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A NEW METHOD FOR MANUFACTURE OF COST EFFECTIVE BRICKS

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ABSTRACT

The paper is addressed to manufacture low-cost durable bricks. Due to rapid increase in population and urbanisation, the conventional type of bricks has become scarce. So, to meet the demand a cost-effective brick have been manufactured using the agricultural waste such as rice husk ash (RHA), sugarcane bagasse ash (SCBA), and bamboo leaves ash (BLA). The crushing strength is determined for different proportions at different burning and cooling temperatures by using Universal Testing machine (UTM) for optimization and are named as Bio-bricks.

Three types of bricks have been prepared in different proportions of mix and its compressive strength and Tensile strength were determined. On observation, these bricks are as per the recommended strength of Indian Standard for a building material and usage. The advantage of these Bio-brick is cost-effective, sustainable, acts as good heat and sound insulator and has overall negative carbon footprint. The watermelon seeds may also be used for adding strength, but it is not attempted here. Based on the strength these bio bricks may be used in building the low-cost houses with a combination of wood or metal structural framework.

Due to its porosity and low density these bio-bricks it maintains humidity of the buildings, so it is more suitable for hot climate like India.

KEYWORDS: *Agro- Waste, Bio Bricks, Cost Effective, Durable*

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INTRODUCTION

India generates large quantity around 400 million tonnes of agricultural waste every year. Building construction is one of India's fastest growing sectors, and it places a significant strain on the country's infrastructure. The most important building materials are clay bricks that are fired/burnt. In fact, people around the world are now talking about replacing actual building methods and materials with green buildings. Even though it is important to note that the concept of green buildings is not new, but it is now needed more than ever because of the problems earth is currently facing such as global warming. The disadvantageous of conventional clay brick manufacturing is it emits a large amount of greenhouse gases, depletion of natural resources, Emission of huge quantity of toxic elements from brick kilns causing serious health hazards. Now, the modern brick manufacturing industry is facing many challenges like cost, raw material shortage and environmental issues[1]. So, it is necessary to develop new construction materials with high thermal and mechanical performance. Thus, this paper is focused on manufacturing of low cost durable bricks using ago-waste. Though some

papers were published on alternate substances to conventional brick manufacturing, but it was not successful.

Figure 1

Figure 2

Figure 3

Methodology

The large clay lumps of the material were subjected to crushing followed by screening to get the optimum particle size. The size analysis o the material is given in the Table. Initially the raw material is chosen such that clay must be devoid of sandy material and , which permits them to be shaped or moulded when mixed with water, produces a homogeneous, plastic clay mass[2].Now the agricultural waste rice husk, bagasse and bamboo ash were mixed in different proportions is added to the clay as given.

Ash **Bamboo ash** **Rice Husk**

Figure 4

Three types of bricks have been prepared Rice Husk (RHA) 10% and Sugarcane bagasse ash (SCBA) 10% and Bamboo leaves ash (BLA) 10% and 70% clay. The proportions are changed as shown in the table.

Normally the unburnt fresh brick contain upto20 percent moisture. Before starting the firing process, the moisture content is sun dried for 1 or 2 days or evaporated in a dryer chambers at temperatures ranging from about 38ºC to 104ºC depending up on the facility available. During this process, it loses most of the water content and the brick is ready for loading into kiln for burning. The bricks are placed manually or by mechanical means depending up on the size of the kiln. The setting pattern has some influence on appearance of the brick. The Brick placed face-to-face will have a more uniform colour than bricks placed cross-set or placed face-to-back.

Table 1: Size Analysis of Brick Material

S. No	Clay%	Silt%	Sand%	Fine Gravel%
1	39	24	32	5
2	41	30	27	2
3	36	34	29	1
4	35	36	23	6

There are two types of kilns used by manufacturers. The most common type is a tunnel kiln, followed by periodic kilns. Fuel may be natural gas, coal, sawdust, methane gas from landfills or a combination of these fuels. Dried brick are set in periodic kilns according to a prescribed pattern that permits circulation of hot kiln gases. Bricks are fired for 20 to 40hours depending upon the number of bricks in the kiln and other variables

When clay bricks are heated to a high temperature, a chemical reaction occurs in the clay which makes the brick permanently hard, durable and resistant to weather and water. After the temperature attained peak and is maintained for a few hours, the cooling process begins. Cooling time is 10 hours for tunnel kilns and from 5 to 24 hours in periodic kilns. Cooling is an important stage in brick manufacturing because the rate of cooling has a direct effect on colour.

A white vapour or steam comes from the top of the kiln during the process of firing. If the firing process is stopped in the middle the bricks in the kiln would be non-suitable for building purposes since they would not be stabilized and would easily be worn down by wind and rain.

The physical properties o materials used are given in Table-2

Table 2: Physical Properties of Materials

S. No	Material	Particle Size (microns)	Bulk Density	pH	Porosity
1	Clay	300-600	1.47	7.3	35.8
	Bagasse	0.10 to 0.60	111.78	5.8	76.77
3	Rice Husk	0.2-0.7	342.08	5.8	65.56
4	Bamboo ash	0.6-20	748.1	6.8	81

RESULTS AND DISCUSSIONS

It is to note that clay bricks that are used for the majority of buildings are fired to very high temperatures (around 1200°c), which adds a lot in the price of their manufacturing. Therefore, it is proposed bio-bricks to make strong clay bricks but with less firing. The fundamentals of brick manufacturing have to be changed with time. It is known that around 300 billion bricks annually are being produced by brick industries. Manufacturing of RCB (Red Clay Bricks) consumes huge amount of clay that leads to erosion of top soil and also land degradation chances gets increased. The phases based on life cycle analysis (LCA) it needs to add the Clay bricks with other waste material (Agriculture waste) due to degrading or reducing natural resources so that the pollution emitted through the brick life is reduced. Agriculture waste such as Rice husk, Sugarcane bagasse ash (SCBA), Bamboo/any tree leaves' ash have been chosen for this study.

In India every year more than30 million tones of paddy is produced. This gives around 25 million tonnes of husk and in turn 5 million tonnes of Rice Husk Ash. Normally, the residue is disposed of by burning at the mill sites and the resultant rice husk ash (RHA) is dumped on a waste land. This generates environmental, pollution and land dereliction problems. The ash that is produced can be used as a supplementary in Clay Bricks.

Similarly, India ranks the second largest producer of sugarcane globally after Brazil and it produces approximately 400 million tonnes of sugarcane annually. From sugarcane about 40-50% fibrous residue is obtained after extraction of sugar juice which is known as sugarcane bagasse. This bagasse is used as fuel in boilers to produce steam which runs the turbines generating power for plant operation. It leaves behind approximately 8-10% ash as solid waste which is known as sugarcane bagasse ash (SCBA). Approximately 15 million tonnes of SCBA is generated yearly in India which is dumped in open spaces or in nearby agricultural fields causing significant land and water pollution. So, this ash is attempted to use for manufacturing of bio bricks.

Bamboo is the fastest growing and highest yielding natural resource available to mankind. According to a study, the annual production of bamboos all over the world is about 20 Mt, mainly in Asia and Latin America and this results in an enormous amount of agricultural wastes from the bamboo sector[5]. However, in India its generation may be less, but it could be used. Similarly world annual potato waste generated is around 12 million tonnes, out of which 2 million tonnes of potato waste is generated in India alone. This generates obnoxious gases and Green House Gases besides foul odour around the landfill sites. So, this also can be tried for manufacturing in bricks.

Three bricks have been prepared The size of brick is being taken as per the B.I.S Code for both Standard and Nominal size of brick which is 20mm X 10mm X 10mm as shown in the table in different combinations and compressive strengths have been determined.

Table 3

Material	Percentage	Percentage	Percentage	Clayey Material (used by Brick Factory)	Total
Rice husk ash (RHA)	10	15	30	45%	100%
Sugarcane Bagasse ash (SCBA)	10	15	20	55%	100%
Bamboo Leaves Ash (BLA)	10	15	10	65%	100%
Clayey material (Brick factory)	70	55	40	-	-
Total	100%	100%	100%	-	-
Tensile strength	1.645	0.987	0.828		
Compressive strength (N/mm2)	2.945	3.932	3.123		

Figure 5

On comparison with different types of bricks the fly ash gives maximum compression strength of 1.25 N/mm2 at 5% and 10%. Coarse aggregate gives maximum compression strength of 1.4 N/mm2 at 10%. Quarry dust gives maximum compression strength of 1.25 N/mm2 at 5%. Bagasse ash gives maximum compression strength of 1.15 N/mm2 at 5%. But from the grain size of soil, the soil passing through 600µ gives better results compared to other grain size. Soil of 600µ gives maximum compression strength of 1.65 N/mm2 when no other admixtures is added to it.

The compressive strength of the agro-bricks varies between 2.50 to 3.25 N/mm2 whereas the conventional clay bricks compressive strength is 3.4 to 4.2 N/m2 which is almost nearer. Also it is well within the standards prescribed by ASTM. Thus, these bricks are durable and suitable for construction. However, the compressive strength of these bio bricks may further improved by using additives.

CONCLUSION

The Special-bricks or agro-waste based bricks when compared to conventional clay bricks are lighter in weight, strong and environment friendly. Even though the compressive strength is slightly less than that of conventional clay bricks, it is suitable as per ASTM Standards. It is also cost-effective and acts as good heat and sound insulator. Out of the three types of bricks prepared the combination of 15% Rice Husk (RHA), 15% Sugarcane bagasse ash (SCBA) and 15% and Bamboo leaves ash(BLA) and 55% clay is ideal in compressive strength and sustainable.

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