Bagasse Ash As An Effective Replacement In Fly Ash Bricks

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***Abstract*- Utilization of industrial and agricultural waste products in the industry has been the focus of research for economic, environmental, and technical reasons. Sugar-cane bagasse is a fibrous waste-product of the sugar refining industry, along with ethanol vapor. Huge quantity of ash which is a waste product, available at very negligible rate. It causes the chronic lung condition pulmonary fibrosis more specifically referred to as bagassios. In this paper, Bagasse ash can be utilized by replacing it with fly ash and lime in fly ash bricks. Trial bricks of size (230x100x75) mm were tested with different proportions of 0%, 10%, 20%, 30%, 40%, 50% and 60% with replacement of fly ash and 0%, 5%, 10%, 15% and 20% with replacement of lime. These bricks were tested in Compression test and Water absorption test as per Indian Standards. The aim of this research was to make economical and green bricks to maintain environmental balance, and avoid problem of ash disposal.**

***Keywords*—Fly ash (Class F), Bagasse ash, Sustainability, Environment, Waste re-uses, cost feasibility, Eco friendly bricks**

I. INTRODUCTION

Population scenario comes towards India by means of increasing industries. The fruitful efforts of industries lead to develop India. As the industries increases also the waste coming from them at the end of product increases. At the end of survey result coming that the amount of the approximately 250 to 300 million tons of industrial wastes are being produced every year by chemical and agricultural process in India. It is very essential to dispose these wastes safely without affecting health of human being, environment, fertile land, sources of water bodies; etc. Sugar cane bagasse, the fibrous residue after crushing and juice extraction of sugar cane, is a major industrial waste product from the sugar industry.

Nowadays, it is commonplace to reutilize sugar cane bagasse as a biomass fuel in boilers for vapor and power generation in sugar factories. Depending on the incinerating conditions, the resulting sugarcane bagasse ash (SCBA) may contain high levels of SiO2 and Al2O3, enabling its use as a supplementary cementious material (SCM) in blended cement systems. Uses of Sugarcane bagasse ash waste in brick can save the sugarcane industry disposal costs and produce a 'greener' bricks for construction.

II. EXPERIMENTAL MATERIALS

a) Bagasse ash

FIGURE 1: Bagasse ash
SOURCE: "Shree Ganesh Khand Udhgyog

The burning of bagasse which a waste of sugarcane produces bagasse ash. Presently in sugar factories bagasse is burnt as a fuel so as to run their boilers. This bagasse ash is generally spread over farms and dump in ash pond which causes environmental problems also research states that Workplace exposure to dusts from the processing of bagasse can cause the chronic lung condition pulmonary fibrosis, more specifically referred to as bagassosis. So there is great need for its reuse, also it is found that bagasse ash is high in silica and is found to have pozollinic property so it can be used as substitute to construction material

TABLE 1
CHEMICAL PROPERTIES OF BAGASSE

Sr. No.	Chemical Compound	Percentage
1	Nitrogen	0.2- 0.3%
2	P_2O_5	1.5 -2%
3	K_2+Na_2	5-10 %
4	CaO	1-2%
5	Mgo	0.07%
6	Sio_2	85-90%
7	Heavy metals	NA
8	Fe	2-4%

SOURCE: Shree Ganesh Khand Udhayog, Sarkada

b) ***Flyash (Class F)***

The burning of harder, older anthracite and bituminous coal typically produces Class F fly ash. This 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 cementitious compounds.

TABLE 2
CHEMICAL COMPOSITION OF CLASS F FLY ASH

Sr. No.	Chemical Compound	Class F
1	SiO_2	54.90
2	$A1_2O_3$	25.80
3	Fe_2O_5	6.90
4	CaO	8.70
5	MgO	1.80
6	SO_3	0.60
7	Na_2O & K_2O	0.60

SOURCE: http://www.flyash.com

c) Acetylene Carbide Lime

Pure calcium oxide is fused with coke in order to render the highest yield in the manufacture of acetylene. The quality of the resultant carbide lime is a direct result of the excellent quality raw materials. Carbide lime is finer in particle size, and physically, having a very finely divided particle size makes carbide lime better. A finer particle size means faster and more reactivity.

FIGURE 2: Fly ash (Class F)
SOURCE: "Shree Ganesh Khand Udhgyog

FIGURE 4: Lime
SOURCE: "Shreeji bricks" Sarkada

TABLE 3
CHEMICAL COMPOSITION OF LIME

Sr. No.	Chemical Compound	Lime
1	SiO_2	5.39
2	$A1_2O_3$	1.06
3	Fe_2O_3	0.39
4	CaO	28.60
5	MgO	2.42
6	SO_3	0.93

SOURCE: GEO Test House, Gorwa, Gujarat

d) Quarry dust

FIGURE 5: Quarry dust
SOURCE: "Shreeji bricks" Sarkada

Quarry dust is a waste product produced during the crushing process which is used to extract stone. It is rock particles. When huge rocks brake in too small parts for the construction in quarries. It is like sand but mostly grey in colour. It is mineral particles. The density of Quarry dust is 1650 kg/m³.

e) *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.

III. MIX DESIGN

The design mix proportion is done in Table 4.

TABLE 4
EFFECTIVE REPLACEMENT OF FLY ASH BY BAGASSE ASH

Sample	F. A (Kg)	B.A (Kg)	Lime (Kg)	Q.D (Kg)
Std	60.00	0.00	20.00	20.00
S1	50.00	10.00	20.00	20.00
S2	40.00	20.00	20.00	20.00
S3	30.00	30.00	20.00	20.00
S4	20.00	40.00	20.00	20.00
S5	10.00	50.00	20.00	20.00
S6	0.00	60.00	20.00	20.00

F.A=Fly ash, B.A= Bagasse ash, Q.D= Quarry Dust

TABLE 5
SAMPLE INFORMATION OF BAGASSE ASH IN REPLACEMENT OF FLYASH IN BRICKS

Sample	F. A (Kg)	B.A (Kg)	Lime (Kg)	Q.D (Kg)
Std	60.00	0.00	20.00	20.00
L1	60.00	5.00	15.00	20.00
L2	60.00	10.00	10.00	20.00
L3	60.00	15.00	5.00	20.00
L4	60.00	20.00	0.00	20.00

F.A=Fly ash, B.A= Bagasse ash, Q.D= Quarry Dust

IV. EXPERIMENTAL SETUP

V. EXPERIMENTAL METHODOLOGY

The evaluation of Bagasse ash for use as a replacement of fly ash material begins with the brick testing. Brick contains fly ash, Lime, water, and Quarry dust. With the control brick, i.e.

10%, 20%, 30%, 40%, 50% and 60% of the fly ash is replaced with Bagasse ash, the data from the Bagasse ash fly ash brick is compared with data from a standard fly ash brick without bagasse ash. Five bricks samples were cast having size of 230x115x75mm.The manufacturing process of bricks broadly consists of three operations viz. mixing the ingredients, pressing the mix in the machine and curing the bricks for a stipulated period. Selection of machinery depends on the bricks mix contents. For manufacturing bagasse ash fly ash bricks, the best suited machinery is a Vibro - press machine, which is an indigenous low cost machine and can be run by ordinary semiskilled worker. Its production capacity is 1000 bricks per shift and can be operated in two shifts without any operation/maintenance load. The maintenance cost is so low that it can be ignored. 15 lakh bricks can be produced for each machine in its life cycle.

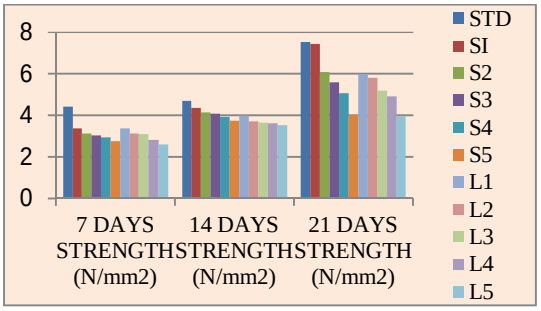
A. Compression Test

The brick specimens are immersed in water for 24 hours. The frog of the brick is filled flush with 1:3 cement mortars and the specimen are stored in damp jute bag for 24 hours and then immersed in clean water for 24 hours. The specimen is placed in compression testing machine with 6 mm plywood on top and bottom of it to get uniform load on the specimen. Then load is applied axially at a uniform rate of 14 N/mm^2. The crushing load is noted. Then the crushing strength is the ratio of crushing load to the area of brick loaded. Average of five specimens is taken as the crushing strength.

FIGURE: - 6 Compression strength test for Brick

TABLE 6
COMPRESSION STRENGTH OF BRICKS (230X115X75) AT 7, 14 AND 21 DAYS FOR BAGASSE ASH FLY BRICKS

Sample	7 Days	14 Days	21 Days
STD	4.43	4.70	7.55
S1	3.38	4.35	7.43
S2	3.13	4.17	6.09
S3	3.03	4.08	5.57
S4	2.94	3.94	5.07
S5	2.77	3.77	4.02
S6	NA	NA	NA
L1	3.39	4.00	5.99
L2	3.12	3.74	5.81
L3	3.08	3.65	5.20
L4	2.83	3.61	4.92



GRAPH 5: Percentage replacement(X axis) Vs Compressive Stress

VI. ECONOMIC FEASIBILITY

TABLE 7
COST OF MATERIALS

Material	Rupees/Kg
Bagasse Ash	0.20
Flyash	0.55
Quarry Dust	0.35
Lime	1.50

TABLE 8
TOTAL COST OF BRICKS OF DIFFERENT PROPORTION

Samples	Cost
STD	3.36
S1	3.25
S2	3.14
S3	3.03
S4	2.92
S5	2.81
S6	2.70
L1	3.28
L2	3.21
L3	3.13

L4	3.06

TABLE 9
COMPARISON BETWEEN BAGASSE ASH FLYASH BRICKS AND ORDINARY CLAY BRICKS

Sr. No	Description	Clay Bricks	Bagasse Ash Fly ash Bricks
1	Size, mm	215x100x70	230x100x75
2	Volume, cm^3	1505	1725
3	Bricks in 1 Cum Masonry	664	500
4	Density, Kg /m^3	1600	1668
5	Cost in Rupees	4000/1000	2420/1000
6	Compressive Strength, Kg/cm^2	30-50	30-50
7	Water Absorption,%	20-25	8-12

VII. CONCLUSION

Based on limited experimental investigations concerning compressive strength of Brick, the following observations are made regarding the resistance of partially replaced Bagasse ash:

(a) Compressive strength decreases on increase in percentage of Bagasse ash as compare to fly ash.
(b) Use of bagasse ash in brick can solve the disposal problem; reduce cost and produce a 'greener' Eco-friendly bricks for construction.
(d) Environmental effects of wastes and disposal problems of waste can be reduced through this research.
(e) A better measure by an innovative Construction Material is formed through this research.
(f) It provides innovative use of class F fly ash which contains less than 20% lime.
(g) This study helps in converting the non-valuable bagasse ash into bricks and makes it valuable.
(h) In this study, maximum compressive strength is obtained at 10% replacement of fly ash as bagasse ash.

(i) Bagasse ash bricks reduce the seismic weight of building.

(j) It reduces the density of bricks from 20 (clay bricks) to 11(bagasse ash bricks)

(k) It reduces the cost of material per brick.

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