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# UTILISATION OF WASTE HDPE PLASTIC IN MANUFACTURING PLASTIC SAND BRICKS

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**Abstract -** *Plastic is one of the most widely used material in the modern world because of its lightweight and durability. it is replacing other materials. Plastic is a non-biodegradable substance which creates land as well as water pollution to the environment. The quantity of plastic waste is expanding rapidly which is great threat for the environment. In this research work an attempt has made to utilize HDPE waste plastic in manufacturing plastic sand bricks by using 600µm and 4.75mm sand respectively. The plastic sand bricks have been carefully studied and compared with locally available conventional clay bricks. The compressive strength was found more for the plastic sand bricks for proportion of 1:4 and with 4.75mm sand. Plastic sand Bricks also gave good results in Impact test, Soundness test and Hardness test. Plastic sand bricks can be a good alternative to locally available conventional clay bricks to reduce the consumption of natural resources such as clay and for efficient and effective utilization of waste plastic for a healthy environment.*

***Key Words***: HDPE, Plastic Sand Bricks, 600µm sand, 4.75mm sand.

## 1. INTRODUCTION

The term "plastic" is derived from the Greek word ''plastikos'', meaning fit for moulding. Plastics are versatile, hygienic, lightweight, flexible and highly durable. The world's first fully synthetic plastic was Bakelite, invented in New York in 1907, by Leo Baekeland who coined the term 'plastics'. Many chemists have contributed to the materials science of plastics, including Nobel laureate Hermann Staudinger who has been called "the father of polymer chemistry" and Herman Mark, known as "the father of polymer physics. Plastic is material consisting of a wide range of synthetic or semi-synthetic organic compounds of high molecular mass and often contain other substances that are malleable and so can be moulded into solid objects. Plastics are made from natural materials such as cellulose, coal, natural gas, salt, crude oil, minerals and plants through the polymerisation or polycondensation process. They are usually synthetic, most commonly derived from petrochemicals , however, an array of variants are made from renewable materials such as polylactic acid from corn or cellulosics from cotton linters. Plastic can be divided into two major categories Thermosetting and Thermoplastic. They are formed from polymers, the word "poly" means many & "mers" means monomers simply many monomers. Plastic are formed by polymerization. Most common types of synthetic organic polymers are Low-Density Polyethylene (LDPE), High Density Polyethylene (HDPE), Polyvinyl Chloride (PVC), Polypropylene (PP), Polystyrene (PS), and Polyethylene Terephthalate (PET or PETE). The Benefits of plastic are undeniable. The material is cheap, lightweight and easy to make. These qualities have led to a boom in the production of plastic over the past century. The quantity of plastic waste is expanding rapidly which is a great threat for the environment. Worldwide, about 50 kg of plastic is produced annually per person, with production doubling every ten years. In 2018, a survey by the Global Oceanic Environmental Survey (GOES) Foundation found that the ecosystem in seas and oceans may collapse in the next 25 years, potentially causing failure of terrestrial ecosystem and "very possibly the end of life on Earth". The main agents of this prediction were hypothesized to be plastic. According to recent estimates 79% of the plastic waste ever produced now sits in landfills dumps or in the environment while 12% has been incinerates and only 9% has been recycled. When discarded in landfills or in the environment, plastic can take up to a thousand years to decompose.

## 2. AIM AND OBJECTIVES

- To develop an efficient way to effectively utilize the HDPE wastes plastic for construction materials.
- To reuse waste plastic for reduce of land and water pollution.
- To reduce the consumption of clay for manufacturing of bricks that results in resource depletion and environment degradation.

## 3. MATERIAL AND METHODOLIGY

### 3.1 Material

### 3.11 HDPE Waste Plastic

HDPE is known for its high strength-to-density ratio. The density of HDPE can range from 930 to 970 kg/m$^3$. It has strong intermolecular forces and tensile strength than LDPE. It is also harder and more opaque and can withstand somewhat higher temperature (120°C) for short periods. In manufacturing plastic sand bricks, hard waste plastics like bottles caps, older ice-cube trays, fruits & bottles crates, stools, chairs, pipes, jugs, barrels, water-tank, toys, dustbins, buckets, etc were used. These waste plastic were shredded using plastic shredder machine and then used in manufacturing plastic sand bricks.

**Fig. 1**: Plastic Shredder machine

**Fig. 2**: High Density Polyethylene (HDPE)

### 3.12 Sand

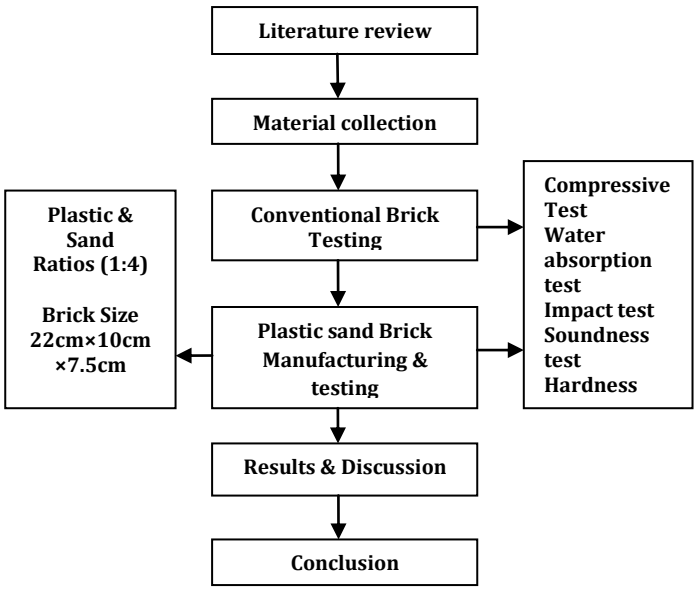
Sand is a granular material composed of finely divided rock and mineral particles. It is defined by size being finer than gravel and coarse than silt. we have used well graded natural river bed sand passing through 600µm sieve and also passing through 4.75mm sieve was used in manufacturing of plastic sand bricks.

**Fig. 3:** Sand passing through 600µm sieve

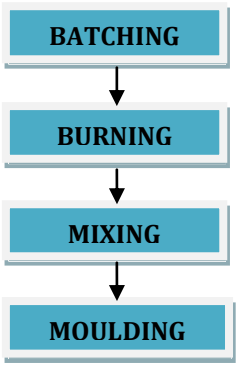
**Fig. 4:** Sand passing through 4.75mm sieve

### 3.2 Methodology

HDPE waste plastic and river sand (600µm/4.75mm) were used as material for manufacturing plastic sand bricks of size 22cm×10cm×7.5cm. Frog of size 14cm×4cm×1cm was provided on one of the flat surface. Plastic sand bricks were prepared in weight proportion of 1:4 (Plastic: Sand) with 600µm & 4.75mm sand respectively. Compressive strength, Water absorption test, Impact test, Soundness test, Hardness test were performed on plastic sand bricks and result were compared with locally available conventional clay bricks.




HDPE waste plastic were cleaned with water and dried in air. Then plastic large pieces were put into plastic shredder machine for breaking down plastic into very small pieces. The sand was washed with water and then sieved by 600µm sieve & bricks were prepared by using HDPE plastic waste. Similarly washed river was sieved by using 4.75mm sieve & bricks were prepared by using HDPE plastic waste.




Burning process includes arrangement of stones, drum and the required firewood. The stones are arranged to hold the drum stable and firewood is placed in the gap and it is ignited. The drum is placed over the setup & it is heated to remove the moisture present in it. Shredded plastic pieces required for making one brick in the weight proportions of 1:4 (plastic: sand) were added into the drum and allow it to fully melt so as to form a hot thick slurry. Then add sand into it. Mix it properly with trowel. Then mixture is poured into the brick mould and compacted by using tamping rod or steel rod. The surface of the brick is finished with the trowel. Before placing the mixture into the mould make sure that, sides of brick moulds are oiled for easy removal of bricks. Moulds can used either of wooden or steel. After finishing the brick surface with the trowel allow it to dry in air for 24hrs and then remove the mould slowly.

## 4. OBSERVATION AND GRAPHS

### 4.1 Compressive Strength Test

#### 4.1.1 Locally Available Conventional Bricks (22cm×10cm×7.5cm)

Table 1: Compressive Strength of Conventional brick

| Sample | Load at failure (T) | Compressive strength (N/mm²) | Average compressive strength (N/mm²) |
|---|---|---|---|
| Conventional Brick | 4.00 | 1.78 | **1.685** |
| | 3.50 | 1.56 | |

#### 4.1.2 Plastic Sand Brick with 600µm sand (22cm×10cm×7.5cm)

Table 2: Compressive strength of HDPE plastic sand brick with 600µm sand

| Sample proportion | Load at failure (T) | Compressive strength (N/mm²) | Average compressive strength (N/mm²) |
|---|---|---|---|
| 1:4 | 16 | 7.134 | **7.468** |
| | 17.5 | 7.803 | |

#### 4.1.3 Plastic Sand Brick with 4.75mm sand (22cm×10cm×7.5cm)

Table 3: Compressive strength of HDPE plastic sand brick with 4.75mm sand (with frog)

| Sample proportion | Load at failure (T) | Compressive strength (N/mm²) | Average compressive strength (N/mm²) |
|---|---|---|---|
| 1:4 | 19 | 8.472 | **9.141** |
| | 22 | 9.81 | |

### 4.2 Water Absorption Test

#### 4.2.1 Locally Available Conventional Bricks

Table 4: Water absorption Test on conventional brick

| Sample | Weight in dry condition $W_1$ (kg) | Weight in wet condition $W_2$ (kg) | $\% = (\frac{W2-W1}{W1}) \times 100$ |
|---|---|---|---|
| Conventional Brick | 2.354 | 2.914 | **23.789** |

#### 4.2.2 Plastic Sand Brick with 600µm sand

Table 5: Water Absorption Test on HDPE plastic sand brick with 600µm sand

| Sample proportion | Weight in dry condition $W_1$ (kg) | Weight in wet condition $W_2$ (kg) | $\% = (\frac{W2-W1}{W1}) \times 100$ |
|---|---|---|---|
| 1:4 | 2.777 | 2.862 | **3.060** |

#### 4.2.3 Plastic Sand Brick with 4.75mm sand

Table 6: Water Absorption Test on HDPE plastic sand brick with 4.75mm sand (with frog)

| Sample proportion | Weight in dry condition $W_1$ (kg) | Weight in wet condition $W_2$ (kg) | $\% = (\frac{W2-W1}{W1}) \times 100$ |
|---|---|---|---|
| 1:4 | 3.292 | 3.318 | **0.789** |

### 4.3 Impact Test

The plastic sand brick with 600µm & 4.75mm sand were tested for impact test. No bricks were found broken after drop from 1m height.

### 4.4 Soundness Test

The plastic sand brick with 600µm & 4.75mm sand were tested for soundness test and all bricks produced clear ringing sound.

### 4.5 Hardness Test

The plastic sand brick with 600µm & 4.75mm sand were tested for hardness test and no scratches were found on the brick surface.

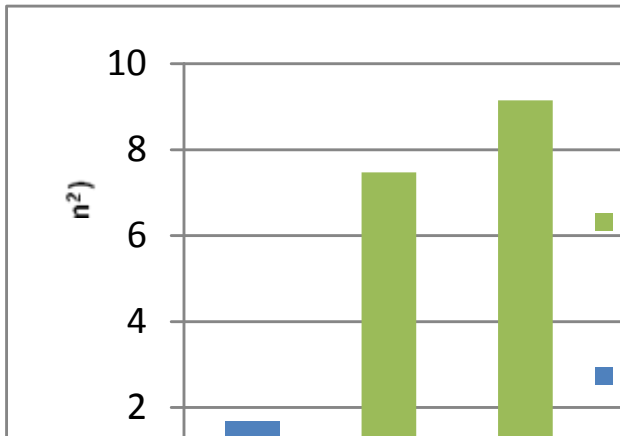



**Chart 1:** Comparison of compressive strength of conventional brick with different types of plastic sand bricks

## 5. RESULTS AND DISCUSSION

The plastic sand bricks were prepared by using HDPE with 600µm and 4.75mm sand. Various tests were conducted on these plastic sand bricks and following results were observed.

### 5.1 Compressive Strength of the Bricks

- The compressive strength of locally available conventional brick was found to be 1.685N/mm$^2$.
- Plastic sand brick with 600µm sand were prepared & tested. The compressive strength was found to be 7.468N/mm$^2$.
- Plastic sand brick with 4.75mm sand were prepared & tested. The compressive strength was found to be 9.141N/mm$^2$.

### 5.2 Water Absorption Test

- Water absorption of locally available conventional bricks was observed 23.789%. Which is greater than the IS limit of 20%.
- Plastic sand brick with 600µm sand were tested for water absorption. Water absorption was observed 3.060%.
- Plastic sand brick with 4.75mm sand were tested for water absorption. Water absorption was observed 0.789%.

The plastic sand bricks with 600µm & 4.75mm sand were found to have good performance in Impact test, Soundness test and Hardness test.

## 6. CONCLUSIONS

From the experimental investigations it can be concluded that

- The Compressive Strength of plastic sand brick was found greater than compressive strength of locally available conventional clay bricks.
- Water absorption was found in the range of 0.789% to 3.060% which is less as compared to water absorption in locally available conventional clay bricks.
- Plastic sand bricks also gave good results in impact test, soundness test & hardness test.
- Considering the cost of waste HDPE plastic & sand, plastic sand bricks might be costlier than conventional clay bricks. But from waste plastic disposal point of view, plastic sand bricks are more advantageous to locally available conventional clay bricks to reduce the consumption of natural resources such as clay and for efficient & effective utilization of waste HDPE plastic.

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## REFERENCES

1. Mr. N. Thirugnanasambantham, P. Tharun Kumar, R. Sujithra, R. Selvaraman, P. Bharathi, (2017), "Manufacturing and Testing of Plastic Sand Bricks", International Journal of science and Engineering Research, ISSN 3221-5687, Vol.5, Issue 4, pp 1150-1155.
2. Lairenlakpam Billygraham Singh, Loukham Gerion Singh, Pongsumbam Boss Singh, Surresh Tholchom, (2017), "Manufacturing Bricks from Sand and Waste Plastic", International Journal of Engineering Technology, Management and Applied Sciences (IJETMAS), Vol.5, Issue 3, ISSN 2349-4476.
3. Siti Aishah Wahid, Sullyfaizura Mohd Rawi, Norlia Md Desa, (2015), "Utilization of Plastic Bottle Waste in Sand Bricks", Journal of Basic and Applied

Scientific Research, ISSN 2090-4304, Vol. 5, Issue1, pp35-44.

4. Dinesh. S, Dinesh. A, Kirubakaran.K, (2016), "Utilisation of Waste Plastic in Manufacturing of Bricks", International Journal of Applied Engineering Research, Vol.11, ISSN 0973-4562.
5. Aiswaria K, Khansa Abdulla, E B Akhil, Haritha Lakshmi V G, Jerin Jimmy, (2018), "Manufacturing and Experimental Investigation of Bricks with Plastic and M-sand", International Journal Of Innovative Research in Science, Engineering and Technology, Vol.7, Issue 6, pp 6558-6562.
6. Shikhar Shrimali, (2016), "Bricks From Waste Plastic", International Journal of Advanced Research, Volume 5, Isssue 5, Issue 1, pp 2839-2845.
7. Sanket K. Misal, S. S. Zambani, Dipali S. Gawande, Omprasad Malekar (2019), "Use of PET Plastic Waste in Manufacturing and Testing Plastic Sand Bricks", Volume 7, Issue V, International Journal for Research in Applied Science and Engineering Technology (IJRASET).
8. http://www.iitk.ac.in/ce/test/IS-codes/is.1077.1992.pdf
9. https://en.m.wikipedia.org/wiki/High-density_polyethylene
10. https://en.wikipedia.org/wiki/Plastic