EXPERIMENTAL INVESTIGATION ON BRICK BY PARTIAL REPLACEMENT OF SUGARCANE BAGASSE ASH FOR THE CEMENT USAGE

Anbarasan.S[1], Balaji.R[1], Balasubramaniyan.P[1], Manimuthu.K[1]

Venkatesan.G[2]

Final year UG students, Kings College of Engineering **1**

Assistant professor, Kings College of Engineering **2**

ABSTRACT

In India, bricks are usually made up of clay, and are generally produced in traditional, unorganized small scale industries. Brick making consumes larger amount of clay which leads to top soil removal and land degradation. To avoid all this environmental threats an attempt was made to study the behavior of bricks manufactured using, waste materials from sugarcane industrial waste. Recycling of such waste as raw material alternatives may contribute in the exhaustion of the natural resources and reduction in waste disposal costs. In this project we choose Sugarcane Bagasse Ash (SBA) in ordinary Portland cement (OPC) Stabilized bricks. The brick was manufactured of size 19cm x 9cm x 9cm. The blocks were named as (1:3) 20%,30%,40% and 50%; (1:4) 20%,30%; (1:5) 20%,30% then it is added with SBA by weight of dry soil, then the bricks followed by curing for period of 28 days. The test like compressive strength, water absorption test, flame test and soundness test etc. in accordance with Bureau of Indian standards (BIS) specifications by also considering the cost.

Key words: sugarcane bagasse ash (SBA), ordinary Portland cement (OPC), cost effective.

1. INTRODUCTION

1.1 GENERAL

There is a strong demand for environmentally safe reuse and effective disposal method for bagasse ash due to the increasing amount of sludge generated by the various industries or plant in India. Landfills are commonly used for disposal of sludge in India; rapid urbanization has made it increasingly difficult to find suitable landfill sites. Therefore, incineration has become one of the few alternatives available for disposal of sludge.

The ultimate disposal of incinerated bagasse ash can be accomplished by using it an engineering construction material. One possible solution for the management of this sludge is to re-use it as a building material, namely, to incorporate this bagasse ash into bricks. The fired clay brick is one of the most common and abundant masonry building materials and remain popular for its many characteristic properties. As such, the recycling of waste materials by incorporating them into bricks has been a popular topic of investigation over the last century, with varying degrees of success across a wide range of waste material.

This popularity is likely due to flexibility on the type of wastes which can be mixed into the brick making material, but more importantly, the high temperature involved in firing the bricks allows for the volatilization of dangerous component, as well as the fixation of wastes into the vitreous phase of the brick. The current study investigates the potential for reusing sugarcane sludge or bagasse ash by using it as a partial replacement material in clay bricks. Due to limited availability of natural resources and rapid urbanization, there is a shortfall of conventional building construction materials. On the other hand, energy consumed for the production of conventional building construction materials pollutes the air, water and land.

Accumulation of unmanaged agro-waste, specially from the developing countries, has an increased environmental concern. Therefore, development of new technologies to recycle and convert waste materials into reusable materials is important for the protection of the environment and sustainable development of the society.

1.2 SCOPE:

- To promote the solid waste from the sugar mills as a useful product
- To manage the disposal of waste product into construction raw material
- To dispose the waste safety
- To encourage the waste products as eco friendly material
- To make the bricks which are energy efficient which is the only viable solution to the environmental concerns and natural resources conservation for future generations

1.3 OBJECTIVE:

- Waste materials from sugar mill can be converted in to construction material.
- The bagasse ash brick's compressive strength may be compared to the fly ash brick's compressive strength.
- Attain maximum strength.
- Should be economical.
- Should be Eco-friendly.

2. LITERATURE REVIEW

Development and Feasibility Analysis Bagasse ash Bricks (Mangesh V. Madurwar, Sachin A. Mandavgane)

Sugarcane bagasse ash (SBA), which is otherwise landfilled, was utilized to develop construction material that serves a purpose of disposal of solid waste management and energy efficient alternate construction material. SBA was characterized using particle size distribution, scanning electron microscopy (SEM), X-ray fluorescence (XRF), X-ray diffraction (XRD), and thermogravimetric analysis (TGA). SEM monographs show the rough surface with plenty of fine pores. XRF, XRD, and physicochemical properties of the SBA prove its suitability as a pozzolanic or cementitious material. TGA confirms thermal stability till 650°C. On the suitability of principal raw material, SBA–quarry dust (QD)–lime (L) bricks were developed with a constant composition of lime (20% by weight) and tested for physicomechanical (weight, dry density, water absorption, efflorescence, and compressive strength), functional (thermal conductivity, k), durability (chloride, sulfate, and carbonation), and environmental [toxicity characteristics leaching protocol (TCLP)] properties as per recommendations. The developed (SBA-QD-L) bricks were further analyzed for technical feasibility with commercially available and accepted masonry products like clay and fly ash bricks. The experimental results showed that the SBA-QD-L combination brick is lighter in weight, durable, nonhazardous, energy efficient, has lower k value, and meets the necessary physicomechanical properties of the standards.

Utilization of Bagasse Ash as a Brick Material, A Review (Rohan Rajput, Mayank Gupta)

As we all know that the waste from the industries is very harmful for the environment as well as to our health, if not disposed in proper manner. The fibrous residue of sugarcane after crushing and extraction of its juice, known as "bagasse" is one of the largest agriculture residues in the world. The bagasse is however used as a biomass fuel for boilers, but after burning the by-product left is of no use and generally disposed into the rivers which affects the health of human being, environment, fertile land, sources of water bodies etc. Depending on the incinerating conditions, the resulting sugarcane bagasse ash (SCBA) may contain high levels of SiO_2 and Al_2O_3.Uses of Sugarcane bagasse ash waste in brick can save the sugarcane industry disposal costs and produce a 'greener' bricks for construction. In this research the bagasse ash, lime, quarry dust and scrap can be used as the replacement of clay and sand in the burnt clay bricks. The different proportions of the bagasse ash, lime, quarry dust and scrap are taken and bricks can be manufactured. After the full manufacturing process the bricks are to be tested in the laboratory and results are analyzed regarding the water absorption and compressive strength.

Use of Sugarcane Bagasse Ash as a Partial Replacement for Cement in Stabilization of Self-Interlocking Earth Blocks (Richard Onchiri, Kiprotich James)

The provision of housing is a challenge around the world, especially in developing countries.The spiraling growth of population, low Gross National Product and the general lack of purchasing power are factors that contribute to the progressive deterioration of the housing situation in developing economies. Building materials such as fired clay bricks, lime and Portland cement require enormous energy input, hence prove to be expensive. The sugar manufacturing industries produce a lot of sugarcane bagasse which is disposed off in an open land (landfill). This ash has pozzolanic properties which can be made use in the construction industry. Pozzolanic materials can be used as a partial cement replacement in the production of low-cost earth building blocks. Ideally, building materials for low-cost housing must be produced from locally available raw materials. The utilization of waste materials in soil stabilization provides a satisfactory solution to some of the environmental concerns and problems associated with waste management. Agro wastes such as rice husk ash, wheat straw ash, nut shell and sugarcane bagasse ash are used as pozzolanic materials for the development of blended stabilizers. This paper presents the use of sugarcane bagasse ash as a partial replacement for cement to stabilize self-interlocking compressed earth blocks (SSIEBs) using various bagasse ash contents. Sugar manufacturing companies are increasing in Kenya in line with Vision 2030, the amount of bagasse produced is expected to increase annually.

Bagasse Ash as an Effective Replacement in Fly Ash Bricks (Apurva Kulkarni, Samruddha Raje, Mamta Rajgor)

Utilization of industrial and agricultural waste products in the industry has been the focus of research for economic, environmental, and technical reasons. Sugarcane 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.

Experimental Investigation on Replacement of Bagasse Ash in Bricks (L. Vignesh Kumar, B. Jai Vignesh)

This paper carried out partial replacement of fly ash by bagasse ash in order to reduce industrial waste. 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. This sugar manufacturing industries produces a lot of sugarcane bagasse ash which is disposed off in an open land. Huge quantity of ash which is a waste product, available at very negligible rate. This sugarcane bagasse ash is a fibrous waste product and has pozzolanic properties which can be made use in construction industry. Pozzolanic materials can be used as a partial replacement in the production of low cost fly ash bricks. The aim of this research was to make economical and green bricks to maintain environmental balance, and avoid problem of ash disposal. It is very essential to dispose these wastes safely without affecting health of human being and environment. So, there is a great need for its reuse, also it is found that bagasse ash in high in silica and found to have pozzolanic property. So it can be used as substitute to construction material.

Review Paper on Replacement of Cement with Bagasse Ash (Bangar Sayali. S, Phakhe Shubhangi N., Gawade Anjali Y.)

Demand and consumption of cement is increasing day by day which has led researchers and scientists to search for locally available alternate binders that can replace cement partially and are ecofriendly and contribute towards waste management. In this direction the industrial & agricultural waste play vital role. The agricultural waste product like Sugar Cane Bagasse Ash (SBCA) is used as alternate binding material in the present study. This will result in saving in cement production equivalent to the alternative binding material used in concrete. The bagasse ash used for the research work is obtained from Vighnahar Sugar Factory (Pune) which is grinded and sieved through sieve of size 150 micron and passing out fraction is used in concrete as a partial replacement of cement in the ratio of 2% 4%, 6%, 8% & 10%by weight of the cement. Ordinary Portland Cement 53 grade cement is used in the study. The effect of replacement of cement by bagasse ash on properties like workability for fresh concrete are tested and for hardened concrete compressive strength at the age of 7 days and 28 days are determined.

Development of Lighter and Eco-Friendly Burnt Clay Bricks Incorporating Sugarcane Bagasse Ash (Anwar Khitap, Syed Minhaj Saleem Kazmi)

Utilization of waste materials in the production of burnt clay bricks can be helpful in reducing the landfill burden. This study aims to develop lighter and eco-friendly burnt clay bricks incorporating sugarcane bagasse ash (SBA). Clay bricks were manufactured in a local brick manufacturing industrial kiln, incorporating SBA by weight of clay in different proportions. To study the properties of bricks, different mechanical and durability tests were performed as per ASTM C67. Results showed that SBA can be helpful in manufacturing of lighter bricks. Bricks incorporating SBA exhibit compressive strength lesser than traditional clay bricks; however, burnt clay bricks incorporating 5% SBA by clay weight fulfilled the minimum requirement for compressive strength according to the Building code of Pakistan. Moreover, efflorescence was improved after adding the SBA in burnt clay bricks. Therefore, lighter and sustainable bricks can be produced after utilization of small amount of SBA (i.e., 5%) in burnt clay bricks.

Use of Sugarcane Bagasse Ash as Brick Material (Rahul V. Ralegaonkar, Sachin A. Mandavgane)

Application of bio-fuel by-product sugarcane bagasse ash (SBA) as a principal raw material for the manufacturing of bricks was studied. The bricks were developed using the quarry dust (QD) as a replacement to natural river sand and lime (L) as a binder. SBA as a principal raw material was characterized using X-ray fluorescence (XRF), thermo-gravimetric analysis (TGA), X-ray diffraction and scanning electron microscopy (SEM). XRF confirms SBA as a cementitious material. TGA confirms thermal stability till 650□C, whereas SEM monograph shows individual ashwith a rough surface and numerous fine pores. Elemental analysis of quarry dust and lime was also carried out using XRF and classic wet test. The physical properties of quarry dust and lime were determined using the laboratory test methods. SBA–QD–L combination bricks were designed and developed in different mix proportions. Physico-mechanical properties of the developed bricks were studied according to recommended standards. The results of the SBA–QD–L bricks were compared with physico-mechanical properties of commercially available burnt clay-and-fly ash bricks.

Silica Extraction and Incineration Process of Sugarcane Bgasse Ash (SCBA) as Pozzolanic Materials: A Review (Rahimah Embongab, Nasir Shafiqa, Andri Kusbiantoroa)

Conventional extraction and incineration process of sugarcane bagasse to extract its reactive silica content has confronted several critical issues, particularly in terms of the amount of reactive silica extracted, energy efficiently, and safety precautions. Based on this evaluation, pretreatment of sugarcane bagasse using acid solution is beneficial, particularly in the removal of alkali metals and increasing the amount of reactive SiO2 . Amorphous SiO2 from the ashes by the hydration product of calcium hydrate (C-S-H) is completely beneficial in improving performance and durability of concrete. These papers attempts to a bridge a review of current literature on the extensive studies that have been undertaken to explore suitable method and pre-treatment to increase the level of silica extraction from SCB with Eco-Friendly approach.

Light Weight Cement-sand And Bagasse Ash Bricks (Anil Pratap Singh, Piyush Kumar)

Sugarcane bagasse ash (SBA) is utilized to developed light weight bricks-that serve a purpose of solid waste management and energy efficient alternative low cost construction material. To replacing the clay bricks, with that in mind a research was conducted by utilizing (SBA) with cement and sand. The research involved the preparation of five mix proportion, which are (15% sba+65% sand+20% cement, 20% sba+60% sand+20% cement, 25% sba+55% sand+20% cement, 30% sba+50% sand+20% cement, 35% sba+45% sand+20% cement) and bricks are casted. After casting the series of the test carried out in accordance with recommended Indian standards to determine water absorption capacity (I.S 3495 (part-2) (BIS-1992b)), compressive strength as per (I.S 3495(part-1) BIS-1992a) and efflorescence (I.S 3495 (part-3) (BIS 1992-C)).This bricks are 225×110×70 mm non modular size.

3.MATERIALS

The waste material used in manufacturing of bricks are as follows:

3.1. SUGARCANE BAGASSE ASH:

Figure. Sugarcane bagasse ash

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.

India alone generates 90 million t of bagasse as a waste material, from sugarcane industry. Bagasse is a residue obtained from the burning of bagasse in sugar producing factory. Bagasse is the cellular fibrous waste product after the extraction of the sugar juice from cane mills. Its 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 3.1 tons of wet bagasse which is a by-product of the sugarcane 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 use 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.

The bagasse ash used in the investigation is obtained from a Corporate Sugar Factory in the nearby vicinity. The sugarcane bagasse consists of approximately 50% of cellulose, 25% of hemicelluloses 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 (SiO2). Table2. gives the chemical composition of bagasse ash.

Pozzolan is generally described as a reactive material included in a concrete to improve its mechanical properties via pozzolanic reaction. Pozzolan is commonly utilized as a cement replacement material in conventional concrete due to its reactive SiO2 content and to fulfill the achievement of sustainability agenda. Pozzolanic reaction involves the consumption of amorphous SiO2 from the ashes by the hydration product of calcium hydrate to form additional calcium silicate hydrate (C-S-H) framework in the cementitious system.

Additional formation of this C-S-H framework is beneficial in improving the performance of mechanical strength and durability properties of Portland cement concrete. There are few factors affecting the pozzolanic reactivity of a substance in conventional concrete, e.g. degree of amorphousness, particle fineness, and total amounts of SiO2 + Al2O3 + Fe2O3 oxide. Higher amount of fine amorphous silica (SiO2) in a pozzolan will normally increase its pozzolanic reactivity. Sugarcane bagasse ash (SCBA) is an abundant waste from sugar industry, ethanol and ash produced after burning the bagasse as fuel steam for electricity generation. With high amount of silica, alumina and calcium oxide as the main constituents, SCBA is widely used in cement and concrete due to its high pozzolanic reactivity.

3.1.1 PROPERTIES:

- **Physical properties of cement and bagasse ash:**

Material	Density (Kg/cum)	Specific gravity	Fineness Passing 45 µm	Specific Surface area (cum/Kg)	Mean grain size (µm)
Cement	1.15	3	82	300	2.1
Bagasse ash	0.4	1.8	95	900	5.1

Table. Physical properties of cement and bagasse ash

- **Chemical properties of sugarcane bagasse ash:**

SI. NO	Component	Mass %
1	Silica (SiO_2)	66.89
2	Alumina (Al_2O_3) Ferric oxide (Fe_2O_3)	29.18
3	Calcium oxide (CaO)	1.92
4	Magnesium oxide (MgO)	0.83
5	Sulphur tri oxide (SO_3)	0.56
6	Loss of Ignition	0.72
7	Chloride	-

Table. Chemical properties

The above waste material are used as a replacement for cement. Other than waste material the materials which used in the manufacturing of bricks are as follows:

3.2 ORDINARY PORTLAND CEMENT:

Portland cement is the most common type of cement in general use around the world, used as a basic ingredient of concrete, mortar, stucco and most non-speciality grout. Portland cement clinker is a hydraulic material which shall consist of at least two-thirds by mass of calcium silicates (3 CaO.SiO2 and 2CaO.SiO2), the remainder consisting of aluminium and iron-containing clinker phases other compounds. The ratio of CaO to SiO2 shall not be less than 2.0. The magnesium oxide content (MgO) shall not exceed 5.0% by mass. Cement sets when mixed with water by way of a complex series of chemical reactions still only party understood. The different constituents slowly crystalline and the interlocking of their crystals gives cement its strength. Carbon dioxide is slowly absorbed to convert the portlandite (Ca(OH)2) into insoluble calcium carbonate. After the initial setting, immersion in warm water will speed up setting. Gypsum is added as an inhibitor to prevent flash setting and quick setting.

When water is mixed with Portland cement, the product sets in a few hours and hardens over a period of weeks. These processes can vary widely depending upon the mix used and the conditions of curing of the product, but a typical concrete sets in about 6 hours and develops a compressive strength of 8MPa in 24 hours. The strength rises to 15 MPa at 3 days, 23MPa at 1 week, 35 MPa at 4 weeks and 41 MPa at 3 months. In principle, the strength continues to rise slowly as long as water is available for continued hydration, but concrete is usually allowed to dry out after a few weeks and this causes strength growth to stop.

Cement used in the experimental work is ordinary Portland cement conforming to I.S 4031-1998. The O.P.C was classified into three grades, namely 33grade, 43grade and 53grade. Depending upon the strength of the cement. In this experiment we used 43grade cement is used. A typical test result of chemical composition of OPC cement given by manufacturer is shown in table.

3.2.1 PROPERTIES:

PHYSICAL PROPERTIES:

Compressive strength (MPa)	44
Fineness (%)	8
Specific gravity	3.157
Initial setting time (Minute)	65
Final setting time	320

Table. physical properties of cement

CHEMICAL PROPERTIES OF CEMENT:

Chemical Composition	OPC
SiO_2	18.621%
Al_2O_3	4.749%
Fe_2O_3	3.02%
CaO	62.42%
MgO	3.21%
Na_2O	1.52%
K_2O	1.43%
SO_4	2.29%
LOI*	3.54%

Table. chemical properties of cement

*LOI- loss on Ignition

3.3 FINE AGGREGATE:

Fine aggregate was purchased which satisfied the requirement of fine aggregate required for experimental work and conforming to zone-2, as per IS 383:1970.The sand was oven-dried and sieved to eliminate any foreign particles before mixing. Locally available natural sand with 4.75 mm maximum size was used as fine aggregate, having specific gravity, fineness modulus and unit weight as given

1) Fineness modulus =2.81
2) Specific gravity =2.61
3) Silt content =2.63

Aggregates are inert granular materials such as sand, gravel or crushed stone that are an end product in their own right. Fine aggregates are basically sands won from the land or the marine environment. Fine aggregates generally consist of natural sand or crushed stone with most particles passing through a 9.5mm sieve the aggregate serves as reinforcement to add strength to the overall composite material.

Due to the relatively high hydraulic conductivity value as compared to most soils, aggregates are widely used in drainage applications such as foundation and French drains, septic drain fields, retaining wall drains, and road side edge drains.

3.4 WATER

Water is 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.

The common specifications regarding quality of mixing water is water should be fit for drinking. Such water should have inorganic solid less than 1000 ppm. This content lead to a solid quantity 0.05% of mass of cement when w/c ratio is provided 0.5 resulting small effect on strength.

But some water which are not potable may be used in making concrete with any significant effect. Dark color or bad smell water may be used if they do not posses deleterious substances. PH of water to even 9 is allowed if it not tastes brackish. In coastal areas where local water is saline and have no alternate sources, the chloride concentration up to 1000 ppm is even allowed for drinking. But this excessive amount of alkali carbonates and bicarbonates, in some natural mineral water, may cause alkali-silica reaction.

A simple way of determining the suitability of such water is to compare the setting time of cement and the strength of mortar cubes using the water in question with the corresponding results obtained using known suitable or distilled water. About 10% tolerance is generally allowed. Such tests are recommended when water for which no service record is available containing dissolved solids in excess of 2000 ppm or, in excess of 1000 ppm. When unusual solids are present a test is also advisable.

4. MIX DESIGN

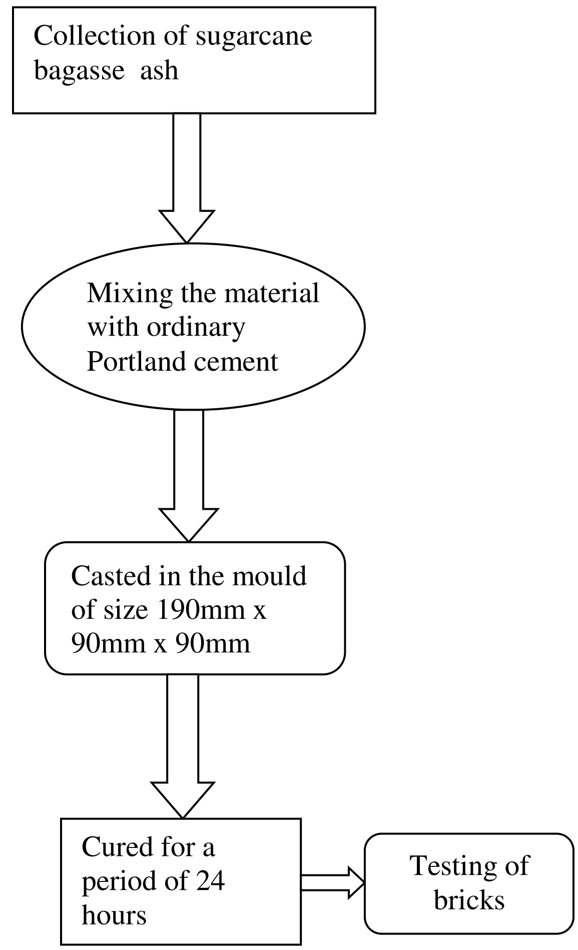
4.1 Mix design according to weight

SI.NO	Ratio	Name of the brick(for identification)	Amount of cement Added (%)	Amount of Bagasse Ash Added(%)
1	**1:3**	**2**	**80**	**20**
		3	**70**	**30**
		4	**60**	**40**
		5	**50**	**50**
2	**1:4**	**2**	**80**	**20**
		3	**70**	**30**
3	**1:5**	**2**	**80**	**20**
		3	**70**	**30**

5. METHODOLOGY

The below flow chart explains the methodology used for manufacturing of bricks:

5.1 Flow chart:



5.2 DRYING OF WASTE MATERIALS:

The waste material are sun dried for a period of 12 hours to eliminate the water content. The bagasse ash contains some amount of water content even it gets turned in to ash. In this study we have replaced the bagasse ash instead of cement, so we should compare some of the physical properties of bagasse ash and cement for better performance. The bagasse ash is subjected to sun dried shown in fig.

Figure . Sugarcane bagasse ash

5.3. SIEVE PROCESS:

After the drying process the materials such as fine aggregate and bagasse ash are finely sieved in IS sieve of 4.5mm. The materials which passed in the IS sieve is taken as a consideration of usage; the retained materials should not be used. It is important to do a sieve analysis process for the proper binding of each material to form a perfect brick.

Figure . Fine aggregate

Figure . Sugarcane bagasse ash

It is essential to sieve the fine aggregate and bagasse ash in Is sieve size of 4.5mm for the proper binding of bricks. The above fig. shows the sieve process of the aggregate and bagasse ash.

5.4. MIXING OF MATERIALS:

The materials such as cement, sugarcane bagasse ash and fine aggregate are mixed with water based on the mix design. The cement is replaced by the bagasse ash.

5.5. CASTING OF BRICKS:

The mixed materials are casted in the mould of size 190mm x 90mm x 90mm.

5.6. CASTED BRICKS:

Figure. Casted bricks (Trail 1)

Figure. Casted bricks (Trail 2)

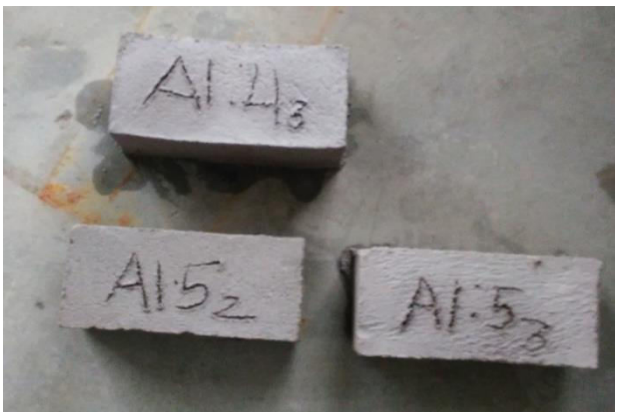


Figure. Casted bricks (Trail 3)

6. TEST RESULTS AND DISCUSSIONS

6.1 WATER ABSORPTION TEST:

Water absorption, % by mass, after 24 hours immersion in cold water is given by the formula

$$W = \frac{W_2 - W_1}{W_1} \times 100$$

W = ((3.289 – 3.152) / 3.152) × 100

W = 4.34%

Water absorption of the given bricks = 4.34%

Figure. Water absorption test

6.2 COMPRESSIVE STRENGTH TEST

The following steps were followed for compression testing.

- First the irregularities of surface were removed
- The concrete cube was placed centrally on the bottom plate of the universal testing machine
- Then the upper plate of the universal testing machine was lowered down up to the concrete cube was hold tightly without any movement
- Then the load was applied till the ultimate strength of brick is obtained
- And the compressive strength was calculated by this formula,

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

SI.NO	Ratio	Fly ash or Bagasse ash added (%)	Fly ash brick Compressive strength (N/mm^2)	Bagasse ash Compressive strength (N/mm^2)
1	1:3	20	2.0	2.6
		30	2.3	3.2
		40	2.1	2.4
		50	1.6	1.9
2	1:4	20	1.8	2.1
		30	1.2	1.5
3	1:5	20	1.5	1.9
		30	1.4	1.7

Table. compressive strength test

Figure. Compressive strength test

6.3 VISUAL INSPECTION TEST

In this test bricks are closely inspected for its shape. The bricks of good quality should be uniform in shape and should have truly rectangular shape with sharp edges.

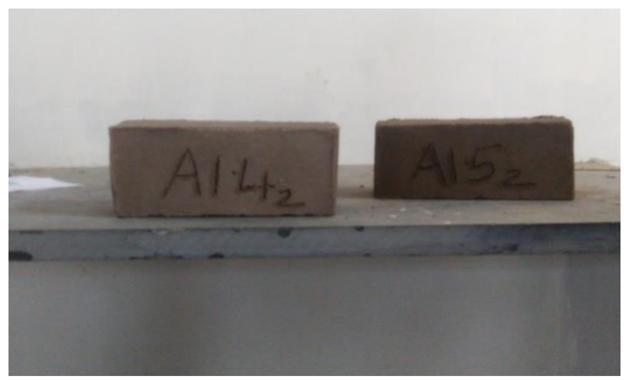


Figure. Visual inspection test

6.4 SIZE AND SHAPE TEST

Bricks are selected at random to check measurement of length, width and height.

Figure. Breadth of the brick

Figure. Width of the brick

Figure. Length of the brick

6.5 HARDNESS TEST

In this test, a scratch is made on brick surface with the help of finger nail. If no impression is left on the surface, brick is treated as to be sufficiently hard.

Figure. Hardness test

6.6 SOUNDNESS TEST

Two bricks are taken, one in each hand, and they are struck with each other lightly. A brick of good quality should not break and a clear ringing sound be produced.

Figure. Soundness test

6.7 STRUCTURE TEST

A brick is Brocken and its structure is examined. It should be homogeneous, compact and free from any defects such as holes, lumps etc.

Figure. Structure test

6.8 FLAME TEST

Brick which is used for construction should not flammable in open flame, so this was carried out for the brick.

The following are the steps involve in this test,

- First, the brick was wiped with cloths and all the foreign matters were removed
- Then the flammable sticks were fired. After that, the bricks held on the flame for five minutes.
- After five minutes fixing was stopped and the brick were observed.

Figure. Flame test

Figure. After flame test

7. CONCLUSION

Based on experimental investigations, the following observations are made regarding of partial replaced Bagasse ash:

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

ii. Environmental effects of wastes and disposal problems of waste can be reduced through this brick manufacturing procees.

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

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

v. In this research maximum compressive strength can be attained.

vi. Compressive strength decreases on increase in percentage of Bagasse ash as compare to fly ash.

vii. It provides innovative use of class F fly ash which contains less than 20% lime.

8. REFERENCE

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