**International Journal of Engineering Inventions**
ISSN: 2278-7461, ISBN: 2319-6491
Volume 1, Issue 11 (December2012) PP: 01-04

# An Experimental study on the compressive strength of concrete by partial replacement of cement with sugarcane bagasse ash

Lavanya M.R[1], Sugumaran.B[2], Pradeep.T[3]
[1,2]Department of Civil Engineering, Dr.Mahalingam College of Engineering and Technology, Pollachi.
[3]Department of Civil Engineering, Kongu Engineering College, Perundurai.

**Abstract:--**Initiatives are emerging worldwide to strike a balance between the developments in infrastructure and prevention of the environment from contamination by reusing the industrial wastes. The feasibility of using sugarcane Bagasse Ash (SBA), a finely ground waste product from the sugarcane industry, as partial replacement for cement in conventional concrete is examined. The tests were conducted as per Bureau of Indian Standards (BIS) codes to evaluate the suitability of SBA for partial replacements up to 30% of cement with varying water cement (w/c) ratio .The physical properties of SBA were studied. Compressive strengths (7, 14 and 28 days) were determined. The results showed that the addition of sugarcane bagasse ash improves the strengths in all cases. The maximum strength increase happens at 15% with 0.35 w/c ratio.

**Keywords:–**Concrete, Compressive Strength, Replacement, Sugarcane Bagasse Ash, Water cement (w/c) ratio.

## I. INTRODUCTION

Cement is the third most energy intensive material after steel and aluminum produced in tones. Cement industry consumes raw materials rich in silica, alumina, iron and calcium. Therefore this industry has been actively involved in finding ways to use waste products in the manufacturing of cement both as secondary fuel and raw material. Sugar manufacturing is the major agro industry in India. Initiatives are emerging worldwide to control and regulate the management of sub - products, residuals, and industrial waste in order to preserve the environment from the point of view of environmental contamination as well as the preservation and care of natural areas. Recently the use of recycled materials as concrete ingredients has been gaining popularity because of increasingly stringent environmental legislation. The most conspicuous of these is sugarcane bagasse ash, a finely ground waste product from the sugarcane industry. In this study, sugarcane baggese ash (SBA) was replaced for cement in various proportions of 0%, 10%,1 5%, 20%, 25%, 30% and for various water cement ratio such as 0.35, 0.4 1nd 0.45 and its compressive strength was studied.

## II. MATERIAL PROPERTIES

The most common cement is used is ordinary Portland cement. Out of the total production, ordinary Portland cement accounts for about 80-90 percent. Many tests were conducted to cement some of them are consistency tests, setting tests, soundness tests, etc. Locally available free of debris and nearly riverbed sand is used as fine aggregate. The sand particles should also pack to give minimum void ratio, higher voids content leads to requirement of more mixing water. In the present study the sand conforms to zone II as per the Indian standards. The specific gravity of sand is 2.68. Those fractions from 4.75 mm to 150 micron are termed as fine aggregate, and the bulk density of fine aggregate (loose state) is 1393.16kg/m3 and rodded state is 1606.84kg/m3. The crushed aggregates used were 20mm nominal maximum size and are tested as per Indian standards and results are within the permissible limit. The specific gravity of coarse aggregate is 2.83. The sugarcane baggese ash are pozzolanic, rough, vascular particles whose maximum sizes can vary extensively from 50- 60 µ. The relative density of the ashes on a saturated surface dry basis range between 1.90 and 2.12. The ashes also have high absorption values of 10±12%.The chemical composition of SBA was determined by X – ray diffraction method and scanning electron microscope and were compared with the properties of Ordinary Portland Cement (OPC) since SBA was partially replaced for cement. From the Table I it is evident that SBA possesses pozzolanic properties and it can be replaced for cement.

**TABLE I** COMPOSITION OF SBA AND OPC

| Oxides | SBA | OPC |
|---|---|---|
| Sio2 | 67.81% | 20.98% |
| Al2o3 | 19.41% | 5.42% |
| Fe2o3 | 3.85% | 3.92% |
| Cao | 4.03% | 62.85% |
| Mgo | 1.11% | 1.76% |
| Na2 | 0.35% | 0.28% |
| K2o | 1.69% | 0.53% |
| So3 | 0.66% | 2.36% |
| Loss in ignition | 1.09% | 1.9% |

**TABLE III** PHYSICAL PROPERTIES OF COARSE AND FINE AGGREGATE

| Properties | Coarse aggregate | Fine aggregates |
|---|---|---|
| Specific Gravity | 2.67 | 2.66 |
| Fineness Modulus | 6.86 | 2.32 |
| Bulk Density(Kg/m3) | 1540 | 1780 |

## III. PREPARATION OF SAMPLES

In this study totally 162 cubes were casted by replacing cement with SBA replaced by 0%, 10%, 15%, 20%, 25% and 30% for three different water cement ratios. For each water cement ratio and replacements 3 cubes were caste and its average compressive strength is tabulated for 7, 14 and 28 days. All the materials used were batched by weight proportions. Concrete were mixed in a 2cft ($0.06m^3$) capacity drum type mixer in the laboratory. Before starting mixer machine the mixer drum was fully washed using portable water and allowed to dry for 5 minutes The coarse aggregate together with 40% of the total calculated water were placed first in the mixer machine and allowed to mix for a minute. The river sand and 30% water was added with the coarse aggregate and the mixing was continued for 2 minutes. Finally cement, SBA and remaining water was added and mixing continued until the concrete gets homogeneous. The same procedure was followed for various mixes. 150 mm cube moulds were used to cast the specimen and a vibrating table was employed to compact the concrete. Immediately after casting the specimens were covered with plastic sheets for 24Hrs to prevent the evaporation of water from the concrete. They were demolded after 24hrs and cured in water under ambient temperature until they were tested.

## IV. TEST RESULTS

Determination of compressive strength of concrete is very important, because the compressive strength is a criteria of concrete quality. This strength will help us to arrive the optimal proportion for replacement. The compressive strength was performed according to IS:516-1959.The compressive strength for 7 day, 14 day and 28 day of various mixes with three w/c ratio (0.35,0.40,0.45) were determined and given in tables below.

**TABLE IIIII** COMPRESSIVE STRENGTH AT 7 DAYS

| Replacement in % / W/C ratio | 0 | 10 | 15 | 20 | 25 | 30 |
|---|---|---|---|---|---|---|
| 0.35 | 16.81 | 16.38 | 18.72 | 13.33 | 10.82 | 9.05 |
| 0.40 | 14.87 | 14.17 | 16.06 | 10.19 | 9.78 | 7.45 |
| 0.45 | 14.02 | 13.68 | 12.85 | 9.82 | 8.72 | 6.77 |

**TABLE IV** COMPRESSIVE STRENGTH AT 14 DAYS

| Replacement in % / W/C ratio | 0 | 10 | 15 | 20 | 25 | 30 |
|---|---|---|---|---|---|---|
| 0.35 | 25.4 | 23.92 | 26.24 | 22.26 | 17.58 | 12.06 |
| 0.40 | 19.09 | 18.63 | 18.99 | 14.66 | 15.25 | 9.34 |
| 0.45 | 18.61 | 17.58 | 15.74 | 12.58 | 12.34 | 8.51 |

**TABLE V** COMPRESSIVE STRENGTH AT 28 DAYS

| Replacement in % / W/C ratio | 0 | 10 | 15 | 20 | 25 | 30 |
|---|---|---|---|---|---|---|
| 0.35 | 33.8 | 32.46 | 34.21 | 28.06 | 25.25 | 15.02 |
| 0.40 | 26.99 | 27.05 | 29.74 | 21.71 | 19.75 | 11.40 |
| 0.45 | 24 | 23.85 | 22.85 | 17.56 | 17.58 | 10.04 |

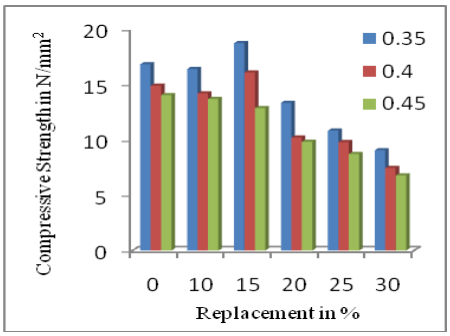


**FIGURE 1** COMPRESSIVE STRENGTH AT 7 DAYS FOR THREE DIFFERENT WATER-CEMENT RATIO

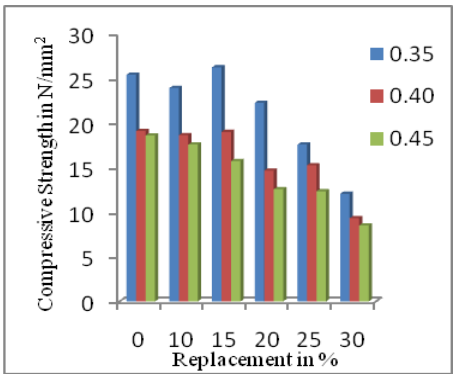


**FIGURE 2** COMPRESSIVE STRENGTH AT 14 DAYS FOR THREE DIFFERENT WATER-CEMENT RATIO

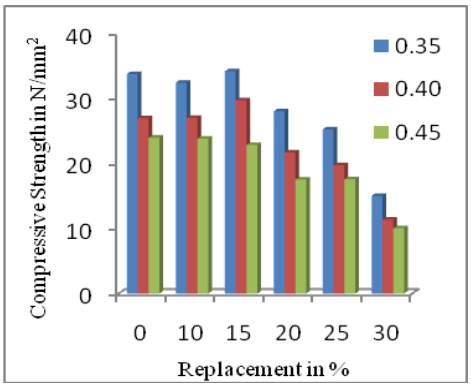


**FIGURE 3** COMPRESSIVE STRENGTH AT 28 DAYS FOR THREE DIFFERENT WATER-CEMENT RATIO

By comparing the above results, the 28 day compressive strength of conventional concrete of w/c ratio 0.35 was found to be 33.8 $N/mm^2$. For the same w/c ratio with 10 %replacement of cement with SBA the compressive strength decreases to 32.46 $N/mm^2$ and at 15% replacement the compressive strength increases to 34.21 $N/mm^2$ which is higher than value of conventional concrete. Further increase in replacement causes decrease in compressive strength of concrete.

## V. CONCLUSION

Based on the conducted experiment and according to the results obtained, it can be concluded that: Bagasse ash can increase the overall strength of the concrete when used up to a 15% cement replacement level with w/c ratio of 0.35.Bagasse ash is a valuable pozzolanic material and it can potentially be used as a partial replacement for cement. This could reduce the environmental problems and minimize the requirement of land fill area to dispose SBA.

## REFERENCES


**1)** Cook, D.J. Swamy, R.N. 1986.Concrete technology and Cement replacement materials. Blackie & SonLtd, London,

**2)** Ghavami, K., ToledoFilho, R.D.,Barbosa, N.P. "Behaviour of composite soil reinforced with natural fibres" Cement and Concrete Composites,1999.

**3)** Ganesan, K., Rajagopal, K., & Thangavel, K. "Evaluation of bagasse ash as supplementary cementitious material" Cement and Concrete Composites, 2007.

**4)** Payá,J.,et. al.,"Sugarcane bagasse ash (SCBA): studies on its properties for reusing in concrete production", Journal of Chemical technology and Biotechnology,2002.

**5)** IS 383 -1970 "Specifications for Coarse and Fine Aggregates from Natural Sources for Concrete", Bureau of Indian Standards, New Delhi.

**6)** IS 516 -1959 "Methods of Tests for strength of concrete", Bureau of Indian Standards, New Delhi