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Plastic Bottles Used in Construction

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Abstract —*Plastic bottles are non-renewable products which are increasing day by day. The destroying and recycling of this product is a major issue. Most of the construction are made up of bricks and mortar, but this leads to emission of carbon dioxide (CO_2) which gives rise in global warming. This problem can be overcome by replacing bricks with plastic bottles. By use of this non-biodegradable plastic bottle can solve environmental problem and pollution to great extent. The waste of plastic is naturally available in much quantity and hence the cost factor comes down, which is economical. Hence this is the effective use of plastic utilization.*

Keywords*- plastic bottle, sustainable material, global warming, construction material, non-biodegradable,*

I. INTRODUCTION

Plastic bottles are increasing in the environment due to manufacturing the chemicals and their improper use and disposal. Major cause of solid waste disposal is waste plastic bottle. This is an environmental issue as waste plastic bottles are difficult to biodegrade and involves processes either to reduce reuse, or recycle. For increasing the strength of structure construction industry is in need of finding cost effective materials. This method has proven to be earthquake resistant and allows short construction period.

Plastic bottle are considered as non-renewable sources. The insolubility about 300 years perhaps if it is used in construction structure with cement it can play as sustainable material. So it is very necessary to take a creative action toward this concept of bottles in place of conventional bricks in construction.

Plastics are produced from the oil that is considered as non-renewable resource. Because plastic has the insolubility about 300 years in the nature, it is considered as a sustainable waste and environmental pollutant. So reusing or recycling of it can be effectual in mitigation of environmental impacts relating to it. It has been proven that the use of plastic bottles as innovative materials for building can be a proper solution for replacement of conventional materials. The use of this material has been considered not only for exterior walls but also for the ceiling of the building. The objective of this project is to investigate the key and positive characteristics of this product and the benefits obtained by using it in building. It also intends to compare the characteristics of some construction materials such as brick, ceramic and concrete block with bottle

The objective of this paper is to introduce the replacing of bricks with plastic bottles and respective benefits in building construction. The detailed comparison of characteristics with convectional bricks, mortar and cost of brick with brick bottle with plastic bottles is done. Today the technology developed in great scale that the utilization of renewable resources is made possible which protect the global environment. Also if technology permits bottles in construction, the carbon emission happens during baking of an ordinary Indian standard bricks can be reduced.

II. PET PLASTIC

Full name: Polyethylene terephthalate Molecular
Formula: C10H8O
Composition: Polyester of terephthalic acid and ethyleneglycol.2, 3

1. **Properties:**
   1. White or light cream material
   2. Density 1.33220 gm/cm3
   3. Melting point. -255 to 2650C
   4. Solubility- Insoluble in water
   5. It is heat resistant and chemically stable.
2. **Uses:**
   1. PET is used for high impact resistant container.
   2. Used for packaging of soda, edible oils and Peanut butter.
   3. Used for cereal box liners.
   4. Microwave food trays.
   5. Used in medicine for plastic vessels and for implantation
3. **Objectives**
   1. To evaluate the possibility of recycling waste PET bottles.
   2. To investigate the mechanical behaviour of the unit.
   3. To test and compare the compressive strength of brick bottle with brick. 3

2.3.3 Water-

Water used for mixing and curing of concrete shall be clean and free from oils, acids, alkalies, salts and organic materials or other substances the may be deleterious to concrete or steel. Portable water shall be used for mixing of concrete. Suspended solid matter in the water shall not exceed more than 200mg/l. The pH value of the water shall not be less than 6.

2.3.4 Sand-

Natural river sand was used as a fine aggregate. The properties of sand were determined by conducting tests as per IS: 2386 (Part-1). The results are shown in test data of materials. The results obtained from sieve analysis are furnished. The results indicate that the sand conforms to zone 11 of IS: 383-1970.

2.3.4.1 Properties of Sand-

S. No Tests Results
1 Specific Gravity- 2.62 2
2 Bulk Density -1690 kg/m3
3 Fineness Modulus -2.92

Materials needed for Bottle masonry construction are:
a) Soil, b) Plastic bottles, c) Cement, d) Nylon rope, e) Water

III. PLASTIC BOTTLE vs STANDARD BRICK

Preparation required for clay brick, time and energy used starting from mixing the clay to baking it in kiln is very length and time, energy consuming. While if we take the bottle is more energy efficient and no such tedious labor work is required.

Cement factories generate heat can be reduced as this method uses only 5% cement. In this construction method it provide thermal storage. This inherent thermal mass storage keeps inside temperature relatively consistent with natural temperature. Once thermal mass storage charges gets heat the plumbing in house would never freezes in spite of outside temperature below 0 degree Fahrenheit.

3.1 Advantages of bottle over other construction materials-

1. Easy to build
2. Green construction
3. Absorbs abrupt shock load (can easily take heavy loads without failure)
4. Low cost
5. No-brittle unlike bricks
6. Reusable and less construction material
7. Bioclimatic

IV. METHODOLOGY

The first step taken was collection of waste plastic bottles from hotels, stores, waste collectors and other possible sources. Then after bottles are collected they have to be filled with local available soil so as to provide them the structural strength for this screening operation of soil is done. In our experimental work we have taken 60,100 and PAN mesh size soil which is first screened by a sieve shaker properly so as to remove any unwanted particles and large size particles. Once all the collected bottles are filled with this prepared soil and compact by using tamping instrument and sealed. Then to check the structural strength and various tests are performed and comparison is made against those for a brick..

Fig. 1: Collection of waste Plastic Bottles

Fig. 2: Bottles filled with Sand

V. EXPERIMENTAL TESTING

Compressive strength test for each bottle was determined on universal testing machine and the average value was considered for analysis. Weight of empty PET bottles and completely filled PET bottles were noted and amount of soil used was calculated for the same. Similarly, compressive strength of brick was calculated by taking the average value and the results were compared and analysed.

The formula used is: Compressive strength =P/A (N/mm2)

Where P = Load at failure in N. A = Area subjected to compression in mm^2.

Fig. 3. Test applied on a waste PET bottles filled with soil and sealed tightly

VI. RESULT AND DISCUSSION

After compressive strength testing done on about 8 bottles an average calculation for concluding a result is done.

The Data obtained as per universal testing machine is tabulated in table 1.

Load (Kg)	Area (mm^2)	Compressive Strength (MPa)	Average
13000	14202.5	8.32	8.367
13000	14205	8.332	
13001	14201.9	8.32	
13000	14201.6	8.31	
13002	14202.5	8.71	
13011	14202.1	8.25	
13005	14201.9	8.30	
13023	14202.8	8.40	

Sample Calculation of first reading:
Load in kg = 13000 kg Load in N. = 13000×9.81 = 127530 N
Area = 14202.5 mm2
Compressive strength =127530/14202.5 = 8.98Mpa

VII. COST CALCULATION

Calculation of bottle market price:
Average wt. of 600ml PET bottle = 30gms.
Cost of waste plastic bottles in market is Rs.10/kg.=> (1000÷30) = 33 nos. of bottles in 1kg. => (10÷33) = 0.303 paisa (approx =0.3)

Cost of soil to be filled:
Quantity & Cost of 1 trolley soil = 2.8 m3 (say =3m3) in Rs. 900

Cost & wt. of 1 m3 soil Rs. 300 & 1600kg
Cost of 1kg soil = 300÷1600 0.187(say=0.190)

• Total cost of bottle brick:
Wt. of empty bottle= 30gms
Wt. of bottle with soil= 1430gms
So, wt. of soil in 1 bottle = 1400gms
Cost of soil used in a unit bottle = 1.4×0.190= 0.266 paise
Therefore total cost of bottle brick cost of empty bottle+ cost of soil =0.3 + 0.266= Rs.0.516 (say = 57paisa)

• Calculation of Profit:
Cost of a unit brick = Rs 5
Therefore it shows a direct profit of (5-0.60) =Rs. 4.40
Thus based upon these observations we can infer that wall made of PET bottle can be use as partition wall or secondary walls and in frame structure as external wall. These are very useful in construction of yarn, warehouses etc.

VIII. CONCLUSION

From the above experimental observation we can infer that no curing time is required if waste PET bottles are used as building material as compared to bricks which require 28 days curing time. In baking of bricks there is a major issue of emission of carbon which is negligible in using PET bottles. The durability of PET bottles is over 300 years which is more as compared to standard bricks. Considering Cost of construction in case of brick bottle is more economical than standard bricks. Weight of a unit bottle brick was found to be less than that of a standard brick. Compressive strength of the bottle brick is also nearly equal than that of a standard brick. In short brick bottle is more advantageous than standard bricks. Thus we can conclude that using the concept of brick bottles is cost effective, energy efficient and commercially feasible. Using PET bottles can say it as a Green construction.

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