International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 09 | Sep 2020 www.irjet.net p-ISSN: 2395-0072

USING CIGARETTE BUTTS AND WASTE GLASS IN FIRED CLAY BRICKS

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Abstract – *worldwide, several trillion tonnes of municipal wastes are disposed-off without any suitable treatment which causes nuisance and may pollute the land or soil, water and air. In that cigarette butts (CBs) and waste glass are two main non-biodegradable and causes the environmental risk. These CBs accumulate in the environment due to the poor biodegradability of the cellulose acetate filters and pose a serious environmental risk. As well as the waste glass accumulation in environment is cause landfilling problem and reduce the infiltration rate of rain water to the ground where the glass accumulated on the soil. Any other way of recycling of the waste glass cause pollution and its costly. This paper presents some of the results from a continuing study on recycling CBs and waste glass into fired clay bricks. Properties including compressive strength, flexural strength, density, water absorption and thermal conductivity of fired clay bricks are reported and discussed.*

Key Words: **Cigarette butts (CBs), waste glass, pollution, Environmental risk, Fired clay bricks, properties.**

1. INTRODUCTION

Worldwide, bricks are a major building material and perhaps one of the oldest. The worldwide annual production of bricks is currently about 1391 billion units and the demand for bricks is predicted to be continuously increasing [1]. Clay materials are mostly used for the manufacture of bricks. Waste can be added in order to enhance its properties. Solid waste is of a great concern among governmental agencies, and environmentalist regarding the increasing amounts of waste throughout the world.

Cigarette litters are most hazardous element for environment. There is a strong demand for safe disposal and reusage of cigarette litters because they are non-biodegradable in nature. In India, National Green Tribunal (NGT) and union ministry of environment and forest (MOEF) estimates that 100 billion of non-biodegradable cigarette butts(CBs) are disposed off into environment every year and MOEF also estimates that by 2025[2], cigarette butts litter shall increase by 50%,.which make this problem very serious while india is working on Swachh Bharat Abhiyan[3]. so, proper disposal of these hazardous litter should be done.

Another one waste material which has a potential as a brick additive is waste glass. It is not biodegradable and therefore it creates a problem for solid waste disposal [4]. The disposal into landfills also does not provide an environment-friendly solution. Hence, the use of waste glass as a construction material is a practical solution to the environmental problems caused by this solid waste.

2. SCOPE

1. To promote the sustainable method for the disposal of cigarette butts.

2 .To save energy during firing process of clay bricks.

3. To encourage the waste product as eco-friendly material.

4. To dispose the waste safely.

3. OBJECTIVES

1. To study the properties of clay bricks while incorporating cigarette butts.
2. To study the Compressive strength of the brick by adding 2.5% of cigarette butts
3. To investigate the effect of the addition of waste glass with different amounts (0, 10, 20, 30 and 40%) to the original brick clay on the properties of the fired clay bricks. each brick.
4. To make the bricks which are energy efficient which is the only viable solution to the environmental concerns and natural resource conservation for future generations.

4. MATERIALS TO BE USED

1. Clay.
2. Cigarette butts.
3. Powdered waste glass
4. Water.

1. CLAY: The main raw material for bricks is clay other than clayey soils or soft slate or shale, which is usually obtained from open pits with the attendant disruption of drainage, vegetation and wildlife habitat. Clays for brick making vary broadly in composition and depend on the locality from which the soil originates. Different proportions of clays are composed mainly of silica (grains of sand), alumina, lime, iron, manganese, sulphur and phosphates.

2. CIGARETTE BUTTS: The common name for the remains of a cigarette after smoking is a cigarette butt. The butt is typically about 30% of the cigarette's original length. It consists of a tissue tube which holds a filter and some remains of tobacco mixed with ash. Cigarette butts are the most common form of man-made litter in the world, as approximately 5.6 trillion cigarettes are smoked every year worldwide. The cellulose acetate fibres used as the predominant filter material in the cigarettes do not readily biodegrade. A normal life span of a discarded filter is thought to be up to 15 years.

3. WASTE GLASS: Glass is a product of the super cooling of a melted liquid mixture consisting primarily of sand (silicon dioxide) and soda ash (sodium carbonate) to a rigid condition, in which the super cooled material does not crystallize and retains the organization and internal structure of the melted liquid. When waste glass is crushed to sand like particle sizes, similar to those of natural sand, it exhibits properties of an aggregate material. Waste glass is prepared in the laboratory to particle sizes smaller than 600 µm.

4. WATER: Water is an 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.

5. MATERIAL COLLECTION

The CBs of different brands and sizes are used. The butts has been collected in dry receptacles (cardboard boxes) and stored in sealed plastic bags.

The waste glass collected from glass materials stores and disposal units. Necessary precautions and safety steps were adhered to during the storing, handling and disposal of wastes. The wearing of masks and gloves was done.

6. MANUFACTURING PROCESS

Cigarette butt bricks:

Mix the clayey soil with suitable amount of water and add the CBs with 1%, 2.5%, 7.5%, 10% percentage by weight (manufacturing encapsulated brick for various intended purposes). Then press the mix in to mould of standard size. Dry the bricks at room temperature, followed by oven drying at 105°C for 24 hours. Then fire the Brick in the kiln.

Powdered glass bricks:

Two different particle sizes (smaller than 150 µm and 600 µm) of powdered glass are added to clay mixes at contents of 0, 10, 20, 30 and 40% per weight. Brick samples are fired at 800-900 °C in an kiln for 6 hours, at a heating rate of 5°C/min.

7. EXPERIMENTAL PROCEDURE

In order to obtain comparable results, different groups of samples were prepared for the tests depending on the amount of powdered glass and CB added. The mix proportions were prepared based on the dry weight of the materials. Mixture proportions were presented. Solid brick clay samples were produced using pilot laboratory procedures and Equipment. The raw materials were mechanically mixed for 5 min to get a uniform consistency. After dry mixing, water about 8% wt. of total weight was sprayed to the powder mixtures for the production of semi-dry moulded brick samples. Test specimens with a dimension 190mm (L) × 90 mm (W) × 90 mm (H) were produced in a mould. The shaped samples were dried (21°C) for 24 h. The dried samples were fired at 800- 900 °C in an kiln. The time taken to reach the required temperature was about 5 h to 6 h. The samples were naturally cooled down in the furnace. Thus, sufficient samples could be produced from each of the series of samples to perform the experiments A total of 27 brick samples were prepared for testing purpose.

7.1 BRICK MAKING PROCESS

Fig-1 MIXING OF CB's AND CLAY

Fig-2 waste glass powder

Fig-3 Hand moulding of bricks

Fig-4 Casted brick

Fig-5 Bricks in kiln

8. TEST TO BE PERFORMED

1. COMPRESSIVE STRENGTH TEST: The brick specimens are immersed in water for 24 hours. The specimen is placed in compression testing machine with 6 mm plywood on top and bottom of it to get uniform load on the specimen. The load is applied axially at a rate of 14 N/mm2.The crushing load is noted. Then the crushing strength is the ratio of crushing load to the area of brick loaded. Average of five specimens is taken as the crushing strength.

2. WATER ABSORPTION TEST: Five brick are taken and it is weighted dry. It is then immersed in water for 24 hours. It is weighed again and the difference in weight indicates the amount of water absorbed by the brick. It is should not be exceed 20 percent of weight of dry brick.

3. SHAPE AND SIZE TEST: In this test, a brick is closely inspected. It should be of standard size and its shape should be truly rectangular with sharp edges. For this purpose, 3 bricks are selected at random and they are stacked length wise, along the width and along the height.

4. IMPACT TEST: In this test, few bricks are dropped from 1 m height. If bricks are broken it indicated low impact value and not acceptable for construction work. Good quality bricks do not break at all.

5. SOUNDNESS TEST: In this test, two randomly selected bricks are hardly punched with each other. If they produce a clear metallic sound and remain unbroken then they are good quality bricks.

6. FIRING SHRINKAGE: Shrinkage is related to the loss of water among clay particles resulting in the closer packing of clay particles and resulted shrinkage. During firing, especially during sintering at high temperatures, ceramic particles fuse together leading to greater proximity and thus enhancing linear shrinkage.

7. BULK DENSITY: Density of fired clay brick depends on specific gravity of the raw material, method of manufacturing and degree of burning. The density of fired clay brick increases, its strength also increases, while its water absorption and apparent porosity decreases.

9. RESULTS

CIGARETTE BUTT BRICKS

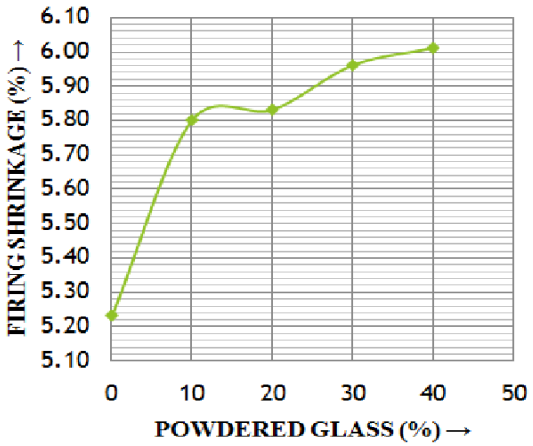
EXPERIMENTAL RESULTS* FOR THE CONTROL MIX AND OTHER TRIAL MIXES CONTAINING CBS

Mixture identification	Compressive Strength (MPa)	Flexural Strength (MPa)	Water Absorption (%)	Initial Rate of Absorption (IRA) (kg/m²/min)	Average Density (kg/m³)
CB (0.0)	25.65	2.79	5	0.2	2118
CB (2.5)	12.57	2.48	9	1.4	1941
CB (5.0)	5.22	2.40	15	2.3	1611
CB (7.5)	3.00	1.24	18	4.9	1482

*Average values of 3 test results

POWDERED GLASS BRICKS

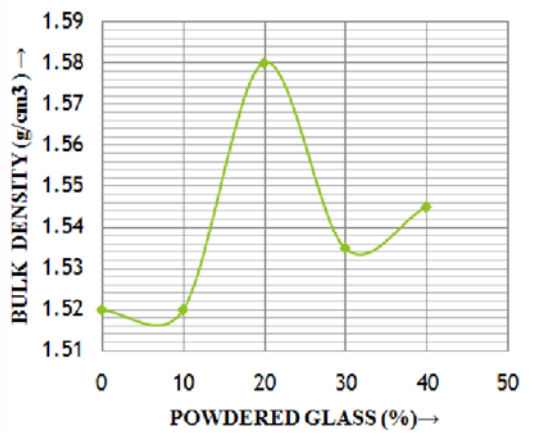
A. Average values of the firing shrinkage.



POWDERED GLASS (%)	FIRING SHRINKAGE (%)
0	5.23
10	5.8
20	5.83
30	5.96
40	6.01

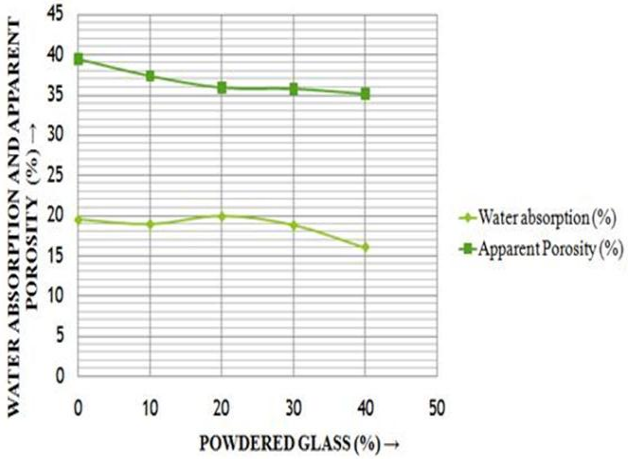
B. Average values of the bulk density

Waste glass %	Compressive Strength (MPa) @ 1000 °C	
	Coarse glass (600 µm glass)	Fine glass (150 µm glass)
10	30.67	38.11
20	32.34	44.84
30	42.75	53.25
40	43.17	65.81

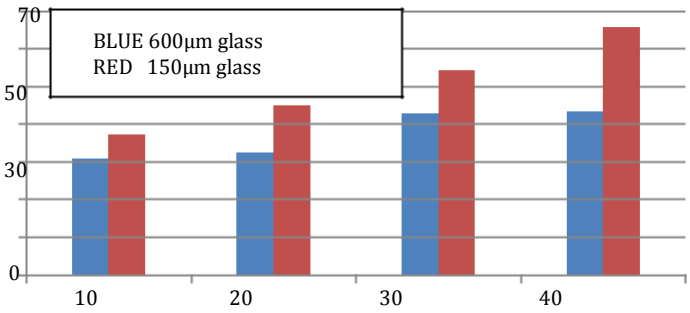


POWDERED GLASS (%)	BULK DENSITY (g/cm³)
0	1.52
10	1.52
20	1.58
30	1.535
40	1.545

C. Water absorption and apparent porosity



D. Average values of the compressive strength



10. CONCLUSION

The results found in this investigation are very promising. It is concluded that cigarette butts can be regarded as a potential addition to the raw materials of new types of light-weight fired bricks, for non-load-bearing as well as load-bearing applications, providing the mix is appropriately designed and prepared for the required properties. And basis of test results, a mixture with up to 30% waste glass additive can be used in building brick production. A suitable firing temperature was determined to be 900 °C. The use of waste glass in the raw mixture minimizes the physical damage that may occur during brick production. Size and shape of these bricks are similar to the required conventional bricks. These bricks can be provided as a conventional alternative to standard bricks. These kinds of bricks can be used in partition walls, low cost housing and refractory linings.

The reuse of cigarette butts and waste glass material in brick production provides an economic contribution and also helps to protect the environment.

REFERENCES

[1] Aeslina Abdul Kadir And Abbas Mohajerani on Bricks: an excellent building material for recycling wastes- review ,IASTED International environmental management and engineering conference.july 4-6,2011.

[2] Chavan and kulkarni on use of wastes for brick manufacturing, in 9th international conference on recent innovations in science, engineering and management (RISEM) 28-29 jan, ISBN:978-93-86171-22-1.

[3] Ahmad Rezazai and Guy as Physico-mechanical property of asphalt concrete incorporated with encapsulated cigarette butts; volume-153, October 2017 in construction and building materials.

[4] Kevin Hii, Abbas Mohajerani, Paul Slatter and Nicky Eshtiaghi (2007)- Reuse of Desalination Sludge for Brick Making School of Civil, Environmental and Chemical Engineering, RMIT University, Melbourne, 3000, Australia

[5] Geiss, O. & Kotzias, D. (2007). Tobacco, Cigarette and Cigarette Smoke: An Overview. Italy: Europe Communities.

[6] Alam, A. (2015). Pre-Feasibility report for proposed brick earth excavation project. Samastipur, Bihar: Niranjan bricks.

[7] Alibaba Group. (1999). Retrieved June 16, 2016, from Alibaba Group for marketing web site: http://www.alibaba.com/product-detail/fused-silica-wafer-opaque-quartz-glass_1851769203.html.

[8] Amrhein, J.E., & Porter, M.L. (2009). Reinforced Masonry Engineering Handbook: Clay And Concrete Masonry.(6th ed.). Washington: Masonry Institute Of America MIA.

[9] ASTM C326-09. (2014). Standard Test Method for Drying and Firing Shrinkages of Ceramic Whiteware Clays. ASTM Book of Standards, USA.

[10] ASTM C373-88. (2006). Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products, Ceramic Tiles, and Glass Tiles. ASTM Book of Standards, USA.