Utilization of Waste Plastic In Manufacturing of Interlocking Brick

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Abstract- *Modern world is facing a serious situation of waste management, especially plastic waste. Everyday thousands of tonnes of plastic are dumped to the garbage but there is no enough method to treat and recycle the plastic world. A large amount of plastic is being brought into the tourist trekking regions are discarded or burned which leads to the contamination of environment and air.*

Accumulation of plastic waste in the environment is hazardous to both plant and animal life. Hence, these waste plastics are to be effectively utilized. Low-density polyethylene bags are cleaned and added with sand at particular percentages to obtain high strength bricks that possess thermal and sound insulation properties to control pollution and to reduce the overall cost of construction; this is one of the best ways to avoid the accumulation of plastic waste which is an on-degradable pollutant. The large volumes of materials required for construction is potentially a major area for the reuse of waste materials. Thus, to overcome this problem the plastic waste is been treated with sand to make brick for construction purpose.

The present work deals with the manufacturing and analysis of bricks made with waste plastic (LDPE) and fine aggregates. The bricks produced are light weight, have smooth surface and fine edges, do not have cracks and have high crushing strength and very low water absorption. The bricks are manufactured by heating waste plastic to temperature range of 120 to 150 degree centigrade and mixing sand to the molten plastic.

Keywords- Plastic Waste, Environment, Compressive strength, Water Absorption, Interlocking Brick.

I. INTRODUCTION

Plastic is one daily increasing useful as well as hazardous Materials. At the time of need plastic is non biodegradable, so it will continue to be hazardous for Centuries. The idea of this is to use the waste plastic as a Construction Material such as Interlocking Brick. So as to reduce the plastic waste and save the the natural resource like Yamuna which is degrading due to waste plastic. The great problem with plastic is it decomposition. The plastic is made of polymer chemicals and they are non-biodegradable. This means the plastic will not decompose when it is placed in earth. Though plastic is very useful material that is flexible, robust and rigid they become waste after their use and they pollute the air and land.

In the recent past research, the replacement and addition have been done with the direct inclusion of polyethylene, polyethylene terephthalate (PET) bottles in shredded form, chemically treated polyethylene-fiber, PET in small particles form by replacing natural aggregate. Globally the estimated quantity of wastes generation was 12 billion tones in the year 2002 of which 11 billion tones were industrial wastes and 1.6 billion tones were municipal solid wastes (MSW). About 19 billion tons of solid wastes are expected to be generated annually by the year 2020. Annually, Asia alone generates 4.4 billion tons of solid wastes and MSW comprise 795 million tons of which about 48 (6%) MT are generated in India. MSW generation in India, is expected to reach 300 Million tones and land requirement for disposal of this waste would be 169.6 km2 as against which only 20.2 km2 were occupied in 1997 for management of 48 Million tones.

The Plastic is classified in 7 types all are given below:-

1. Polyethylene tere phthalate also known as polyester (PETE).
2. High density polyethylene (HDPE).
3. Polyvinyl chloride (PCV).
4. Low density polyethylene (LDPE).
5. Polypropylene (PP).
6. Polystyrene (PS).
7. Other type of plastic including acrylic, acrylonitrile, etc.

II. MATERIAL USED

2.1 Waste Plastic

We are using Low Density Polyethylene Waste Plastic (LDPE) in this project because the High-Density Polyethylene Plastic become powder when heated or melted. But the LDPE plastic become liquid when heated and in atmospheric temperature it again hardens and act like a binding material in manufacturing of soil bricks.

Low-density polyethylene (LDPE) is a thermoplastic made from the monomer ethylene. It was the first grade of polyethylene, produced in 1933 by Imperial Chemical Industries (ICI) using a high-pressure process via free radical polymerization. Its manufacture employs the same method today. The EPA estimates 5.7% of LDPE is recycled. Despite competition from more modern polymers, LDPE continues to be an important plastic grade. In 2013 the worldwide LDPE market reached a volume of about US$33 billion.

According to UN estimates, every year the world uses 500 billion plastic bags while half of the plastic used is of single use or in disposable items such as grocery bags, cutlery and straws. Each year, at least eight million tonnes of plastic end up in the oceans, the equivalent of a full garbage trucks every minute.

We collected waste plastic by municipal town panchayat which is collected by cleaning our city every day and also some amount of plastic is collected by cleaning our campus.

2.2 RIVER 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.

Table 1: Properties of Sand

S.NO	TESTS	RESULTS
1	Specific Gravity	2.56
2	Apparent Specific gravity	2.7
3	Water Absorption	1.97
4	Bulk Density	1.497 KG/L
5	Fineness Modulus	2.805

III. METHODOLOGY

- Collection of Materials.
- Batching.
- Melting
- Mixing
- Moulding
- Curing

3.1 Collection of Plastic Material

The plastic material should be collected from the factories waste and hospital waste and industries waste and also food packages and plastic bottles this will come under the LDPE and HDPE plastic type

Figure 1: collection of plastic

3.2 Batching of plastic

Measurement of materials for making brick is called batching. After collection of materials we separate the types of plastic and remove any other waste presented in the collected material and check that any water content in in sample collected ten proceed for burning.

3.3MELTING

we are using LDPE plastic as binding material in manufacturing of bricks it needs melting of plastic. we melted plastic in a pan by using fire & wood. The melting point of plastic is **120˚C -180˚C.**

Figure 2: Melting

3.4 Mixing

Mixing of materials is essential for the production of uniform and strength for brick. The mixing has to be ensuring that the mass becomes homogeneous, uniform in color and consistency. We can use only 1:.5 or 1:1 (Plastic: Soil) proportion in manufacturing of plastic sand bricks to get proper strength and shape. In this project, we adopted hand mixing. Until the entire plastic content required for making plastic brick of one mix proportion is added into it. Then these plastic liquids thoroughly mixed by using trowel before it hardens. The mixture has very short setting bags are turned to molten state; the river sand is added to it. The sand added is mixed time. Hence mixing process should not consume more time.

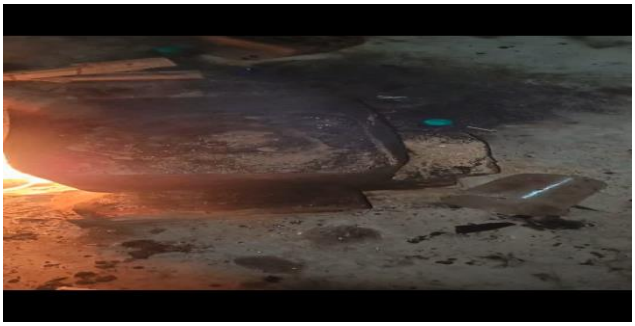

Figure 3: Mixing

3.5 MOULDING

Immediately after mixing process we should pour the mix into mould. Because immediately after mixing the mix starts cooling and it get hardens so the quickly the mix should be poured into the mould and compacted. The size of mould which we have used is 190mm X 60mm X 150mm.

Figure 4: Moulding

3.6 CURING

Since immediately after moulding the bricks cools and hardens in atmospheric temperature the process of curing is not required. The brick itself leave the mould after 30 minutes and it automatically cooldown after 1hour to 1.5 hour.

IV. TESTS

4.1WATER ABSORPTION

No brick should absorb water more than 20% of its dry weight when kept immersed in water for 24 hours. Plastic soil bricks do not absorb water hence water absorption of plastic soil bricks is 0%.

Figure 5: Water Absorption

4.2 CRUSHING STRENGTH

No brick should have the crushing strength below 5.5N/mm2. The plastic soil bricks have the compressive strength of 7.46 N/mm2.

4.3 SOUNDNESS

Two bricks should give clear ringing sound when struck against each other.

4. 4 HARDNESS

The bricks should be so hard that finger nail should not be able to make any impression on its surface when scratched. Bricks should not break when dropped flat on hard ground from a height of about 1m.

4.5 EFFLORESCENCE TEST

A good quality brick should not contain any soluble salts in it. If soluble salts are there, then it will cause efflorescence on brick surfaces.

To know the presence of soluble salts in a brick, placed it in a water bath for 24 hours and dry it in shade. After ,If there is any white or grey colour deposits, then it contains soluble salts and not useful for construction.

These bricks do not contain any soluble salts in it, therefore there is no white or grey colour deposits on the surface of the bricks after brick is in a water bath of 24 hours and dried in a shade.

Figure 6: After Efflorescence Test

4.6 COMPRESSIVE STRENGTH TEST

The tests on Compressive strength of the specimen brick shall be calculated for 3 aspects after 7, 14 & 28 days of curing using the formula as follows,

Compressive strength = $\frac{\text{Applied max load x 1000 (N)}}{\text{Cross sectional Area (mm}^2\text{)}}$

V. RESULT

COMPRESSIVE STRENGTH

Samples	Load taken by specimen	Compressive Strength
Specimen -1	**170 KN**	**7.23 N/mm²**
Specimen -2	**200 KN**	**8.51 N/mm²**
Specimen-3	**250 KN**	**10.6 N/mm²**
Average	**206.6 KN**	**8.76 N/mm²**

VI. ADVANTAGES AND DISADVANTAGES

6.1 ADVANTAGES

- The compressive strength of the brick is greater than burnt bricks
- It is a technique of plastic waste management
- We can reduce the impact of plastic waste on the environment
- These bricks do not absorb water so that we can achieve damp proof construction
- After dismantling we can again melt the bricks and prepare new bricks which can be used for construction of temporary structures, sheds etc.
- Less skilled labour can be adopted
- We can use this type of bricks as pavers or we can manufacture pavers using same methodology
- These bricks are economical than burnt bricks
- Since plastic is non-biodegradable the durability of the bricks is more

6.2. DISADVANTAGES

- These bricks are not fire resistant if the temperature is greater than 150˚C the structure collapse.
- Release harmful gases at the time of preparation which is very dangerous.
- The manufacturing process is very dangerous and protective equipment should be used .

VII. CONCLUSION

- Waste plastic, which is available everywhere, may be put to an effective use in brick.
- Plastic bricks can help reduce the environmental pollution, thereby making the environment clean and healthy.
- Plastic sand bricks reduce the usage of clay in making of bricks.
- Plastic sand bricks give an alternative option of bricks to the customers on affordable rates.
- Water absorption of plastic sand brick is zero percent.
- Compressive strength of plastic sand brick is 7.37N/mm2 at the compressive load of 175KN.
- We conclude that the plastic sand bricks are useful for the construction industry when we compare with Fly Ash bricks and 3rd class clay bricks.
- Plastic Sand brick possesses more advantages which includes cost efficiency, resource efficiency, etc.,
- Plastic Sand brick is also known as “Eco-Bricks” made of plastic Waste .

- It increases the compressive strength when compared to burnt bricks.

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