

Studies on Partial Replacement of Cement by Bagasse Ash in Concrete

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Abstract: This paper carried out partial replacement of cement by bagasse ash in order to reduce industrial waste and to save cement and by saving cement reduced greenhouse gases emission and makes environmental green. The waste product sugarcane bagasse ash is already causing serious environmental problems. The effective use of these waste products is challenging task for researcher through environmental impact. Bagasse is often used as a primary fuel source for sugar mills; when burned in quantity, it produces sufficient heat energy to supply all the needs of a typical sugar mill, with energy to spare.

Bagasse ash partially replaced in the ratio of 0%, 5%, 10%, 15% and 20% by weight of cement in four different experiment to find out maximum compressive strength and compare it with the strength of normal concrete by using grade M-30 at 7 days and 28 days.

Keywords: Bagasse ash, ordinary Portland cement, concrete, compressive strength.

1. INTRODUCTION

For each ten tonnes of sugarcane crushed, a sugar factory produces nearly three tonnes wet bagasse ash. Bagasse ash is residue obtained from burning of bagasse in sugar producing factory. When bagasse waste is burned under the controlled manner. It also gives ash having amorphous silica, which has pozzolanic properties. The combustion yields ashes containing high amounts of unburned matter like silica and alumina oxides. Sugarcane bagasse ash use as cement replacement material to improve quality and reduce the cost of concrete pavers, soil cement interlocking block.

India alone generates approximately 90 million of bagasse as a solid waste from the sugarcane industry. Disposal of solid waste generated from industrial production activity is the other serious problem. The accumulation of wastes is not only a burden to the industry, but also affects the environment adversely. In this experimental study we have to analyses the effects of bagasse ash in concrete by partial replacement of cement at ratio of 0%, 5%, 10%, 15% and 20% The main components of concrete is bagasse ash, ordinary Portland cement, fine aggregate, coarse aggregate. After prepare concrete mould were casted and subsequently all specimen were cured in water for 28 days.

2. MATERIALS

Cement:

Cement used in the experimental work is ordinary Portland cement conforming to I.S 4031-1988.

Table1:-Physical properties of cement

| S.NO | CHARACTERSTICS | TEST RESULT | STANDARD RESULT(as per IS CODE) |
|------|----------------------|---------------------|-----------------------------------|
| 1 | Consistency | 35% | 30% |
| 2 | Initial Setting Time | 95 min | Not less than 30 min |
| 3 | Final Setting time | 310 min | Not more than 600 min |
| 4 | Specific Gravity | 3.156 | 3.15 |
| 5 | Fineness Modulus | 6% | Not more than 10% |
| 6 | Compressive Strength | 45N/mm ² | Not less than 43N/mm ² |

Bagasse Ash:

Bagasse ash is obtained from new India sugar factory in Kushinagar district in Uttar Pradesh. The high moisture content of bagasse, typically forty to fifty percent, is detrimental to its use as a fuel. In general, bagasse is stored prior to further processing. This material contains amorphous silica which is indication of cementing properties.

a)- Colour- Black

b) - Specific Gravity- 1.306

Table2:- Chemical composition of Bagasse Ash.

| Sr. No | Description of properties | Percentage (%) |
|--------|---------------------------|----------------|
| 1. | Silica | 65.43 |
| 2. | Magnesium | 0.7 53 |
| 3. | Calcium | 10.6 |
| 4. | Iron | 4.58 |
| 5. | Sodium | 1.07 |
| 6. | Potassium | 3.56 |
| 7. | Alumina | 11.47 |

Fine aggregate:

Fine aggregate was purchased which satisfied the required properties of fine aggregate required for experimental work and the sand conforms to zone II as per the specifications of IS 383:1970.

a) Specific gravity = 2.63

b) Fineness modulus = 2.84

(c) Silt content=2.63

Coarse aggregate:

The crushed aggregates used were 20mm nominal maximum size. The sieve analysis of combined aggregates confirms to the specifications of IS 383: 1970 for graded aggregates.

a) Specific gravity =2.71

b) Fineness Modulus = 6.814

Water:

Mixing water should not contain undesirable organic substances or inorganic constituents in excessive proportions. In this project clean potable water is used.

Mix design for M-30 Grade Concrete:

Characteristic Compressive Strength required at the end of 28 days: 30 N/mm²

Maximum size of Aggregate: 20mm

Type of Exposure: Severe

Test Data for Materials:

Specific Gravity of Cement: 3.157

Specific Gravity of Coarse Aggregate: 2.70

Specific Gravity of Fine Aggregate: 2.62

Target Mean Strength of Concrete:

For a tolerance factor of 1.65, the obtained target mean strength for the given grade of concrete

$$= 30 + 5 \times 1.65 = 38.25 \text{ N/mm}^2$$

Table 1:-The mix proportion then becomes

| | | | |
|-------|--------|------------------|----------------|
| water | cement | coarse aggregate | fine aggregate |
| 186 | 413 | 1117 | 706 |

Mixing Proportion:

The mixture proportioning was done according the Indian Standard Recommended Method IS 10262:2009. The target mean strength was 38.25MPa for OPC control mixture, the total binder content 413kg/m³, fine aggregate is taken 706kg/m³ coarse aggregate is taken 1117kg/m³ the water to cement ratio was kept constant 0.45.

Hence cement was replaced by bagasse ash at various percentage of replacement 0%, 5%, 10%, 15%, 20% and 25% by weight of cement and 150x150x150mm cube casting.

Table 2:-The results of the compressive strength of bagasse ash Concrete

| | Age (days) | Control concrete | Percentage Replacement with bagasse ash | | | |
|------------------------------------------------|------------|------------------|-----------------------------------------|-------|-------|-------|
| | | | 5% | 10% | 15% | 20% |
| Average Compressive strength N/mm ² | 7 | 13.80 | 15.84 | 12.65 | 9.70 | 8.40 |
| | 28 | 21.47 | 30.12 | 25.54 | 20.17 | 19.86 |

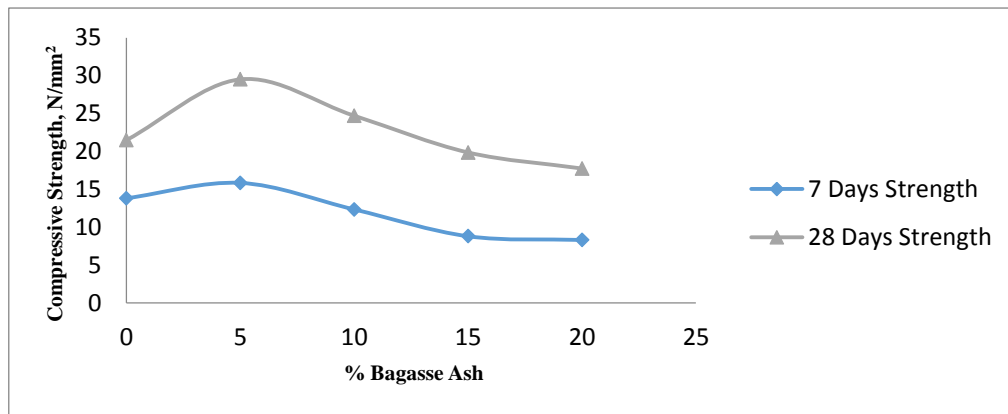


Figure 1:-Percentage of Bagasse Ash v/s Compressive strength

3. CONCLUSIONS

It is found that the cement could be advantageous replaced with bagasse up to maximum limit of 10%.

Replacement of cement by bagasse ash reduce industrial waste and to save cement. By saving cement reduced greenhouse gases emission and makes environmental green.

OPC replacement by bagasse ash results in reduction of cost of production of concrete in the range of 5 to 10%.

Using bagasse as replacement of OPC in concrete, the emission of greenhouse gases can be reduced up to a greater extent.

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