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Experimental Study on Concrete Brick using Plastic and Glass Waste

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Abstract— **Plastics and glass waste are key resources in circular economy and recycling after the end of useful life with economic value creation and minimal damage to environment is the key to their sustainable management. Bricks are a commonly used building material all over the world for constructing walls, pavement and other elements in masonry construction. Conventional bricks are manufactured by firing of clay in high temperature kilns. Studies in a large stream of researches have explored impregnating waste plastics and glass fiber in concrete and reported encouraging results with multiple benefits. The present study makes a critical review of some of these findings and gleans some common useful trends in the properties reported in these studies. The study introduces a new strand of research on sustainable thermoplastic and glass waste management.**

Keywords—*Bricks, waste plastic waste, glass waste, water binder ratio*

I. INTRODUCTION

Conventional bricks are manufactured by firing of clay in high temperature kilns. Studies in a large stream of researches have explored impregnating waste plastics and glass fiber in concrete and reported encouraging results with multiple benefits. The present study makes a critical review of some of these findings and gleans some common useful trends in the properties reported in these studies. The study also presents results of experimental work on bricks made of non-recyclable waste thermoplastic granules and glass fibers constituting 0 to 20% by weight, 4kg of fly ash, cement and sand making up the remainder. The bricks were cured under water for 28 days and baked at temperature ranging from 90oC to 110oC for 2 hours. A substantial growth is seen in the consumption of plastic and glass in recent years which leads to growth in their waste and creates huge environmental treat. Waste materials which are not biodegradable are given more emphasis to use in such projects. The aim of the study focused on the possibility of utilizing plastic wastes, glass bottles making quality concrete brick. Since the building material is very costly due to the demand of the growing in a populace with the shortage of the materials. It is always a challenge to civil engineers on how to reduce the amount of solid waste and convert it to eco-friendly and advantageous building and construction materialThe bricks are likely to add energy efficiency in buildings and help create economic value to manufacturers, thereby, encouraging the ecosystem of plastic and glass waste management involving all actors in the value chain. A mathematical model is developed to predict compressive strength of bricks at varying plastic and glass content.

II. OBJECTIVES

- To reduce the cost of the brick by adding partial replacement of plastic and Glass Waste
- To reduce the pollution in land
- To prepare a lightweight, porous brick

III. ADVANTAGES

The key characteristics of these bricks are found to be lightweight, porous, of low thermal conductivity, and of appreciable mechanical strengths. Though such bricks hold promise, no similar study appears to have been reported so far.

Unlike other processes of making porous bricks, which usually involve incineration to burn combustible materials in order to form pores with implication of high carbon emission, the proposed process is non-destructive in that the bricks are merely baked at low temperature, sufficient to melt the waste plastic that gets diffused within the body of the bricks.

IV. MATERIALS AND METHODS

A. Plastic waste

Plastic plays a predominant role in reusable in this era, as it is compact and light in weight. Common plastic items that are used are covers, bottles, and food packages.

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The great problem with plastic is its decomposition. Plastic is made of polymer chemicals and they are non-biodegradable. This means that plastic will not decompose when it is placed in earth. Though plastic is a very useful material that is flexible, robust and rigid they become waste after their use and they pollute the air and land. Recycling isprocessing use waste materials into new products to prevent waste of potentially useful materials.

Plastic waste

B. Glass waste

Glass is an amorphous (non-crystalline) that in essence, a super cooled liquid and not a solid. Glass can be made with excellent homogeneity in a variety of forms and sizes from small fibres to meter-sizes pieces. Primarily glass is made up of sand, soda ash, limestone and other additives (Iron, Chromium, Alumina, Lead and Cobalt). Glass has been used as aggregates in construction of road, building and masonry materials

Glass waste

C. Mix design procedure

In present study M15 grade concrete was designed. The weight ratio of mix proportion is 1:2:4 keeping water cement ratio 0.4. It was proposed to investigate the properties of brick.

In this experimental work, physical properties of materials used in the experimental work were determined. M15 grade of reference concrete was mixed and cured in potable water.

D. Specimen preparation

Sl. No	PLASTIC %	CEMENT (KG'S)	FLYASH (KG'S)	MSAND (KG'S)	PLASTIC GLASS (KG'S)
1	5	0.992	4.04	3.078	0.162
2	10	0.992	4.04	2.916	0.324
3	15	0.992	4.04	2.754	0.486

V. MATERIAL PROPERTIES

A. Soundness test

This sound is carried out to find out that a clear ringing sound is produced or not when the two bricks are with each other without breaking any of the two bricks. If the two bricks are not broken after striking with each other and a clear ringing sound is produced, then it means that the bricks are sufficiently sound.

B. Compressive strength test

Compressive strength test on bricks are carried out to determine the load carrying capacity of bricks under compression with the help of compression testing machine. Bricks are generally used for construction of load bearing masonry walls, columns and footings. These load bearing masonry structures experiences mostly the compressive loads. Thus, it is important to know the compressive strength of bricks to check for its suitability for construction. Compression strength is the total load observed by the brick. The strength of brick is usually defined and determined by the crushing strength of 230mm x 80mmx 110mm, at an age of 14days. It is most common test conducted on hardened brick as it is an easy test to perform and also most of the desirable characteristic properties of brick are qualitatively related to its compressive strength. Wooden mould made of Tee wood dimension 230mm x 80mmx 110mm used for casting of brick filled. The mould and its base rigidly damped together so as to reduce leakages during casting. The sidesof the farm and base plates were oiled before casting to prevent bonding between the farm and brick. The brick was then stored for 5mins undisturbed at temperature of 18°C to 22°C and a relative humidity of not less than 90%

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Compressive strength test

Compressive strength = Failure load / cross sectional area

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Material	Avg. Load on 7 days curing (KN)	Avg. Load on 14 days curing (KN)	Avg. Load on 28 days curing (KN)	Avg. Compressive Strength @7 days(N/mm2)	Avg Compressive Strength @14 ays(N/mm2)	Avg Compressive Strength @28 ays(N/mm2)
Specimen 1	488	612	816	21.63	27.45	33.65
Specimen 2	421	635	872	22.65	30.25	36.54
Specimen 3	462	675	817	22.96	31.26	34.87

C. *Flexural strength test*

Flexural strength, also known as modulus of rupture, bend strength, or fracture strength, is a material property, defined as the stress in a material just before it yields in a flexure test. The transverse bending test is most frequently employed, in which a specimen having either a circular or rectangular cross-section is bent until fracture or yielding using a three points flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture. It is measured in terms of stress.

SNo	Flexural strength N/mm2 7 days	Flexural strength N/mm2 14 days	Flexural strength N/mm2 28 days
1	5.5	7.12	8.32
2	5.32	6.98	7.96
3	4.85	6.47	8.12

D. *Water absorption test*

The average dry weight of concrete specimens after removing from farm was measured and the average weight of cube specimens after submerging in water for curing was measured at 1 days of age.

The percentage of water absorption was measured for each concrete specimen and it gave indirect measure of durability.

The results of water absorption test is tabulated in the tabular column.

Water absorption test

Sno	Dry Weight (Kg)	Wet Water Weight (Kg)	Water Absorbed (gm)
1	7.14	7.42	280
2	7.09	7.35	260
3	7.01	7.25	240

VI. CONCLISION

This paper presents an experimental study carried out on bricks made from plastic and glass waste. This investigation also aims to use waste materials effectively since plastic and glass is a waste obtained from local Scrap Market. The properties of the plastic and glass bricks are investigated by conducting various tests like Compressive strength test, water absorption test. 50%, 75%, 100% of plastic have been replaced for testing and validation of new form of brick. Bricks are made of waste plastic and glass. These can be extensively used in all building constructional activities.

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