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Experimental Analysis on Utilization of Cigarette Butts in Fired Clay Bricks

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ABSTRACT

The main objective of this study was to investigate the possibility of recycling CBs into fired clay bricks. The results of the investigation are very encouraging. The fired clay bricks produced by incorporating 0% to 10% CBs by mass, equivalent to approximately 0% to 30% by volume can be used in different applications according to the required strength. The major findings presented throughout this study are summarized as follows:

The dry density of manufactured fired clay bricks decreased when CBs were incorporated into the raw materials. This is because the bricks became more porous as CB content increased. CB addition increased from 2.5% to 10% by mass. Low-density or light-weight bricks have great advantages in construction including lower structural dead load, easier handling, lower transport costs, lower thermal conductivity and a higher number of bricks produced per tones of raw materials. Light bricks can be substituted for standard bricks in different applications according to the required strength. CBs can also be regarded as a potential addition to the raw materials used in the manufacture of light-weight fired bricks. Therefore, manufactured clay- CB bricks are appropriate for these applications.

The compressive strength of the bricks tested in this study was reduced markedly from 26 MPa (for 0% CBs) to 13, 5, 3 and 3 MPa for 2.5%, 5.0%, 7.5% and 10% of CB content respectively. Common minimum values recommended for characteristic compressive strength for non-load- bearing and load-bearing fired clay bricks are 3 to 5 MPa and 5 to 10 MPa

Keywords : Compressive strength, Low-density or light-weight bricks, manufactured clay, fired clay bricks

I. INTRODUCTION

There are several methods of disposal of cigarette butts i.e. land filling, incineration and resurge. Land filling is one of the disposal method but as it contain high amount of inorganic content and toxic substances, which may pollute the underground water and may leak pollutants into the soil and surrounding environment. Second method of disposal is incineration, it does not look a sustainable solution as burning such kind of waste may contain various hazardous substances which may evolved in the atmosphere. Third method is resurge, which we have adopted in this study. The alternative disposal of cigarette butts can be accomplished by using it as an engineering construction material.

II. REVIEW OF LITERATURE

Karim Galal Abdullatif et al (2020) Tobacco filters are one of the most polluted objects in the world that are harmful to the environment. Incorporation into building bricks provides the prospect of damage control and solves the typical non-biodegradable waste recycling problem. This paper aims to investigate this outlook by adding a tobacco filter to the production of two samples of calcined clay bricks. Tobacco filters occupy 5% and 10% of the volume. The mixing and forming process was done manually and affected the bricks during the test. Test results were consistent with previous studies (outside Egypt), but only one sample of brick containing 5% bat volume meets Egypt's requirements for bricks used for non-structural purposes. I did. Industrial production of these bricks is highly recommended as it exceeds the required Egyptian standards, saves large amounts of natural resources and eliminates tobacco waste.

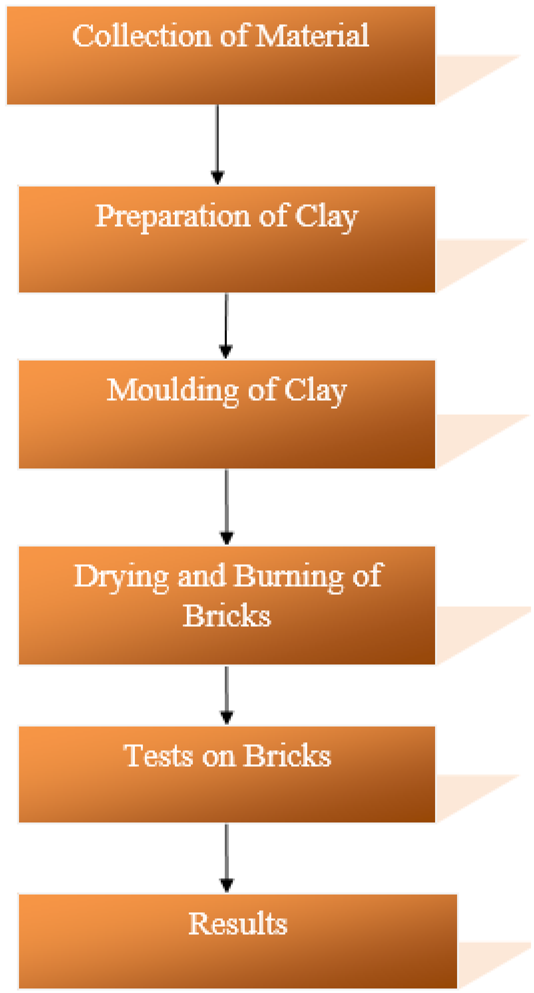
Yi CUI, Zhao-rong et al (2018) China is the number one smoker in the world. The problem of environmental pollution and recycling of cigarette butts is becoming more and more serious. Some countries and regions of the world are taking steps to better recycle cigarette butts. To determine the utility of cigarette butts in driving behavior, this test uses Matrix No. 70 bitumen and tobacco waste as raw materials. The optimum amount of cigarette butt content in the experiment is further determined based on the test performance of the modified asphalt mixture, and the modified bitumen mixture is prepared by the addition method. Performance indicators of modified bitumen mixtures at various doses were tested and studied. Optimal tobacco butts content of the modified asphalt mixture, combined with production and economic realities, is determined to optimize road performance

Objectives of Present Work:

Present work includes the following objectives

- ✓ To determine the feasibility of mixing of cigarette butts and quarry dust in the clayey mixture.
- ✓ To determine the density of manufactured brick by adding different percentage of cigarette butts in brick manufacturing.
- ✓ To determine the engineering properties of cigarette butt clay bricks by performing laboratory and field tests.
- ✓ To reduce the manufacturing cost of brick by using such waste. So, as to develop economical bricks.

III. METHODS



SOIL

- ✓ Soil word used in this study of brick manufacturing is defined as a mixture of silty sandy clay and quarry dust.
- ✓ According to Indian standard classification clay with appreciable amount (about 12%) of silt and sand are known as silty sandy clay.
- ✓ Clay mineral has been used for brick manufacturing because of versatility of clay. When clay mineral is mixed with water and it forms a plastic mass that can be formed by pressure and fired in the furnace. This turns this clay into building component of high performance properties.
- ✓ Quarry dust is a byproduct waste which is formed during the crushing of rock.
- ✓ It is used as a replacement of natural river sand in brick and collected from the local crusher plant.
- ✓ Different proportion of silty sandy clay and quarry dust has been used in brick manufacturing.

CIGARETTE BUTTS

- ✓ The leftover part of cigarette after smoking is known as cigarette butt. It is approximately 30% of the brand new cigarette length. it is basically a tissue which is used as filter while smoking.
- ✓ Cigarette butts are made up of cellulose acetate (plastic), rayon and paper.
- ✓ The main component of cigarette butt is cellulose acetate which is present at about 95%.
- ✓ It is disposed without any treatment; which causes water pollution, land pollution and also hazardous for the environment.
- ✓ Before using it is disinfected by using H_2SO_4.

Uses of cigarette butts litter in the manufacturing of brick may solve the environmental problem and may produce light weight brick at low costs

IV. RESULT DISCUSSION

Results of the testing method including drying and firing shrinkage, dry density, compressive strength, flexural strength and water properties for the control samples and the clay-CB brick samples are presented and discussed in this section. Note that all the results reported are the average of three measurements and the graphs obtained are valid within the testing conditions in this study only

Dry Density

Table 4.1 shows the effect of CB addition on the dry density of fired clay bricks after firing. The dry density of the manufactured bricks decreased from 2118 kg/m³ for the control samples (0% CBs) to 1482 kg/m³ for bricks with 10% CB content. According to AS 3700 (2001), the dry density of the standard clay brick is between 1800 to 2000 kg/m³. The dry density of bricks decreased by 8.3%, 23.9% and 30% when 2.5%, 5% and 10% CBs was incorporated (Figur4.1. The results obtained from the tests were approximated into a linear regression line .

$$D_d = -65.14CBs + 2073$$

Low-density or light-weight bricks have great advantages in construction including, for example, lower structural dead load, easier handling, lower transport costs, lower thermal conductivity and a higher number of bricks produced per tones of raw materials. Light bricks can be substituted

Table Dry density results for the control mix and other trial mixes containing CBs

Mixture identification	Dry density (kg/m³)
CB (0.0)	2118
CB (2.5)	1941
CB (5.0)	1611
CB (10.0)	1482

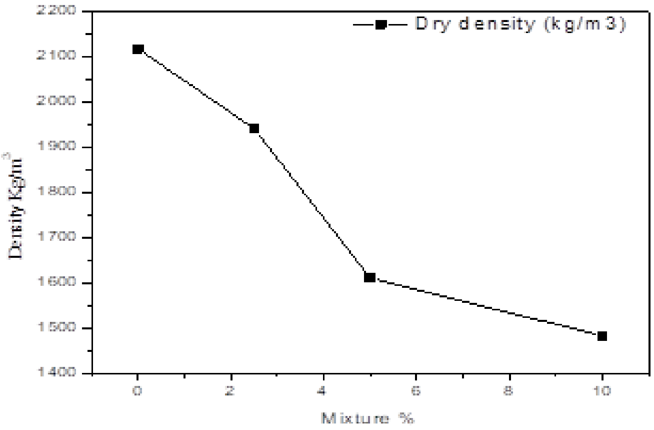


Figure 1. Dry density for the control mix and other trial mixes containing CBs

Compressive Strength

Results of the compressive strength tests, shown in Table 4.2, indicate that the strength is greatly dependent on the amount of CB addition in the fired clay brick. Figure 4.2 shows the compression-tested side view of a cube with 5% CB content (by mass). The compressive strength of the bricks tested in this stage was reduced markedly from 25.65 MPa (for 0% CBs) to 12.57, 5.22 and 3.00 MPa for 2.5, 5.0 and 10% CB content respectively. As can be seen from the graph, the relationship is represented by the polynomial regression line obtained

$$C = -0.01CBs^3 + 0.55CBs^2 - 6.54CBs + 25.65$$

The reduction pattern for the strength properties was attributed to the loss of organic content from the incorporated CB in the bricks that were subjected to firing in the furnace. The burnt CB generated bigger pores, producing more porous bricks with lower strength as the percentage ofCB content increased in the mixes

Table 1. Compressive strength results for the control mix and other trial mixescontaining CBs

Mixture identification	Compressive strength (MPa)
CB (0.0)	25.65
CB (2.5)	12.57
CB (5.0)	5.22
CB (10.0)	2.99

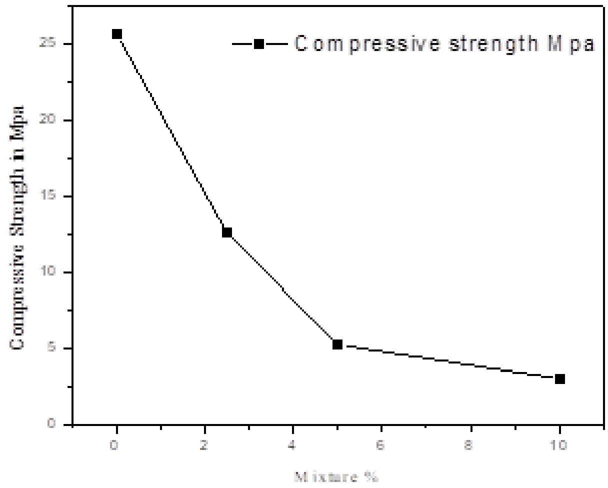


Figure 2. Compressive strength for the control mix and other trial mixescontaining CBs

Conclusion

The main objective of this study was to investigate the possibility of recycling CBs into fired clay bricks. The results of the investigation are very encouraging. The fired clay bricks produced by incorporating 0% to 10% CBs by mass, equivalent to approximately 0% to 30% by volume can be used in different applications according to the required strength. The major findings presented throughout this study are summarized as follows:

The dry density of manufactured fired clay bricks decreased when CBs were incorporated into the raw materials. This is because the bricks became more porous as CB content increased. Electron micrograph images showed significant changes in the growth of pores sizes as CB addition increased from 2.5% to 10% by mass. Low-density or light-weight bricks have great advantages in construction including lower structural dead load, easier handling, lower transport costs, lower thermal conductivity and a higher number of bricks produced per tonne of raw materials. Light bricks can be substituted for standard bricks in different applications according to the required strength. CBs can also be regarded as a potential addition to the raw materials used in the manufacture of light-weight fired bricks. Therefore, manufactured clay- CB bricks are appropriate for these applications.

The compressive strength of the bricks tested in this study was reduced markedly from 26 MPa (for 0% CBs) to 13, 5, 3 and 3 MPa for 2.5%, 5.0%, 7.5% and 10% of CB content respectively. Common minimum values recommended for characteristic compressive strength for non-load- bearing and load-bearing fired clay bricks are 3 to 5 MPa and 5 to 10 MPa respectively (AS/NZS 4455.1, 2008; Electronic Blueprint, 2009; Arnold et al, 2004). Compressive strength is important for the determination of the load bearing capability of the brick and different strengths of brick have different applications.

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