. Evaluation of bagasse ash as supplementary cementitious material. Cement and Concrete Composites, 29, 515-524.
5. Hernandez JM, Middendorf B, Gehrke M, Budelmann H. Use of wastes of the sugar Industry as pozzolana in lime-pozzolana binders: study of the reaction. Cem Concr Res 1998; 28(11): 1525–36.
6. Martirena JF, Middendorf B, Gehrke M, Budelmann H, (1998) Use of wastes of sugar industry as pozzolana in lime-pozzolana binders: study of the reaction, Cement and Concrete Research, 28, pp. 1525-1536.
7. Nuntachai Chusilp1, Napongsatorn Likhitsripaiboon and Chai Jaturapitakkul, "Development of bagasse ash as a pozzolanic material in concrete" Asian Journal on Energy and Environment, 2009, 149-159.
8. Singh NB, Singh VD, Rai S, (2000) Hydration of bagasse ash-blended Portland cement, Cement and Concrete Research, 30, pp. 1485-1488.
9. Is: 12269-1987, Specification for53 grade ordinary Portland cement, B.I.S., New Delhi.
10. I.S.: 383 – 1970, Indian standard specification for coarse & fine aggregates from natural sources for concrete, B.I.S., New Delhi.
11. I.S.: 456 – 2000, Indian standard Specification for plain and reinforced concrete – code of practice. (Fourth revision), B.I.S., New Delhi.
12. IS 10262 -2009 "IS Method of Mix Design", Bureau of Indian Standards, New Delhi
13. IS 516 -1959 "Methods of Tests for strength of concrete", Bureau of Indian Standards, New Delhi