ISSN: 2455 – 4200
International Journal of Engineering Research and Modern Education
Impact Factor 6.525, Special Issue, April - 2017
6th National Conference on Innovative Practices in Construction and Waste Management
On 25th April 2017 Organized By
Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu

EXPERIMENTAL STUDY ON PARTIALLY REPLACEMENT OF CLAY BY USING SUGARCANE BAGASSE ASH IN BRICK MANUFACTURING

R. Shanmugapriyan*, R. Devaki* & S. Saran**
* Assistant Professor, Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu
** PG Scholar, Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu

Cite This Article: R. Shanmugapriyan, R. Devaki & S. Saran, "Experimental Study on Partially Replacement of Clay by Using Sugarcane Bagasse Ash in Brick Manufacturing", Special Issue, April, Page Number 92-96, 2017.

Abstract:

Brick is one of the most important materials for the construction industry. This project is mainly based on making of waste materials in to construction material. Utilization of industrial and agricultural waste products in the industry has been the focus of economic, environmental and technical reasons. Sugarcane bagasse ash is a fibrous waste product of the sugar mill industry. Scba is partially replaced of 10%, 20% & 30% by weight in clay brick. Lime as a binding material for scba in to the soil. Scba-cs-l combined bricks were designed and developed in 3 proportions. The size of brick is 190x90x90mm. The fundamentals of brick manufacturing have not changed over time. However, technological advancements have made contemporary brick plants substantially more efficient and have improved the overall quality of the products. A more complete knowledge of raw materials and their properties, better control of firing, improved kiln designs and more advanced mechanization have all contributed to advancing the brick industry.

1. Introduction:

A. General: A Brick is a block or a single unit of a ceramic material used in a masonry construction. Typically bricks are stacked together or laid as brick work using various kind of mortar to hold the bricks together and make a permanent structure. In the world Asia produces 87% of the total production of the bricks. Moreover, the India and china are the major consumer countries of the bricks. Bricks are typically produced in common or standard sizes in bulk quantities. They have been regarded as one of the longest lasting and strongest building material used in 20th century. Manufacturing of bricks produces harmful gases which results in substantial air pollution. As per in India produces over 60 billion clay bricks annually resulting in strong impact on soil erosion and unprocessed emissions. Use of traditional technologies in firing the brick resulted in significant local air pollution. The standard size of brick provided by IS: 2212 (1991) is (19cm × 9cm × 9cm). Bricks are laid in horizontal courses, sometimes dry and sometimes wet mortar. In some instances, such as adobe the brick is merely dried. More usually it is fired in a kiln of some sort to make a true ceramic. Clay bricks are used in a wide range of buildings from housing to factories, and in a construction of a tunnels, waterways, bridges, etc. Their properties vary according to purpose for which they are intended, but clays have provided the basic material of construction for centuries. The brick production graph continuously decline from last five decades in India because importing the above ingredients from outside which will resulting in higher production cost. In order to satisfy the ever increasing demand for the energy efficient building construction material there is a need to adopt cost effective, environmentally appropriate technologies and upgrade traditional techniques with available local materials. This trend attracts researcher to find probable solution of this problem with using different materials like fly ash, black cotton soil, concrete blocks, agro waste, etc

Raw Materials of Brick: Clay is one of the most abundant natural mineral materials on earth. For brick manufacturing, clay must possess some specific properties and characteristics. Such clays must have plasticity, which permits them to be shaped or moulded when mixed with water; they must have sufficient wet and air-dried strength to maintain their shape after forming. Also, when subjected to appropriate temperatures, the clay particles must fuse together

Facing Bricks: Quality, durable bricks with an attractive appearance for external use above ground

Wire-Cut Bricks: The clay is continuously extruded to a required size and shape and then cut into individual bricks by means of a wire, much like a cheese is cut by cheese wire. Thousands of variations in colour and texture. Usually the cheapest facings available as the manufacturing process is highly automated.

B. Sugarcane Bagasse Ash: Ordinary Portland cement is recognized as a major construction material throughout the world. Researchers all over the world today are focusing on ways of utilizing either industrial or agricultural waste, as a source of raw materials for industry. This waste, utilization would not only be economical, but may also result in foreign exchange earnings and environmental pollution control .Industrial wastes, such as blast furnace slag, fly ash and silica fume are being used as supplementary cement replacement materials2. Currently, there has been an attempt to utilize the large amount of bagasse ash, the residue from an in-line sugar industry and the bagasse-biomass fuel in electric generation industry3. When this waste is burned under controlled conditions, it also gives ash having amorphous silica, which has pozzolanic properties4. 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 cement5. Therefore it is possible to use sugarcane bagasse ash (SCBA) as cement replacement material to improve quality and reduce the cost of construction materials such as mortar, concrete pavers, concrete roof tiles and soil cement interlocking block. The present study was carried out on SCBA obtained by controlled combustion of sugarcane bagasse, which was procured from the Tamilnadu province in India. Sugarcane production in India is over 300 million tons/year leaving about 10 million tons of as unutilized and hence, wastes material. sugar-cane bagasse is a fibrous waste-product of the sugar refining industry, along with ethanol vapour. Part of the great volume of this waste produced is recycled as a raw material for paper manufacture, but the industrial processing required for delignification and bleaching of the resulting paper pulp can be damaging for the environment. Seeking to overcome these drawbacks, IRD researchers UMR and INRA working jointly within IFRBAIM have elaborated a new bioprocess that transforms the bagasse into paper pulp and also produces an industrially useful enzyme, laccase. The process is based on the metabolism of a filamentous fungus which, when raised in culture on bagasse in the presence of ethanol, produces this enzyme. Laccase breaks down the lignin in the cane waste, changing the latter into paper pulp. Preliminary laboratory trials show that this integrated bioprocess can be adapted to other potential fibre-yielding materials, opening up promising applications for the paper industry

C. Properties of Sugarcane Bagasse:

- ✓ Easily available material
- ✓ High silica content (87%)
- ✓ Low specific gravity (2)
- ✓ Absorb low temperature

D. Aim & Objective: The aim of this project is to use the sugarcane bagasse ash in 10,20,30% in brick material.

- ✓ To minimize the agricultural waste and avoid environmental pollutions by using SCBA in brick.
- ✓ To minimize the usage of clay in brick and save the clay for future use.
- ✓ To attain a high sterngth brick.

2. Lime:

Lime is a generic term referring to the calcium oxide component of a material. When the term lime is used, it should always be followed by another term. For instance, lime in terms of a rock type is limestone and lime in the context of mortar is quicklime, lime putty and hydrated lime. When a farmer wants to lime his field he will use crushed limestone, and when he wants to white wash or lime wash his dairy, he may use crushed limestone in the form of chalk or may use hydrated lime in a wet slurry. To only say lime is not often enough information. Always think about which lime is being discussed. To manufacture hydrated lime, one must first calcine (heat) limestone to quicklime, then add water to hydrate the quicklime to get hydrated lime . The phrase quicklime refers to very rapid exothermic reaction that occurs on the addition of water to the calcium oxide (CaO). Once the reaction starts, it is quick and hot. The added complexity is that not only limestone, which is pure or high in calcium, is calcined to be used for a varied number of applications. The following is a summary of the terms commonly used by United States lime industry for quicklime.

Types of Lime:

- ✓ High calcium quicklime – derived from limestone containing the mineral calcite and 0 to 5 percent magnesium in the calcite structure ($CaCO3 \Rightarrow CaO$).
- ✓ Magnesian quicklime – derived from limestone containing 5 to 20 percent magnesium in the calcite structure ($Ca(Mg) CO3 \Rightarrow CaO$ + minor MgO)
- ✓ Dolomitic quicklime – derived from the rock dolomite, made up of the mineral dolomite containing the ratio of 40 to 44% calcium and 54 to 58% magnesium ($CaMg(CO3)2 \Rightarrow CaO + MgO$) Today in the United States, hydrated lime for masonry, stucco and plasters is dominantly from dolomitic quicklime. Lime putty when formed directly from quicklime is dominantly from high calcium quicklime.

3. Sugarcane Bagasse:

Sugar-cane bagasse is a fibrous waste-product of the sugar refining industry, along with ethanol vapour. Part of the great volume of this waste produced is recycled as a raw material for paper manufacture, but the industrial processing required for delignification and bleaching of the resulting paper pulp can be damaging for the environment. Seeking to overcome these drawbacks, IRD researchers UMR and INRA working jointly within IFRBAIM (Biotechnologies Agro-Industries de Marseille), have elaborated a new bioprocess that transforms the bagasse into paper pulp and also produces an industrially useful enzyme, laccase. The process is based on the metabolism of a filamentous fungus which, when raised in culture on bagasse in the presence of ethanol, produces this enzyme. Laccase breaks down the lignin in the cane waste, changing the latter into paper pulp. Preliminary laboratory trials show that this integrated bioprocess can be adapted to other potential fibre-yielding materials, opening up promising applications for the paper industry. Sugarcane bagasse (SCB) which is a voluminous by-product in the sugar mills when juice is extracted from the cane. It is, however, generally used as a fuel to fire furnaces in the same sugar mill that yields about 8-10% ashes containing high amounts of un-burnt matter, silicon, aluminum, iron and calcium oxides. But the ashes obtained directly from the mill are not reactive because of these are burnt under uncontrolled conditions and at very high temperatures. The ash, therefore, becomes an industrial waste and poses disposal problems. For obtaining amorphous and reactive sugarcane bagasse ash (SCBA), several trials were conducted to define optimum burning time and temperatures.

4. Mix Proportion for Brick:

S.No	CLAY	SCBA	LIME
1.	80%(2.8kg)	10%(0.350kg)	10%(0.350kg)
2.	70%(2.45kg)	20%(0.700kg)	10%(0.350kg)
3.	60%(2.10kg)	30%(1.05kg)	10%(0.350kg)

A. Water Ratio:

FIRST PROPORTION - 35%
SECOND PROPRTION - 45%
THIRD PROPOTION - 55%

B. Testing for Raw Materials and Ordinary Brick:

✓ Specific Gravity Test of SCBA

Specific gravity (G) = (w2-w1)/(w2-w1)-(w3-w4)
W1-empty weight of pycnometer
W2-wt of pycnometer+oven dry ash
W3- wt of pycnometer+oven dry ash+water
W4- wt of pycnometer+water

S.No	Observation	Result (Kg)
1.	Empty weight of pyconometer (w 1)	0.560
2.	Weigh of pyconometer +sugarcanebagasse(w2)	1.010
3.	Weight of pyconometer + sugarcane bagasse+ water (w3)	1.302
4.	Weight of pyconometer +water(w4)	1.518

✓ Calculation:

Specific gravity (G) = (w2-w1)/(w2-w1)-(w3-w1)
Specific gravity (G) = 2.00

✓ Specific gravity test of lime

S.No	Observation	Result (Kg)
1.	Empty weight of pyconometer (w 1)	0.560 kg
2.	Weight of pyconometer + Lime(w2)	1.202 kg
3.	Weight of pyconometer+ Lime+ water(w3)	1.572 kg
4.	Weight of pyconometer+ water (w4)	1.219kg

✓ Calculation:

Specific gravity (G) = (w2-w1)/(w2-w1)-(w2-w1)
Specific gravity (G) = 2.20

✓ Sieve analysis of scba

Weight of the SCBA (W) = 1000 gm

✓ Result for sieve analysis

Percentage of gravel size (> 4.75) = 90.8%Percentage of coarse size (4.75 – 2.36mm) = 8.9%Percentageof medium size (2.36–0.425mm) = 66.6%Percentage of fine size (0.42 – 0.075mm) = 19.3%
Percentage of fineness size (< 0.075) = 0.3%

✓ Sieve analysis of lime

Weight of the lime (W) = 1000 gm.

✓ Result for sieve analysis

Percentage of gravel size (> 4.75) = 88% Percentage of coarse size (4.75 – 2.36mm) = 6.8%
Percentage of medium size (2.36 -0.425mm) = 61.7%
Percentage of fine size (0.425 – 0.075mm) = 19.3% Percentage of fineness size (< 0.075)= 0.2%

C. Compressive Strength Test of Ordinary Brick:

✓ **Compressive Strength:** The strength activity index test in accordance with ASTM C 109 (8) was tested at the age of 4 days of bricks .Mortars were put in a mould to obtain the specimens of I90x90x90mm .which were stored in a open areas at 36°C for 4days. The specimens were curing in 4 days until the time of the test. The reported compressive strength is one sample. The mix proportions of the mortar were used in the current study with proportion of SCBA-CS-L brick.

✓ Compressive strength of ordinary brick

Proportion	Weight of brick(kg)	Load (KN)	Compressive strength (N/mm2)
Normal	3.2	73	4.2

✓ Calculation

1. Measurements
Length (mm) =190, Breadth (mm) =90, Height (mm) =90
2. Area subjected to compression (A) =17.10x103mm2
3. Volume (V) =1.53x106 mm3
4. Weight of brick (W) =3.2kg
5. Unit weight of cube (W/V)=2.072x10-6Kg/mm3
6. Breaking load (B) =73KN
7. Compressive strength (C) =4.29 N/mm2

✓ Water absorption test of ordinary brick

Calculation
Initial weight of aggregate(X) = 3208g
Final weight of aggregate (X1) = 3557g
%of water absorption =11.15%

ISSN: 2455 – 4200
International Journal of Engineering Research and Modern Education
Impact Factor 6.525, Special Issue, April - 2017
6th National Conference on Innovative Practices in Construction and Waste Management
On 25th April 2017 Organized By
Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu

- ✓ Flexural strength of ordinary brick

Specimen	Weight(Kg)	Load (Kn)	Modulus of Rupture (N/Mm2)
1.	3.26	1.2	0.24

5. Test Done For After Making the SCBA-CS-L Brick:

***A.* First proportion (10%)**

Proportion	Weight of brick(kg)	Load (KN)	Compressive strength (N/mm2)
1. (10%)	3.217	29	1.70

B. Second proportion (20%)

Proportion	Weight of brick(kg)	Load (KN)	Compressive strength (N/mm2)
1. (10%)	3.125	38	2.22

C. Third proportion (30%)

Proportion	Weight of brick(kg)	Load (KN)	Compressive strength (N/mm2)
1. (10%)	3.281	21	1.22

D. Flexural strength test

- ✓ First proportion (10%):

Specimen	Weight(Kg)	Load (Kn)	Modulus of Rupture (N/Mm2)
1.	3.178	4.5	1.17

- ✓ Second proportion (10%):

Specimen	Weight (Kg)	Load (Kn)	Modulus of Rupture (N/Mm2)
1.	3.226	6	1.56

- ✓ Third proportion (10%):

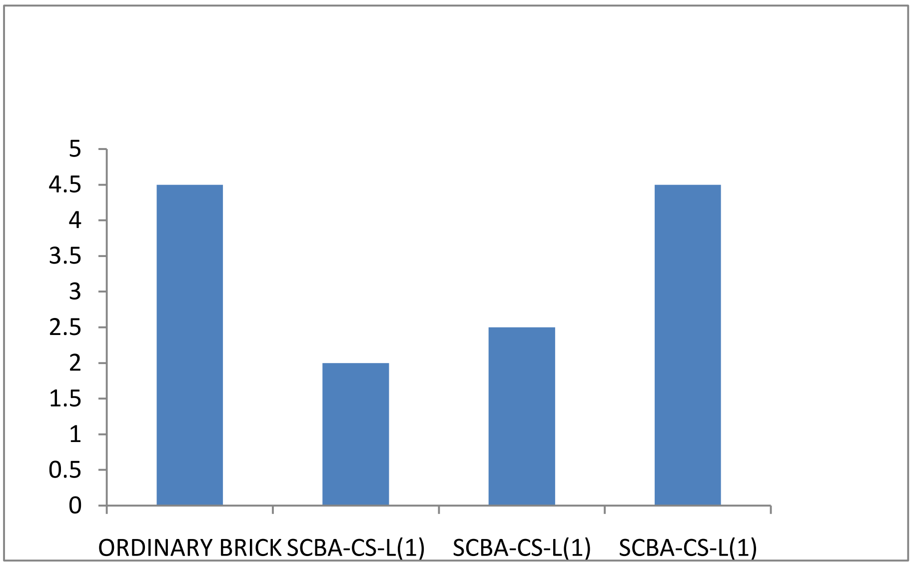
Specimen	Weight(Kg)	Load (Kn)	Modulus of Rupture (N/Mm2)
1.	3.212	3.5	1.02

E. Water Absorption Test:

- ✓ First proportion (10%)
  - Initial weight of aggregate(X) = 3279g
  - Final weight of aggregate (X1) = 3557g
  - %of water absorption = 8.48%
- ✓ Second proportion (10%)
  - Initial weight of aggregate(X) = 3235g
  - Final weight of aggregate (X1) = 3763g
  - %of water absorption = 16.32%
- ✓ Third proportion (10%)
  - Initial weight of aggregate(X) = 3214g
  - Final weight of aggregate (X1) = 4108g
  - %of water absorption = 27.81%

6. Graph Plotted Between Ordinary Brick and SCBA-CS-L:

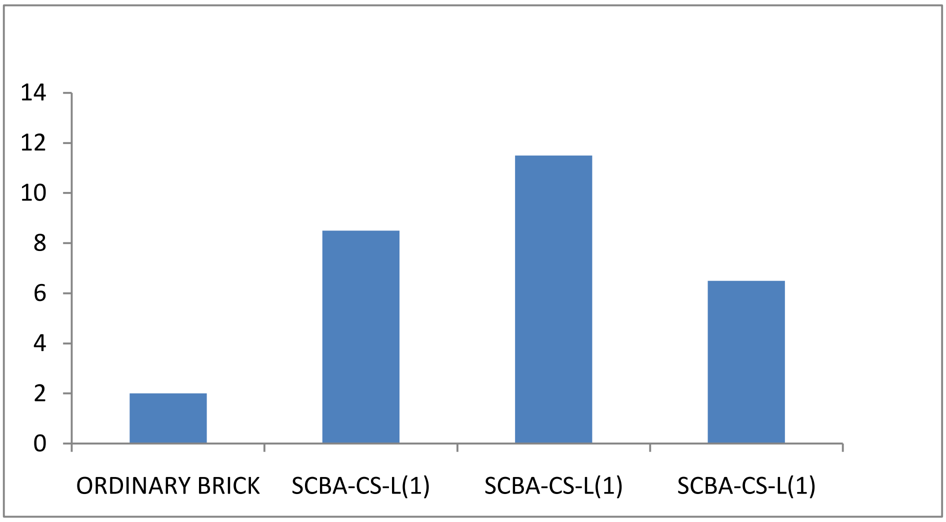
A. Bricks in Compressive Test:



Graph plotted between ordinary brick and SCBA-CS-L

ISSN: 2455 – 4200
International Journal of Engineering Research and Modern Education
Impact Factor 6.525, Special Issue, April - 2017
6th National Conference on Innovative Practices in Construction and Waste Management
On 25th April 2017 Organized By
Department of Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu

B. Bricks in Flexural Strength Test:



7. Conclusion:

From the present investigation and limited observations reported, the combined use of sugarcane bagasse ash and lime and claysoil exhibited excellent performance. It was observed that the increase in early strength by the addition of SCBA. Therefore, the result of our project proved that use of sugarcane bagasse ash increases compressive strength and reduce the waste disposal. Sugarcane bagasse ash, lime and clay (20%) proportion gives more strength as compare with other proportions.

8. References:

1. K. L. Loewenstein , The Manufacturing Technology of Continuous Glass Fibers, 3rdrevised ed., Elsevier, 1993
2. F. T. Wallenberger , Structural Silicate and Texturizing Silica Glass Fibers, in Advanced In organic Fibers Processes, Structures, Properties ,Applications, F. T. Wallenberger, Ed., Kluwer Academic Publishers, 1999, p 129–168
3. D. M. Miller, Glass Fibers, Composites, Vol1, Engineered Materials Handbook, ASM International, 1987, p 45–48
4. “Standard Specification for Glass Fiber Strands”, D 578-98, Annual Book of ASTM Standards, ASTM
5. P. K. Gupta, Glass Fibers for Composite Materials, Fibre Reinforcements for Composite Materials, A. R. Bunsell, Ed., Elsevier Publishers, 1988, p 19–72
6. Sanjuan, M. A., Andrade, C., and Bentur, A., “Effect of Crack Control in Mortars Containing Polyethylene Fibers on The Corrosion of Steel in A Cementitious Matrix,” ACI Mater., Vol. 94, No. 2, pp.134-141, 1997.