CONCOCTION OF PLASTIC AND BITUMEN WITH LATERITE SOIL AS A BRICK

A.Saravanan¹, B.Mohanraj²,
¹,² U.G Student, Department of Civil Engineering
K.S.R. College of Engineering, Tiruchengode –Tamilnadu, India.

Abstract
This paper addresses the issue of recycling waste plastic by considering the feasibility of use of PET bricks for constructional purposes. The PET bricks are formed by packing plastic within Polyethylene Terephthalate bottles. Guidelines were provided for the construction of these bricks. Experiments were carried out to characterize some of the properties of these bricks. Compression test, sound insulation assessment and water absorption were considered in this regard and compared with traditional construction materials and conditions. Possible applications of PET bricks were discussed. The paper presents the first attempt to characterize these bricks and the results encourage future use of them to a significantly wider extent and for various purposes.

Key Words : Polyethylene Terephthalate, Bitumen, Laterite, Compressive Strength Test, Variation in Water Absorption, Absorbing Temperature

1. INTRODUCTION

The polyethylene terephthalate (PET, PETE and PETP) was invented in 1941, being initially used in the textile industry. As regards the production of packages for drinks, it started being used in the ‘70s. The rapid development of the production for a series of products as well as the imposition of certain hygiene rules as regards their manipulation and preservation, have led to increasingly perfected disposable packages, especially made of plastic. The environmental problems the PET raises are paramount, considering that, once thrown away in the open the plastic bottle degrades over hundreds of years. Although the material is cheap, the price we pay for using “plastic bottles” on a large scale is extremely big over the recent years, the quantity of plastic waste randomly left in nature has increased significantly. The PET is not biodegradable and resists for hundreds of years, bringing important prejudices to the environment. Because of this, the recent years have seen an attempt to find as efficient as possible solutions for recycling this waste or for using them in other fields, so as to lessen the prejudices brought to the environment.
2. MATERIAL USED

⇒ Laterite soil
Laterite is not uniquely identified with any particular parent rock, geologic age, single method of formation, climate per geographic location. It is a rock product that is a response to a set of physiochemical conditions, which include an iron containing parent rock, a well drained terrain, abundant moisture for hydrolysis during weathering, relatively high oxidation potential, and persistence of these conditions over thousands of years. Typical laterite is porous and claylike. It contains the iron oxide minerals goethite, $\text{HFe}_2\text{O}_3$ lepidocrocite, $\text{Fe}_2\text{O}_3\cdot\text{H}_2\text{O}$; and hematite, $\text{Fe}_2\text{O}_3$. It also contains titanium oxides and hydrated oxides of aluminum, the most common and abundant of which is gibbsite, $\text{Al}_2\text{O}_3\cdot3\text{H}_2\text{O}$. The aluminum-rich representative of laterite is bauxite. The soil which is used in this process of making PET (Polyethylene Terephthalate) brick which are retained from 2.36 mm sieve as a fine grain in size.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Test value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water content %</td>
<td>10.65</td>
</tr>
<tr>
<td>Liquid limit %</td>
<td>38.57</td>
</tr>
<tr>
<td>Plastic limit %</td>
<td>27.50</td>
</tr>
</tbody>
</table>

⇒ Bitumen
It is black or brown in colour & possesses waterproofing and adhesive properties. It is obtained by refinery processes from petroleum, and is also found as a natural deposit or as a component of naturally occurring asphalt, in which it is associated with mineral matter. When temperatures are raised, as well as when a load is applied to bitumen, the bitumen will flow, but will not return to its original position when load is removed. In this process 0 % to 7 % of bitumen by a weight of soil is added and melted at 260°C. When it attains 260°C immediately the plastic is added and mixed properly because the plastic needs 135°C to melts. This condition is referred to as plastic behavior. Applying a load means that you put a weight on the bitumen in order to subject it to stress. This could be in a lab or in the bitumen's final position in the road and it is done to assess the bitumen's reaction to the load.

<table>
<thead>
<tr>
<th>Properties</th>
<th>Test value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ductility (cm)</td>
<td>58.90</td>
</tr>
<tr>
<td>Softening point (°C)</td>
<td>57.60</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>1.02</td>
</tr>
</tbody>
</table>

⇒ Plastic
Plastics like PET most likely touch your everyday life. Polyethylene Terephthalate, known commonly as PET is best known as the clear plastic used for water and soda bottle containers. As a raw material, PET is globally recognized as a safe, non-toxic, strong, lightweight, flexible material that is 100% recyclable. The plastic are cutted into the fine pieces it need 135°C to melt so it is added with the bitumen at 260°C after few mixtures a
sieved soil is added simultaneously with proper mix for an hour. PET can be identified by looking at the bottom or backs of containers for the #1 resin identification code – a symbol recognized by the #1 in the middle surrounded by “chasing arrows”.

Figure 1: Recycling Bottles

3. MIX DESIGN

Two percentage of bitumen is added by the weight of soil and melted at 113°C then fine pieces of plastics is added on to it. After few minutes the sieved laterite soil is added to it after proper mix it is filled in the mould. After 30 minutes it is demoulded the brick is obtain. To check the role of PET (polyethylene therephthalate) in bricks seven different percentage of bitumen is selected. Which are 0.5%, 1%, 1.5%, 2%, 2.5%, 3%, and 3.5%. All different proportions contain the 60% of plastic by the weight of soil is used. The compressive strength of the bricks PET bricks are observed are resulted in fig.

Figure 2: Absorbing Temperature
4. EXPERIMENTAL PROCEDURE

⇒ Compressive Strength

The size of brick used for this test was 230 mm × 110 mm × 75 mm. The compressive strength of the brick was determined as per the code IS 12894: 2002 - Pulverized Fuel Ash - Lime Bricks – Specification. The demoulded brick is kept in a Universal Testing Machine (UTM) and load is applied gradually on it.

The compressive strength of normal bricks is 10.51 N/mm². The Maximum compressive strength of PET (Polyethylene therephthalate) bricks with addition of 2.5 % of bitumen will be 14.82 N/mm². Therefore, as per the result of this test it is concluded that PET (Polyethylene therephthalate) bricks has more compressive strength as compared to normal laterite soil bricks.

Due to the pore filling effect the particles are fully packed with the bitumen. So these bricks are with stand the high amount of load when compared to the normal first class brick.

Figure 4: Variation in Compression Strength of bricks
Water Absorption

The water absorption value was found as per the code IS : 3495 (Part 2):1992 - Methods of Tests of Burnt Clay Building Bricks - Determination of Water Absorption. The brick is de moulded and undergoes water absorption test by keeping it in water for 24 hours the resultant of the water absorption test clearly shows the PET (Polyethylene therephthalate) bricks absorb a maximum of 0.1-0.7 % of water because of no porous due to ductility.

![Figure 5: Variation in water absorption](image_url)

5. RESULTS

The compressive strength test results for PET bricks with 70% plastic content by weight of soil with the binder(bitumen) content of 2.5% by weight of soil will gives a compressive strength of 4.32 N/mm$^2$ which is higher than laterite stone (3.18 N/mm$^2$) and has a lesser water absorption(0.1%) than laterite stone (14.58%). So it can be a better alternative building material. From the compressive strength test results of PET bricks for various percentages of binder (bitumen) content by weight of soil with constant plastic content of 70% by weight of soil, it is observed that on increasing the percentage of binder (bitumen) the compressive strength of brick also increases up to 5.5% (10.75 N/mm$^2$), but further increase in bitumen decreases the strength (7.90N/mm$^2$). But from economical considerations 2.5% of bitumen content is taken as optimum binder content which results in compressive strength 4.32 N/mm$^2$ that is greater than laterite stone (3.18 N/mm$^2$). The efficient usage of waste plastic in the bricks has resulted in effective usage of plastic waste and thereby can solve the problem of safe disposal of plastics, also avoids its wide spread littering and the utilization of quarry waste has reduced to some extent the problem of its disposal.

1. Use of innovative materials with sustainable application such as plastic bottles can have considerable benefits including finding the best optimization in energy consumption of the region, reducing environmental degradation.

2. Re-using the plastic bottles as the building materials can have substantial effects on saving the building embodied energy by using them instead of bricks in walls and reducing the CO2 emission in manufacturing process.
3. Plastic bottles can cause the green construction by saving energy and resources, recycling materials, minimizing the emission, having significant operational savings and increasing workplace productivity.

6. REFERENCES


This is certified that the paper entitled

Concoction of plastic and bitumen with laterite soil as a brick

Authored by

A. Saravanan

U.G Student, Department of Civil Engineering
K.S.R. College of Engineering, Tiruchengode – Tamilnadu, India

has been accepted & published online in IJIFR continuous 62nd edition


The mentioned paper is accepted after rigorous evaluation through double blind peer reviewed process.

Dated: 29/10/2018
This is certified that the paper entitled
Concoction of plastic and bitumen with laterite soil as a brick
Authored by
B. Mohanraj
V.G Student, Department of Civil Engineering
K.S.R. College of Engineering, Tiruchengode – Tamilnadu, India
has been accepted & published online in IJIFR continuous 62nd edition
The mentioned paper is accepted after rigorous evaluation through double blind peer reviewed process.

Dated: 29/10/2018

Authorised Signature With Seal