EXPERIMENTAL TESTING ON CONCRETE BY PARTIAL REPLACEMENT OF CEMENT USING BAGASSE ASH

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ABSTRACT

Over 300 million tons of industrial wastes are being produced per annum by chemical and agricultural process in India. These materials pose problems of disposal and health hazards. The wastes like phosphogypsum, fluorogypsum and red mud contain obnoxious impurities which adversely affect the strength and other properties of building materials based on them. Out of several wastes being produced at present, the use of phosphogypsum, fluorogypsum, lime sludge, Bagasse ash, red mud, and mine tailing is of paramount significance to protect the environment. To produce low cost concrete by blending various ratios of cement with Bagasse ash & to reduce disposal and pollution problems due to Bagasse ash it is most essential to develop profitable building materials from Bagasse ash.

The cement has been replaced by waste Bagasse ash accordingly in the range of 0% (without Bagasse ash), 5%, 10%, 20% & 30% by weight for M-25 mix. To increases the usage of waste product for the purpose of commercial work. To control the adverse effect of pollution because of disposal of waste (Bagasse ash). To reduce the economic cost of Construction, because usage of raw wastage from the sugar industry.

Keywords: Bagasse ash, mine tailing, lime sludge, plastic aggregate, red mud, partial replacement, volumetric substitution, grade substitution.

1. INTRODUCTION

Ordinary Portland cement is the most extensively used construction material in the world. Since the early 1980's, there has been an enormous demand for the mineral admixture and in future this demand is expected to increase even more. Also in this modern age every structure has its own intended purpose and hence to meet this purpose modification in traditional cement concrete has become essential. This situation has led to the extensive research on concrete resulting in mineral admixture to be partly used as cement replacement to increase workability in most structural application. If some of raw material having similar composition can be replaced by weight of cement in concrete then cost could be reduced without affecting its quality. A few studies have been carried out on the ashes obtained directly from the industries to study pozzolanic activity and their suitability as binders, partially replacing cement.

The present study was carried out on SCBA obtained by controlled combustion of sugarcane bagasse, which was procured from the Maharashtra in India. Sugarcane production in India is over 300 million tons/year leaving about 10 million tons of as unutilized and, hence, wastes material. This paper analyses the effect of SCBA in concrete by partial replacement of cement at the ratio of 0%, 10%, 20%, and 30% by volume. The main ingredients consist of Portland cement, SCBA, crushed sand, coarse aggregate and water. After mixing, concrete specimens were casted and subsequently all test specimens were cured in water at 7, 14 and 28 Days.

1.1 Definition of Bagasse Ash

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 (SiO_2). 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.

Why The Bagasse Ash:- Bagasse ash **behaves like cement** because of **silica and magnesium properties**. This silica and magnesium improve the setting of the concrete.

- While producing sugar the various wastes are comes out from the various processes in sugar industries. From the preliminary waste named as Bagasse ash, due to its low calcium is taken out for our project to replace the cement utilization in concrete.

- For producing 4 million tons of cement, 1 million tones greenhouse gases are emitted. Also, to reduce the environmental degradation, this sludge has been avoided in mass level disposal in land.
- To eliminate the ozone layer depletion, production of cement becomes reduced. For this, the Bagasse ash is used as partial replacement in the concrete as high performance concrete.
- By utilizing this waste the strength will be increased and also cost reduction in the concrete is achieved.

1.2 Objectives

a) To investigate the utilization of Bagasse ash as Supplementary Cementitious Materials (SCM) Influence of these Bagasse ash on the Strength on concretes made with different Cement replacement levels.

b) To produce low cost concrete as various ratio aspect as cement with Bagasse ash.

c) To increases the usage of waste product for the purpose of commercial work.

d) To control the adverse effect of pollution because of disposal of waste (Bagasse ash).

e) To reduce the economic cost of Construction, because usage of raw wastage from the sugar industry.

1.3 Scope

a) To provide a most economical concrete and easily adopted in field.

b) Using the wastes in useful manner.

c) To reduce the cost of the construction.

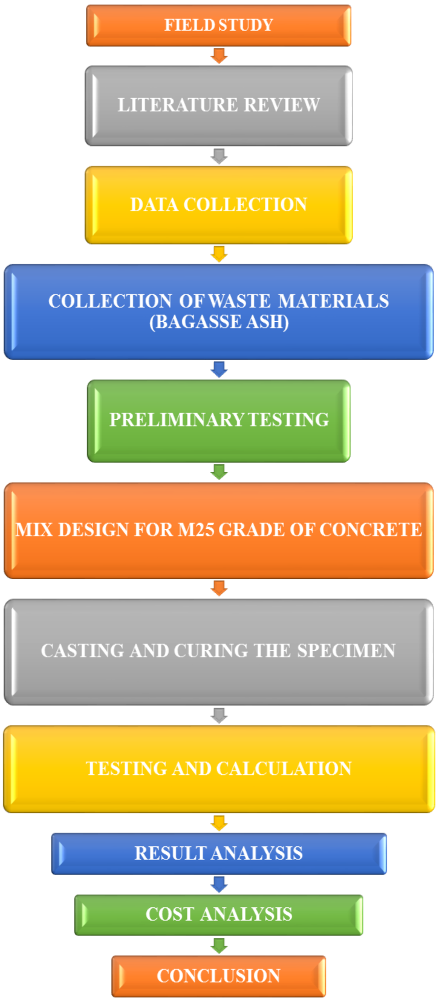
d) To find the optimum strength of the partial replacement of concrete.

e) Minimize the maximum degradation in environment due to cement and demand for cement.

f) To decrease the ozone layer depletion from greenhouse gases.

g) To decrease the usage of natural minerals for Producing of Cement.

2. METHODOLOGY



2.1 Material

a) Cement b) coarse aggregate c) Fine aggregate (sand), d) Bagasse Ash (Cement Replacement ash). e) Water.

a) Cement: - Ordinary Portland Cement of 43-grade was used as it satisfied the requirements of IS: 269- 1969 and results have been tabulated in table.

Table.1: Properties of cement

Sl. No	Details of test performed	Results
1	Standard consistency	32%
2	Setting time	
	a) Initial setting time	30 minutes
	b) Final setting time	600 minutes
3	Specific gravity	3.15
4	Fineness test	95%

b) Coarse Aggregate: - coarse aggregate shall comply with the requirement of IS 383 as for as possible crushed Aggregate shall be used for ensuring adequate durability. The aggregate used for production of block shall be Sound and free from soft and honeycombed particle the nominal maxi size of coarse aggregate used in Production of paver block shall be 10 mm.

Table. 2: Physical properties of Coarse aggregate

Sl. No	**Details of test performed**	**Results**
1	Type	Crushed 20 mm size
2	Specific gravity	2.75
3	Impact value	8.08%

c) Fine aggregate:- Fine aggregate shall conform to requirement of IS 383 For river sand

Table. 3: Physical properties of Fine aggregate

Sl. No	**Details of test performed**	**Results**
1	Specific gravity	2.65
2	Uniformly coefficient	2.56
3	Density	1.83 g/cc
4	Bulking factor	1.48%

d) Water: - The water used for mixing concrete mix should be potable drinking water having PH 6 TO 8.

Table. 4: As per design M25 Grade Material Requirement for 1 M3

Material	**Quantity in kg**
Cement	442.85
Coarse aggregate	603
Fine aggrigate	1145
water	186

e) Baggase ash: - Where, this Bagasse ash contains, low calcium and maximum calcium chloride and minimum amount of silica. Bagasse ash behaves like cement because of silica and magnesium properties.

Table. 5: Physical properties of Bagasse ash

Sl. No	**Details of test performed**	**Results**
1	Specific gravity	4.36
2	Fineness test	85%

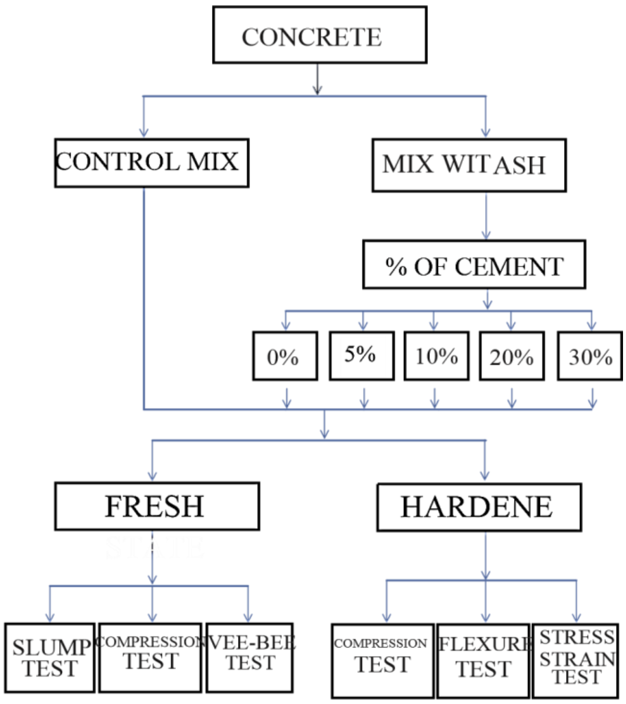


Table. 6: chemical properties of Bagasse ash

Sl. No	**Constituent**	**Present in Bagasse ash, [%]**
1.	Magnesium oxide (MgO)	6.491
2.	Calcium oxide (CaO)	9.968
3.	Loss on ignescent	4.233
4.	Silica (SiO2)	72.853
5.	Alumina	1.077

2.2 Design Mix

As per design mix M25 grade given table shows the quantity of material for this reference to take the material quantity for 1 Nos cube each proportion material required.

Table. 7: Comparisons of Cement and Bagasse ash

Sl. No	**Constituent**	**Cement[%]**	**Bagasse ash [%]**
1	Lime (CaO)	62	9.968
2	Silica (SiO_2)	22	72.853
3	Alumina	5	1.077
4	Magnesium	1	6.491
5	Calcium sulphate	4	-

2.2.1 IS Mix Design

Degree of quality control = very good (k=1.65).
Type of cement = OPC (Cettinadu cement)
Type of aggregate = 20 mm max size of crushed granite.
Type of fine aggregate = River sand.

Specific gravity:

Cement = 3.15
Coarse Aggregate = 2.70
Fine Aggregate = 2.64
Bagasse ash =

Design steps

1. Target mean strength.
   f'ck = fck+1.65x4
   = 25+1.65x4
   = 31.6 N/mm²

2. Water ratio.
   W/C = **0.42**

3. Water content.
   Max water content for 20 mm aggregate = **186 kg**

4. Cement content.

$$C = \frac{\text{Water content}}{\text{w/c ratio}}$$

= 186/0.45
= **442.85 kg**

5. Correct volume of concrete.
   = Volume of concrete – Air content
   V = 1 – 0.02
   = **0.98 m³**

6. Mix calculation
   a) Volume of concrete = **1 m³**

   b) Volume of cement = $\frac{\text{Mass of cement}}{\text{S.gravity of cement}} \times \frac{1}{1000}$

   = 0.1405 m³

   c) Volume of water = $\frac{\text{Mass of water}}{\text{S.gravity of water}} \times \frac{1}{100}$

   = 0.186 m³

   d) Volume of all in aggregate= a-[b+c]
   =1-[0.1405+0.186]
   d = 0.6735 m³

   e) Volume of mass of Coarse Aggregate
   $V = [W + (C/Sc) + (c_a/(1\text{-}q).S_{ca})] \times [1/1000]$
   $0.98 = [186 + (442.85/3.15) + (c_a/([1\text{-}0.35] \times 2.70)] \times [1/1000]$
   = 1146.72 kg/m³

   f) Volume of mass of Fine Aggregate
   V = [W + (C/Sc) + (fa/q.Sfa)] x [1/1000]
   0.98 = [186 + (442.85/3.15) + (fa/(0.35 x 2.70)] x [1/1000]
   = 603.74 kg/m ³

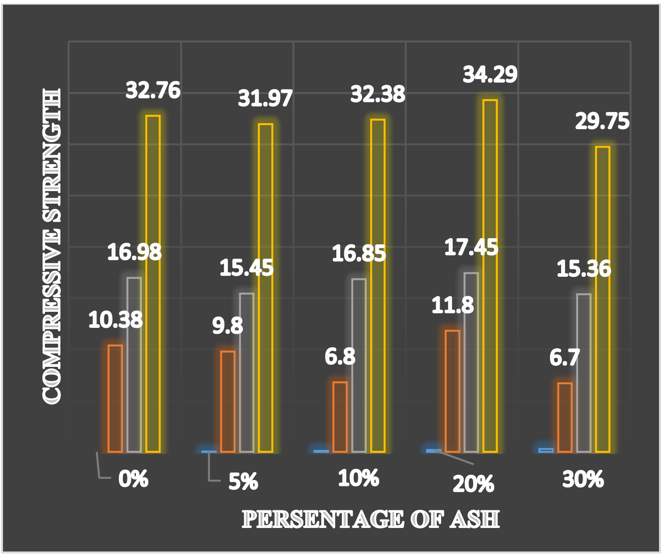
Table. 7: Material proportion in weight batching (All weight in Kg)

Material	**0%**	**5%**	**10%**	**20%**	**30%**
Cement	1.49	1.47	1.45	1.41	1.33
Fine aggregate	2.03	2.03	2.03	2.03	2.03
Coarse aggregate	3.87	3.87	3.87	3.87	3.87
Water(lit)	0.57	0.57	0.57	0.57	0.57

After the casting the cube remove from the mould after 24hrs and then put the curing tank for curing of 14 days and 28 days after the curing completed .remove from curing tank and dry to normal atmosphere atlest 2hrs for the surface dry then to check it for compression testing machine get the result.

Table. 8: Comparison of Compressive Strength

Days / Persentage	**Ultimate Compressive strength, [N/mm ²]**		
	7days	**14 days**	**28 days**
0 %	10.38	16.98	32.76
5%	9.80	15.45	31.97
10%	6.80	16.85	32.38
20%	11.80	17.45	34.29
30%	6.70	15.36	29.75



In above investigation it is found that the optimum replacement of Baggase ash was 10% to 20% by volume of cement from the test result it was observed that the compressive strength of concrete mix satisfy the I.S.456-2000Table no.11 (Clauses 16.1 Md 16.3) acceptance criteria comparison of concrete.

4. CONCLUSION

Concrete is the most widely used manmade construction material. It is obtained by mixing cement, water and aggregates (and sometimes admixtures) in required proportion. The mixture when placed in form and allowed to cure becomes hard like stone.

Following conclusion were arrived within the scope of present investigation.

- The physical properties of higher grade ordinary Portland cement (cettinadu cement-43 grade) are satisfied Indian standard code requirements.
- The property of concrete at fresh stage the workability such as the slump value was maintained and the vee-bee consistency was slightly reduced. So, addition of admixture to increase the workability of fresh concrete.
- For M25 grade of concrete using Bagasse ash with 0% reduced in cement content. It was found that the compressive strength of concrete on 7 days, 14 days, and 28 days.
- For `M25 grade of concrete using Bagasse ash with 5% to 45% reduced in cement content it was found that the compressive strength of concrete on 7 days, 14 days, and 28 days are moderately increased as compare with control mix.

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