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Review on bagasse ash an effective replacement in fly ash bricks

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Abstract - *This paper deals with use of sugarcane bagasse ash as brick material. Sugar-cane bagasse is a fibrous waste-product obtained after crushing and burning of waste, along with ethanol vapor. Recycling of sugarcane bagasse ash waste as a method to provide raw material for clay brick bodies, through replacement of natural clay by up 20wt%. In this paper, bagasse ash as an effective replacement in fly ash bricks with different proportions of 10%, 20%, 30%, 40%, 50%, 60%, 70% and 80% with replacement of fly ash. These bricks were tested in compression and water absorption test as per Indian standards. The aim of this research is to make economic and eco-friendly brick and to avoid problem of ash disposal.*

Key Words: Bagasse ash, Recycling, Eco-friendly, Proportion, Economic

1. INTRODUCTION

The research on bagasse ash an effective replacement in fly ash bricks was made earlier by Apurva kulkarni[1]. In that paper, bricks were tested with proportions of 0% to 60% replacement in fly ash and 0% to 20% replacement in lime. But in this paper we are going to do an review with additional percentage of 70 and 80 with different proportion of constituent materials. Due to the limited availability of natural resources and degradation there is a shortfall of building construction material. Bagasse ash brick can be economic in construction work and its eco-friendly doesn't produce any harm full things. It can be consider as a greener material.

1.1 Bagasse ash

Sugar cane waste is subjected to heat under the boiler at maximum temperature to produce an ash, such ash known as Bagasse ash. It contains lots of fibrous content in it.

The dry pulpy residue left after the extraction of juice from sugarcane. It is used in the boiler for the heating process and bricks used as construction material. Similar kind of bagasse ash is agave bagasse which contains similar residue after the extraction process.

It is generally stored so that it can be use full in the removal of short fibers for the process of paper manufacturing and then to remove remaining sugar in it.

Bagasse ash must contains this type of chemicals in it based on the analysis:

- Cellulose 45-55%
- Hemi cellulose 20-25%
- Lignin 18-24%
- Ash 1-4%
- Waxes <1%

1.2 Acetylene carbide lime

Carbide lime is obtained as a by-product in the generation of acetylene gas as according to the chemical formula below. It is also known as high quality hydrated lime slurry.

$$CaC_2 + 2H_20 \rightarrow C_2H_2 + Ca(OH)_2$$

It is produced as 10% solids slurry and is stored in tanks, where the excess water is decanted to increase the solids content to the 30-40% range for distribution in 5000 gallon tank trucks.

Carbide lime used for more years, especially in construction work its used as a binding material. In village side mostly used for house works. Then in purifying process like leather, chemicals in waste water treatment and other applications. The calcium hydroxide content of the dry solids is in the 90% range.

Gilmour & company has been handling and marketing the product since 1969 as a 12successfull alternative to more expensive commercial hydrated lime slurries. The solids content of carbide lime will vary (averages around 30-35% solids) with each truck load. However, this variability is accounted for in our weighing and billing procedures.

Lime slurry can be easily stored in mild steel tanks. Agitation can be accomplished with a slow speed mechanical agitator, pump recirculation, air, etc. Lime slurry with a density of 35% solids will weigh approximately 10.3 pounds per gallon and contain 3.6pounds dry solids per gallon.

1.3 Class F-fly ash:

Class F- fly ash is pozzolanic in nature, and contains less than 20% lime (CaO). Possessing pozzolanic properties, the glassy silica and alumina of Class F fly ash requires a cementing agent, such as Portland cement, quicklime, or hydrated lime, with the presence of water in order to react and produce cementations compounds.

1.4 Quarry Dust:

Stone, rock, aggregate, sand, gravel or slate is a natural resources obtained in a quarry which has been excavated from the ground. At the same time minerals also extracted in this manner. Open pit excavation and dimension stones are commonly referred to as quarries. Its only a slight difference between them two.

Quarry dust is a waste product produced during the crushing process which is used to extract stone. In quarry rocks are subject to explode, such a case rocks broken into small parts such as stone, aggregate and sand etc... It is like sand but mostly grey in color. It is mineral particles. The density of Quarry dust is 1650 kg/m^3.

It is a waste obtained during quarrying process. It has very recently gained good attention to be used as an effective filter material instead of fine aggregate. In the present study, the hardened and durable properties of bricks were investigated.

1.5 Water:

Water is an important ingredient of brick as it actually used for manufacturing of brick. Since it helps to bind all the raw materials for giving proper mix. Water used for making brick should be free from impurities.

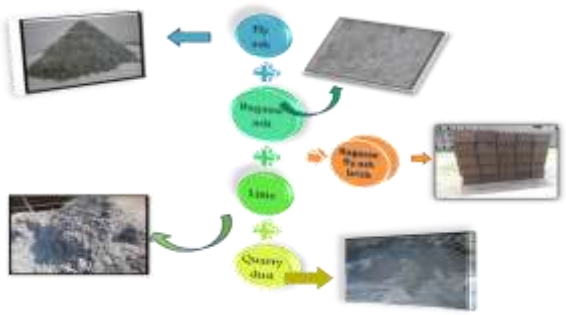

Fig -1: Materials used

2. MATERIAL COST AND COLLECTED AREA

2.1 Material cost:

Bagasse ash - Rs.0.33 / Kg
Fly ash - Rs. 0.76 / Kg
Lime - Rs. 1.5 / Kg
Quarry dust - Rs. 0.84 / Kg

2.2 Collected Area:

Bagasse ash – Vellore Co-op sugarmill, Thiruvalam
Fly ash - Prakash fly ash brick company, Walajapet
Lime - Lime dealer, Arcot
Quarry dust- Prakash fly ash brick, Walajapet.

3. MIX DESIGN

The mix design was prepared with various proportions as shown in the **table1**. In this project we have taken 9samples with different proportions whereas the fly ash is effectively replaced from 80% to 0% and Bagasse ash is introduced from 10% to 80% at the final trial. In all the sample lime & quarry dust 10% is constant. Lime is used as a bonding agent instead of cement in this project. From the mix design we have to observe that what is the optimum percentage of Bagasse ash and then properties of the brick to be checked with each proportion.

Table -1: Effective replacement of Fly ash by bagasse ash

S.No	Sample	Fly ash(%)	Bagasse ash(%)	Lime(%)	Quarry dust(%)
1	Std	50	10	20	20
2	S1	70	10	10	10
3	S2	60	20	10	10
4	S3	50	30	10	10
5	S4	40	40	10	10
6	S5	30	50	10	10
7	S6	20	60	10	10
8	S7	10	70	10	10
9	S8	0	80	10	10

4. EXPERIMENTAL METHEDOLOGY

4.1 Manufacturing process

The manufacturing process consists of 4 different types of procedure. They are,

- Batching
- Mixing
- Handling & pressing of the mix
- Curing

4.2 Tests for bricks

Compression test is to determine the compressive strength (crushing strength) of bricks. It can be find using the formula,

$$\text{Compressive strength} = \frac{\text{Maximum load at failure (N)}}{\text{Average area of bed face (mm}^2\text{)}}$$

Water absorption test is to check the quality of brick by observing the percentage of water it absorbs. The test has carried out based on IS: 3495 (Part-2)-1992. The apparatus used are balance (0-10kg) to weigh the brick.

$$\text{Water absorption} = \frac{W2 - W_1}{W_1} \times 100$$

5. RESULTS AND DISCUSSION

5.1 Compressive strength results

The table shows the compressive strength results which have the sample symbols, weight, density and compressive strength. From the result we have find that Sample (S1) which has bagasse ash content 10% have greater compressive strength compared to other samples. It clearly shows that decrease in powder content (ash) increases the compressive strength.

Table -2: Results for compression test

S.No	Sample	Weight (kg)	Density (kg/m³)	Compressive strength (MPa)
1	Std	4.46	2203	7.33
2	S1	4.38	2164.03	8.98
3	S2	4.19	2070	8.86
4	S3	4.00	1976	7.52
5	S4	3.87	1912	7.02
6	S5	3.04	1502	6.21
7	S6	2.98	1472	6.13
8	S7	2.93	1447.6	2.37
9	S8	2.86	1413	NA

Maximum compressive strength = 8.98 N/mm²

5.2 Water absorption results

The table shows the compressive strength results. It contains dry weight, wet weight, density and water absorption ratio. From the result we have found that water absorption ratio is not exceeding 20%. The result observed that it is between 8-12%.

Table -3: Results for Water absorption test

S.no	Sample	Dry wt(Kg)	Wet wt (Kg)	Density (kg/m³)	Water absorption ratio (%)
1	Std	4.46	4.53	2164	15.7
2	S1	4.38	4.45	2100	16
3	S2	4.19	4.33	1922	3
4	S3	4.00	4.14	1759	3.5
5	S4	3.87	3.96	1640	2.32
6	S4	3.04	3.42	1502	12.6
7	S6	2.98	3.27	1472	10
8	S7	2.93	3.16	1448	8
9	S8	2.86	3.15	1413	10.2

Maximum water absorption = 16%

5.3 Comparison between normal brick and bagasse ash bricks

The table shows the difference between the clay bricks (normal bricks) and the bagasse ash bricks. From that we have observed that it,

- Reduction in number of bricks per cum
- The density of brick is minimized
- The brick was economic
- The compressive strength is more compared to normal bricks
- Water absorption is also reduced less than 20% only. So the property of brick is increased, it tends to increase in the strength.

Table -4: Difference between normal brick and bagasse ash brick

S.NO	Description	Clay bricks	Bagasse ash bricks
1	Size	210x 100 x 70	230 x 100 x 80
2	Volume (cm³)	1470	1840
3	Bricks in cum masonry	680	543
4	Density	2380	1922
5	Cost (Rs)	4000 / 1000	3420/1000
6	Compressive strength	3.5 N/mm²	8.86 N/mm²
7	Water absorption	20 – 25%	Less than 20 %

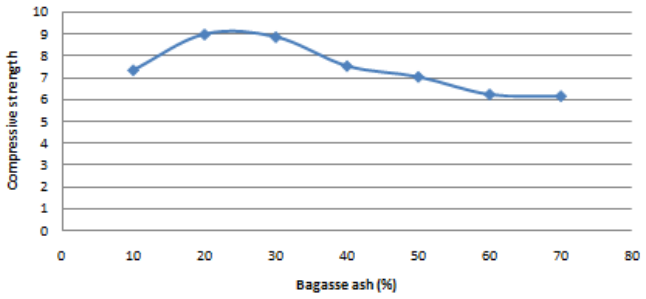

Chart -1: Compressive strength result

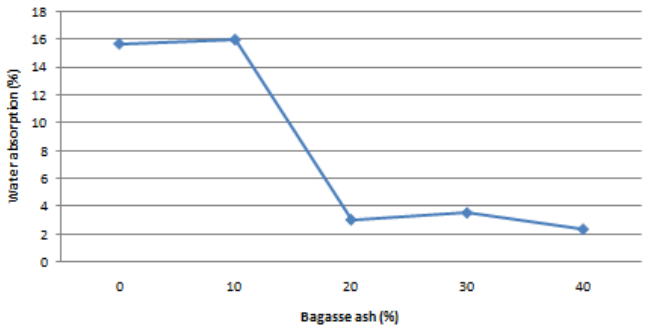

Chart -2: Water absorption result

6. CONCLUSIONS

In this experiment, the bagasse ash is partially introduced in fly ash bricks and various tests have been carried out to determine the strength of the brick. From the observation after weighing different bricks, the 10% of Bagasse ash attains the maximum strength, when compared to 80% and 90%. Also it is found the 60% of Bagasse ash in fly ash brick attains slight crack which is clearly indicated in the snapshot below and further sample like 70%, 80%, 90% of Bagasse ash in fly ash brick undergoes collapse formation which is shown in further snapshots.

Up to 50% addition of Bagasse ash there is no crack formation and has a great bonding in it. Further little addition of bagasse ash starts the formation of crack and improper bonding in the material which is shown in the snapshot. Even though it is well handled & pressed in the machine, it does not possess such binding property. It starts to bulge from the original volume. There will be a change in volume from the original volume at the addition of 70%.

In the addition of 80% it clearly shows that there is no bonding in the mix and at the time of casting itself it starts to collapse and failure. From that we have observed that more addition of powder content leads to failure and they will not sufficient strength. From the experiment we have noted that decrease in Bagasse ash increase the strength of the fly ash brick.

Fig -2:Crack formation during casting (60%)

Fig -3: After casting(60%) **Fig -4**: Crumbles after lifting

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