"BAGASSE ASH BRICK"

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ABSTRACT

The main objective of this study is to investigate the utilization potential of bagasse production residues in clay brick. In India annually 90 million tonnes of bagasse produces and expected increasing percentage in future. The attempt has been made for producing light weight bricks with increasing percentage of bagasse by weight. The effects of bagasse addition on the mechanical properties of the bricks were investigated The investigated results shows combination of clay, fly ash and bagasse is light weight and meets compressive strength requirements of IS 1077.Application of bio-product sugarcane bagasse ash (SBA) as a principal raw material for the manufacture of bricks was study. The bricks are developing use the quarry dust (QD) as a replacement to natural river sand and lime as a binder. Sugarcane Bagasse Ash (SBA) as a principal raw material was characterized using X-ray fluorescence (XRF), thermos – gravimetric analysis (TGA), X-ray diffraction and scanning electron microscopy (SEM). XRF confirm SBA as a cementations material.

Keyword: - *Sugarcane Bagasse Ash, Clay, Brick, Light weight, Compressive strength*

1. INTRODUCTION

India, as we all know is the second biggest sugarcane growing country in the world, only behind Brazil. Every year, 4 million hectares had been panted with sugarcane. Sugar plant can process 40 million tons sugarcane every year. For each tonne of sugar cane crushed, about 300kg of bagasse is retrieved. Previously bagasse is used as the fuel of sugar production. However only a third of bagasse are flamed, the remaining is discarded. That is to say, making bagasse into briquettes contains huge briquettes contains huge potential.

The high moisture content of bagasse, typically 40 to 50%, is detrimental to its use as a fuel. In general, bagasse is stored prior to further processing. For electricity production, it is stored under moist conditions, and the mild exothermic reaction that results from the degradation of residual sugars dries the bagasse pile slightly. For paper and pulp production, it is normally stored wet in order to assist in removal of the short pith fibers, which impede the papermaking process, as well as to remove any remaining sugar.

Bagasse is an extremely inhomogeneous material comprising around 30-40% of "pith" fiber, which is derived from the core of the plant and is mainly parenchyma material, and "bast", "rind", or "stem" fiber, which comprises the balance and is largely derived from sclerenchyma material. These properties make bagasse particularly problematic for paper manufacture and have been the subject of a large body of literature.

1.1 WHAT IS BAGASSE?

Bagasse is sugarcane fiber waste left after juice extraction.

1.2 WHY USE BAGASSE SUGARCANE PRODUCTS?

Sugarcane is a tree-free renewable resource. Historically, bagasse waste has been burned in the fields, and thereby creating pollution. Now, bagasse is used to manufacturer eco-friendly food service products replacing traditional paper, plastics and Styrofoam products. Products manufactured from bagasse require less energy than plastics products. By adopting bagasse products, you indirectly help in reducing the pollution and energy consumption. Bagasse sugarcane plates, bowl, compartment trays, to go containers, clamshells are much better alternative for food service industry.

1.3 BRICKS

A **brick** is a block or a single unit of a kneaded clay-bearing soil, sand and lime, or concrete material, fire-hardened or air-dried, used in masonry construction. Lightweight bricks (also called "lightweight blocks") are made from expanded clay aggregate. Bricks are produced in numerous classes, types, materials, and sizes which vary with region and time period, and are produced in bulk quantities. Two basic categories of bricks are fired and non-fired bricks. Fired bricks are one of the longest-lasting and strongest building materials, sometimes referred to as artificial stone, and have been used since circa 5000 BC. Air-dried bricks, also known as mud bricks, have a history older than fired bricks, and have an additional ingredient of a mechanical binder such as straw. Bricks are laid in courses and numerous patterns known as bonds,

collectively known as brickwork, and may be laid in various kinds of mortar to hold the bricks together to make a durable structure.

1.4 USE

Bricks are used for building, block paving and pavement. In the US, brick pavement was found incapable of withstanding heavy traffic, but it is coming back into use as a method of traffic calming or as a decorative surface in pedestrian precincts. For example, in the early 1900s, most of the streets in the city of Grand Rapids, Michigan, were paved with brick. Today, there are only about 20 blocks of brick paved streets remaining (total ling less than 0.5 percent of all the streets in the city limits).

Bricks in the metallurgy and glass industries are often used for lining furnaces, in particular refractory bricks such as silica, magnesia, chamotte and neutral (chromomagnesite) refractory bricks. This type of brick must have good thermal shock resistance, refractoriness under load, high melting point, and satisfactory porosity. There is a large refractory brick industry, especially in the United Kingdom, Japan, the United States, Belgium and the Netherlands.

1.5 LITERATURE SURVEY

(A). Bagasse Ash as an Effective Replacement in Fly Ash Bricks

Kulkarni et.al (2013) have publish is paper "bagasse ash an effective replacement in fly ash brick".

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 vapour. Huge quantity of ash which is a waste product, available at very negligible rate. It causes the chronicling condition pulmonary fibrosis more specifically referred to as bagasse's. 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.

(B). Potential Utilization of Solid Waste (Bagasse Ash)

Aigbodion et.al (2011) have publish is paper "Potential Utilization of Solid Waste (Bagasse Ash)". Utilization of industrial and agricultural waste products in the industry has been the focus of research for economical, environmental, and technical reasons. Sugar-cane bagasse is a fibrous waste product of the sugar refining industry, along with ethanol vapor. This waste product is already causing serious environmental pollution which calls for urgent ways of handling the waste. In this paper**,** Bagasse ash has been chemically and physically characterized, in order to evaluate the possibility of their use in the industry. X-ray diffractometry determination of composition and presence of crystalline material, scanning electron microscopy/EDAX examination of morphology of particles, as well as physical properties and refractoriness of bagasse ash has been studied.

2. MATERIALS

In this chapter different materials and methods has been use for bagasse ash brick.

USE OF MATERIALS

1. Bagasse ash
2. Clay
3. Water
4. Sand
5. Admixture

2.1 BAGASSE ASH

Bagasse is a residue obtained from the burning of bagasse in sugar producing factories. Bagasse is the cellular fibrous waste product after the extraction of the sugar juice from cane mills. It is currently used as a bio fuel and in the manufacture of pulp and paper products and building materials. For each 10 tons of sugarcane crushed, a sugar factory produces nearly 3 tons of wet bagasse which is a by-product of the sugar cane industry. When this bagasse is burnt the resultant ash is bagasse

ash. Western Maharashtra is having maximum number of sugar factories, these factories faces a disposal problem of large quantity bagasse. The effective utilization of these waste products is a challenging task for a researcher through economical and environmental impact. This material contains amorphous silica which is indication of cementing properties, which can develop good bonding between soil grains in case of weak soil.

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 present, 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.

2.2 CLAY

Clay is a fine-grained natural rock or soil material that combines one or more clay minerals with traces of metal oxides and organic matter. Clays are plastic due to their water content and become hard, brittle and non–plastic upon drying or firing. Geologic clay deposits are mostly composed of phyllosilicate minerals containing variable amounts of water trapped in the mineral structure. Depending on the content of the soil, clay can appear in various colors, from white to dull grey or brown to a deep orange red.

Clays are distinguished from other fine-grained soils by differences in size and mineralogy. Silts, which are fine-grained soils that do not include clay minerals, tend to have larger particle sizes than clays. There is, however, some overlap in particle size and other physical properties, and many naturally occurring deposits include both silts and clay. The distinction between silt and clay varies by discipline. Geologists and soil scientists usually consider the separation to occur at a particle size of 2μm (clays being finer than silts), sedimentologists often use 4–5μm, and colloid chemists use 1μm. Geotechnical engineers distinguish between silts and clays based on the plasticity properties of the soil, as measured by the soils' Atterberg limits. ISO 14688 grades clay particles as being smaller than 2μm and silt particles as being larger.

2.3 WATER

Mixing water should not contain undesirable organic substances or inorganic constituents in excessive proportions. In this project clean potable water is used. Water in three states: liquid, solid (ice), and gas (invisible water vapor in the air). Clouds are accumulations of water droplets, condensed from vapor saturated air.

Water on Earth moves continually through the water cycle of evaporation and transpiration (evapotranspiration), condensation, precipitation, and runoff, usually reaching the sea. Evaporation and transpiration contribute to the precipitation over land. Water used in the production of a good or service is known as virtual water.

2.4 SAND

Sand is a naturally occurring granular material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type; i.e. a soil containing more than 85% sand-sized particles (by mass).

The composition of sand varies, depending on the local rock sources and conditions, but the most common constituent of sand in inland continental settings and non-tropical coastal settings is silica (silicon dioxide, or SiO_2), usually in the form of quartz. The second most common type of sand is calcium carbonate, for example aragonite, which has mostly been created, over the past half billion years, by various forms of life, like coral and shellfish. It is, for example, the primary form of sand apparent in areas where reefs have dominated the ecosystem for millions of years like the Caribbean.

3. TEST SET UP

To know the quality of bricks following 8 tests can be performed. In these tests some are performed in laboratory and the rest are on field.

1. Size, Shape and Colour Test
2. Colour Test
3. Soundness Test
4. Water Absorption
5. Hardness t Test
6. Compressive strength Test

1-2. Size, Shape and Colour Test
In this test randomly collected 20 bricks are staked along lengthwise, widthwise and height wise and then those are measured to know the variation of sizes as per standard. Bricks are closely viewed to check if its edges are sharp and straight and uniform in shape. A good quality brick should have bright and uniform color throughout.

3. Soundness Test
In this test two bricks are held by both hands and struck with one another. If the bricks give clear metallic ringing sound and don't break then those are good quality bricks.

4. Water Absorption Test
In this test bricks are weighed in dry condition and let them immersed in fresh water for 24 hours. After 24 hours of immersion those are taken out from water and wipe out with cloth. Then brick is weighed in wet condition. The difference between weights is the water absorbed by brick. The percentage of water absorption is then calculated. The less water absorbed by brick the greater its quality. Good quality brick doesn't absorb more than 20% water of its own weight.

5. Hardness Test
In this test a scratch is made on brick surface with a hard thing. If that doesn't left any impression on brick then that is good quality brick.

6. Compressive strength Test
This test is done to know the compressive strength of brick. It is also called crushing strength of brick. Generally 5 specimens of bricks are taken to laboratory for testing and tested one by one. In this test a brick specimen is put on crushing machine and applied pressure till it breaks. The ultimate pressure at which brick is crushed is taken into account. All five brick specimens are tested one by one and average result is taken as brick's compressive/crushing strength

3.1 COMPRESSIVE STRENGTH TEST FOR BRICKS (IS 3495-PART-1:1992)

Apparatus
A compression testing machine, the compression plate of which shall have a ball seating in the form of portion of a sphere the centre of which coincides with the centre of the plate, shall be used.

Preconditioning
Remove unevenness observed in the bed faces to provide two smooth and parallel faces by grinding. Immerse in water at room temperature for 21 hours. Remove the specimen and drain out any surplus moisture at room temperature. Fill the frog (where provided) and all voids in the bed face flush with cement mortar (1 cement, clean coarse sand of grade 3 mm and down). Store under the damp jute bags for 24 hours followed by immersion in clean water for 3 days. Remove, and wipe out any traces of moisture.

Procedure
Place the specimen with flat faces horizontal, and mortar filled face facing upwards between two to 3 plywood sheets each of 3 mm thickness and carefully centered between plates of the testing machine. Apply load axially at a uniform rate of 14 N/mm² (140 kg/cm²) per minute till failure occurs and note the maximum load at failure. The load at failure shall be the maximum load at which the specimen fails to produce any testing machine.
NOTE - In place of plywood sheets plaster of Paris may be used to ensure a uniform surface for application of load.

Report

$$\text{Compressive strength in N/mm}^2 = \frac{\text{Maximum load at failure in N}}{\text{Average area of the bed faces in mm}^2}$$

The average of results shall be reported.

3.2 WATER ABSORPTION TEST FOR BRICK (IS 3495 – PART 2)

How to calculate water absorption value for bricks (IS 3495 part 2)
Water absorption value of bricks largely influences the bond between brick and mortar. If water absorption in bricks is more and bricks are not soaked before the masonry work, the water from freshly laid mortar is likely to be absorbed by bricks. This results into poor mortar strength as the sufficient quantity of water will not be available for hydration process. This article describes the details procedure for water absorption test For bricks as per IS 3495,P-2

1. Sensitive weigh balance
2. Ventilated oven

Test Procedure for Water Absorption for Bricks:

1. The specimen is dried in a ventilated oven at a temperature of 105 to 1150C; till it attains substantially constant mass. The specimen is cooled to room temperature and its weight is recorded as M1
2. The dried test specimen is immersed completely in clean water at a room temperature of 27±20C for 24 hours.
3. The specimen is then removed and any traces of water are wiped out with a damp cloth and the specimen is weighed. The weighing is completed 3 min after the specimen has removed from water. Record the weight as M2

Calculation of %of Water Absorption:

Water absorption, percent by mass, after 24-hour immersion in cold water is given by the following formula:

$$\% \text{ water absorption} = ((M2-M1) / M1) \times 100$$

4. RESULTS AND DISCUSSION

4.1 SIZE SHAPE AND COLOUR TEST

Table No.1 Result of Size & Shape Test

BAGGASE ASH PROPORTION	LENGTH	WIDTH	HEIGHT
00%	224.00	106.70	75..70
10%	223.00	107.00	77.00
20%	223.80	106.80	76.30
30%	223.70	107.00	76.20
50%	223.40	106.70	76.20
STANDARDS	225.00	100.00	80.00

As we can see from result size of the bricks are near the standard values of any proportion for bagasse ash.

4.2 COLOUR TEST

Up to 20% proportion for bagasse ash, bricks has good red uniform colour. But after 20% proportion, bricks have yellowish colour. Under burnt bricks.

4.3 SOUNDNESS TEST FOR BRICKS

When two bricks are struck with one another, up to 20% proportion, they give metallic sound. But 30% and 50% proportion gives dull sound.

4.4 WATER ABSORPTION TEST

Table No.2 Result of Water Absorption Test

Proportion	Weight of dry brick (W1 kg)	Weight of wet brick (W2 kg)	Weight of water absorbed (W2-W1) kg	% water absorbed (kg)	Average %
0%	2.702	3.099	0.397	14.69	13.89
	2.725	3.105	0.380	13.94	
	2.719	3.074	0.355	13.056	
10%	2.731	3.124	0.393	14.39	15.89
	2.751	3.204	0.453	16.46	
	2.672	3.122	0.450	16.84	
20%	2.668	3.126	0.458	17.16	15.55
	2.762	3.167	0.405	14.66	
	2.675	3.072	0.397	14.84	
30%	2.706	3.122	0.416	15.37	15.34
	2.668	3.062	0.394	14.76	
	2.653	3.075	0.422	15.90	
50%	2.704	3.149	0.445	16.45	16.26
	2.654	3.088	0.434	16.35	
	2.686	3.116	0.430	16.00	

As we can see in result, as percentage of bagasse ash increased water absorption of bricks increased. Up to 20 % bagasse ash is adequate to replace.

4.5 HARDNESS TEST

Up to 30% proportion, bricks are hard. When scratch is made, it doesn't left mark. But after 30% proportions, there was scratch left on brick surface.

4.6 COMPRESSIVE STRENGTH TEST

Table No.3 Result of Compression Strength Test

Proportion	Size of brick (mm^2)	Surface area (mm^2)	Load at Failure (P) in KN	Compressive Strength (P/A) in N/mm^2	Average
0%	224 x 127	28448	120	4.22	4.57
			150	5.27	
			120	4.22	
10%	224 x 127	28448	80	2.81	3.16
			100	3.52	
			90	3.16	
20%	224 x 127	28448	80	2.81	3.05
			80	2.81	
			100	3.52	
30%	224 x 127	28448	90	3.16	2.81
			80	2.81	
			70	2.46	
50%	224 x 127	28448	60	2.11	2.34
			70	2.46	
			70	2.46	

As per the results of compressive strength test, up to 20% bagasse ash strength is as per requirement. After 20 % the strength reduces. It is desirable to use only up to 20 % bagasse ash.

5. CONCLUSIONS

From the analysis of the results given above, the followings conclusions can be made:

1.Use of bagasse ash in brick can solve the disposal problem; reduce cost and produce a 'greener' Eco friendly bricks for construction.

2. Environmental effects of wastes and disposal problems of waste can be reduced through this research.

3. A better measure by an innovative Construction Material is formed through this research.

4. This study helps in converting the non-valuable bagasse ash into bricks and makes it valuable.

5. It reduces the cost of material per brick.

6. From the tests conducted in laboratory, in all tests it is observed that up to 20% bagasse ash all the characteristics of bricks are adequate and desirable for use in building construction.

7. As addition of bagasse ash more than 20% causes more water absorption, reduction in compressive strength, less hardness, under burnt.

8. So we recommend that upto 20 to 25 % bagasse ash can be replaced by clay in bricks.

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