USE OF GARMENT WASTE FABRICS MAKING ECOFRIENDLY, LIGHTWEIGHT & LOW COST BRICKS

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ABSTRACT

At the present condition of environmental hazards global warming is the most alarming one. Our brick fields contribute a lot in this serious condition by producing huge carbon emissions at the time of burning bricks. Also, huge amounts of garment waste are disposed every day in our country that also pollute our river and fill the river day by day specially around Dhaka region.In this study, an attempt was made to combine the two problems to find one fruitful solution.By using garment wastes to produce ecofriendly, light weight and economic brick. Ecofriendly bricks are prepared in the laboratory by using garment waste fabrics with cement and sand that can be replaced brick fields by green brick manufacturer industry. Several sets of bricks are prepared in laboratory and tested to assure the quality of bricks by comparing it to the conventional burnt clay bricks. Satisfactory results are found for compressive strength, hardness, water absorption and unit weight test.The capacity of ecofriendly bricks against compression is very satisfying. The compressive strength for traditional burnt clay brick is 2500 psi (according to ASTM) but this modified brick poses 5500 psi. Also, some parameters are checked for eco-friendliness. This type of brick industry is free from pollution because generation of heat energy due to burning of wood is not required here. The amount of waste fabrics in a modified brick is about 14% of its weight, so it can be said that, a large amount of waste fabrics are consumed.

The weight of modified lightweight brick is 2.3 kg which is 1.2 kg less than our conventional burnt clay brick.

Cost analysis for making 1 brick is done which is less than the present cost of burnt clay brick.It can be highly recommended in our construction sector.

Keywords:*Eco-friendly bricks, Garment wastes, Unburnt bricks, Global warming, Compressive Strength, Hardness, Soundness, Durability.*

1. INTRODUCTION

The Countries all over the world are disposing huge amounts of cotton and textile wastes. The bulk of cotton and textile wastes are disposed of in a way that has a negative impact on the environment. Rivers are occupied day by day due to this kind of poor management of garment wastes. Also, global warming due to carbon emission is increasing at an alarming rate and traditional brick field contributes a lot in this sectors. In Figure 1 & Figure 2 present condition of garment waste management is presented which is very disappointing. The goal of this project is to conduct experimental research to determine whether cotton and textile wastes may be combined to create an eco-friendly, lightweight & economic building material with good insulating qualities(S.P. Raut, R.V. Ralegaonkar & S.A. Mandavgane, 2011). The findings demonstrated that the cotton and textile waste bricks meet the ASTM and IS standards for compressive strength and other tests (Antico, F. C., M. J., Araya-letelier, G. & Durán D., 2017).

Figure 1: No proper management

Figure 2: Garments wastes are disposed randomly

From the above discussion, the following objectives are selected for the present study.

a. To investigate garments wastes as an environmental hazard, proper investigation should be carried out to get some idea about probable hazard created by random disposal of waste fabrics.
b. To make ecofriendly, lightweight and economic bricks by using waste fabrics in brick to remove carbon emission. So that, the risk of global warming may be reduced.
c. To perform several test mainly compressive strength, unit weight & hardness for ensuring the quality of bricks.
d. To calculate cost analysis of a brick so that economic building materials can be obtained.

2. METHODOLOGY

The successive processes are to be done in order to accomplish the necessary objectives, have shown in Figure 3.

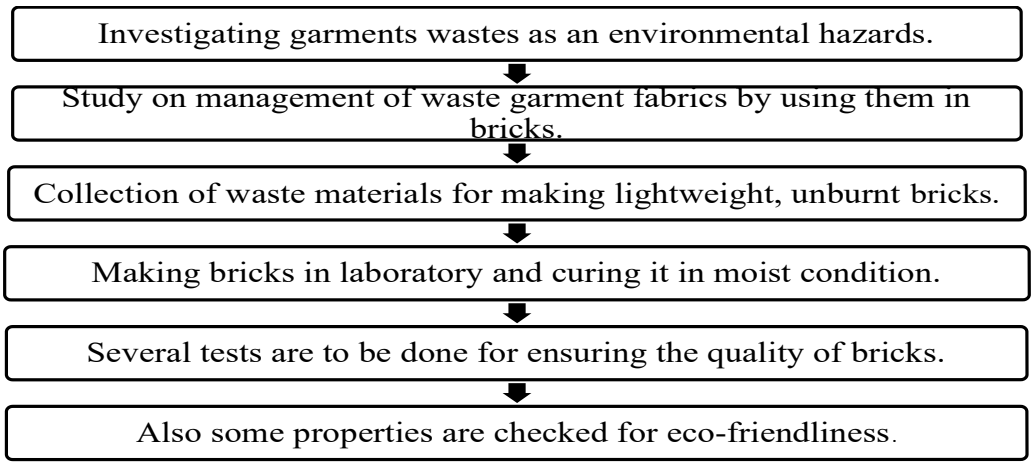

Figure 3: Workflow diagram

2.1 Preparation of Bricks

Materials collection: Waste fabrics are collected from different sources near the bank of Buriganga River close to garments factory.
Mix ratio: Different mix ratios (ACI mix ratios) are fixed to make light weight brick named modified brick set 1& modified brick set 2.Water cement ratio 0.6 for modified brick set 1and 0.55 is selected for modified brick set 2 (from literature rivew).
Laboratory work:2 sets of bricks are prepared by using the given mix ratio. Firstly, wastes fabrics are dry mixed with sand and cement. Then precise amount of water is mixed with dry mixture. After mixing, the mixture is placed in a mold of standard brick size by 2 layers.After giving each layer 25 numbers of blows are given to compact properly.
Curing of bricks: The modified bricks are kept in a moist condition for curing.It is cured in moist condition using jute mats.Different tests are conducted in laboratory for ensuring the quality of bricks after 28 days of curing.

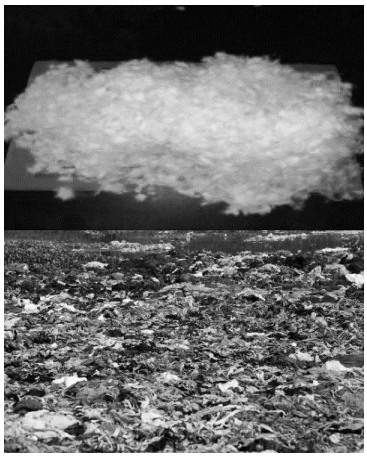

Figure 4: Collected waste fabrics

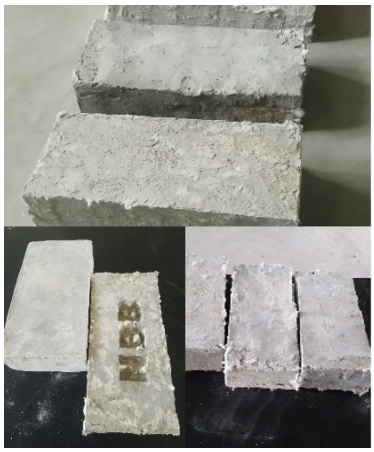

Figure 5: Prepared bricks

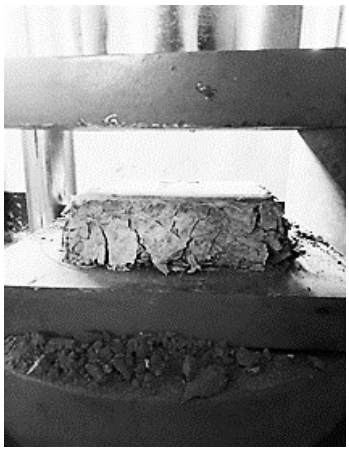

Figure 6: Compression test

Table 1: Materials composition

Brick type	Brick size	Cement: Sand	$\frac{W}{C}$	Weight of fabrics for making 1brick (gm)
Modified brick set 1	$9.5 \times 4.5 \times 2.75$	1:2	0.6	350
Modified brick set 2	$9.5 \times 4.5 \times 2.75$	1:1	0.55	300
Burnt clay brick	$9.5 \times 4.5 \times 2.75$	No cement	Conventional	No fabrics

2.2 Test of bricks

In order to find the quality and sustainability of the bricks, various tests on bricks are to be performed (according to ASTM). Further in this article, several tests of bricks are listed below.

Table 2: List of test name

Serial No.	Test Name
1.	Compressive strength test of brick
2.	Colour and weight test of bricks
3.	Water absorption test of brick
4.	Unit weight test of bricks

5.	Efflorescence test of brick
6.	Hardness test.

For each modified brick set, 9 nos bricks are prepared and tested in laboratory. The average results are presented in tabular form. Also, a set of locally available burnt clay brick is tested to compare with modified brick.

2.2.1 Compressive strength test of brick

From the result of compressive strength test it is observed that, this brick is quite good in compression. Also nowadays bricks are used only for partition wall not load bearing wall.

Table 3: Compressive strength test for 28 days

Brick Type	Compressive Strength (PSI)
Modified brick set 1	5504.87
Modified brick set 2	6366.96
Burnt clay brick	2500 (According to ASTM standard)

2.2.2 Colour& weight test of brick

Table 4: Colour& weight test of brick

Brick Type	Color	Weight of Brick(kg)
Modified brick set 1	Gray	2.3
Modified brick set 2	Gray	2.5
Burnt clay brick	Red	3.5

2.2.3 Water Absorption test

Table 5: Water absorption test of brick

Brick Type	Water Absorption Value
Modified brick set 1	21.7%
Modified brick set 2	19.2%
Burnt clay brick	20%

Here, for modified brick set 1
Weight of dry brick, W1=2.5kg
Weight of wet brick, W2=2.98kg

$$\text{Water absorption (\%)} = \frac{W_2 - W_1}{W_1} = \frac{2.98 - 2.5}{2.5} = 19.2\%$$

Absorption capacity of modified bricks is very close to Burnt clay brick.

2.2.4 Unit weight of bricks

Table 6: Unit weight of brick

Brick Type	Unit weight of bricks(Kg/m^3)
Modified brick set 1	1198
Modified brick set 2	1302
Burnt clay brick	1823

Unit weight of modified brick is less than conventional burnt clay brick which will reduce structural dead load.

2.2.5 Efflorescence test of bricks

Efflorescence causes due to soluble salt presents in bricks. The presence of such salts were determined as follows.
The brick was placed in a 25 mm depth of water in a porcelaindish with a diameter of 150 mm and depth of 30 mm.
The experiment was done in a well-ventilated room at 25 degrees C till all the water in the dish was either absorbed by the specimen or evaporated.
After drying the specimen, similar quantity of water was added again to the dish and let it be absorbed by the specimen or for second evaporation.
After that the brick was observed very carefully, but no deposition of whitish powder of different salts (calcium sulphate, magnesium sulphate and carbonates) were found.

2.2.6 Hardness test

The hardness test of brick was done by the scratch of the fingernail. To do the scratch on the brick, a nail was used, but there was no scratch left on the surface of the brick, so it is considered that the brick is sufficient hard.

2.3 Test for Eco-friendliness

Table 7: Test for Eco-friendliness (K.KrishnaBhavaniSiram, 2012)

Serial No.	Parameters	Modified bricks	Burnt clay bricks
1.	Pollution	Free from pollution	Huge carbon emissions due to burning of woods.
2.	Energy requirement	No energy required	High heat energy required for burning of clay brick.
3.	Waste reuse	Consume 14% waste fabrics	Fresh agricultural soil, no waste consumption.

Since less energy is required, this modified brick is considered as a sustainable construction material.

3. ADVANTAGES

Some significant advantages of modified bricks are briefly described here.
The most significant advantage of this modified light weight brick is its dead load is reduced without sacrificing strength.
This brick will reduce carbon emission in a large scale which has a remarkable effect on our environment, hence reduce global warming problem.
Garment waste fabrics that fill our rivers surrounding Dhaka city may be reduced by using this waste material in the brick industry, which is a sustainable idea.

4. COST ANALYSIS

Table 8: Cost analysis for a single brick

Brick Type	Cost (Tk.)
Modified brick set 1	8

Modified brick set 2	10
Burnt clay brick	14

Here, price of cement for 1bag(50kg) =485tk
Price of sand 1cft(46.01kg)=17tk
For modified brick set 2.
Amount of cement needed=1kg
Amount of sand needed=1kg
So, cost of 1 brick=9.7+0.4=10tk

5. USE OF MODIFIED BRICKS

Different applications of modified bricks are described below:
Partition wall: It can be widely used in building structures as a partition wall.
Boundary wall: This modified brick can be used in boundary wall like traditional burnt clay bricks.
Brick made roads: Nowadays it is common practice to make structure aesthetically acceptable, from this point of view this type of modified brick made road is quite acceptable from aesthetic point of view as well as load carrying capacity.
Retaining wall: In hilly areas retaining wall is a widely used structures and modified brick made of waste garments fabrics can be used in retaining wall.

6. CONCLUSIONS

Garment waste fabrics that are disposed of randomly in the environment are identified as environmental hazards. By using garment waste, a lightweight brick weighing 2.3 kg is made in the laboratory, which is 1.2 kg less than the weight of a burnt clay brick (3.5 kg). The eco-friendliness of the modified brick is very satisfying since no energy consumption is required to make this brick. A cost analysis for making one brick has been done, which is less than the present cost of burnt clay bricks. Also, the quality of the modified brick is so satisfying that it has been assured by performing several tests in the laboratory and comparing it with burnt clay bricks.

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