A Study of Manufacturing Bricks Using Plastic Wastes

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ABSTRACT

Plastic waste which is increasing day by day becomes eyesore and in turn pollutes the environment, especially in high mountain villages where no garbage collection system exists. 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. 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. This alternatively saves the quantity of sand/clay that has to be taken away from the precious river beds/mines. The plastic waste is naturally available in surplus quantity and hence the cost factor comes down. Also coloring agents can be added to the mixture to attain desired shades. Hence in this thesis, an attempt is made to study regard the properties of the brick which is manufactured using plastic wastes. 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, Brick.

1. INTRODUCTION

Low density polyethylene (LDPE) is the most common packaging material used worldwide and is used for packaging a variety of products. It is also used for making containers and bottles. However they pose great threat to the environment as their effective disposal is a herculean task. They are not easily degradable; it usually takes more than ten decades to decompose. As a result, they clog water ways, channels and drains. As they require many years to decompose, they fill up the landfills faster. Polythene bags and packaging sheets harm aquatic life and wildlife as they pose the threat of chocking if ingested. Low density polythene can be reused for making bricks. Bricks are the basic components of a building and are required in bulk.

By using plastic in making the brick, the overall cost of the brick will get reduced as, waste polyethylene is being reused. Brick earth is costly, and digging of brick earth poses some damage to the environment. Hence using plastic to make bricks is not only cost effective and ecofriendly but also the plastic bricks have a smooth finish, devoid of cracks and have low water absorption value, and will not have problems like efflorescence in future.

Plastic Brick

1.2. PRESENT SCENARIO OF WASTE GENERATION IN INDIA:

Growth of population has increased our urbanization as a result rising standard of living due to technological innovations have contributed to an increase both in the quantity and variety of solid wastes generated by industrial, agricultural activities, mining and domestic. 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. As it is studied that apart from municipal wastes, the organic wastes from agricultural sources alone contribute more than 350 million tons per year. However, it is reported that about 600 million tons of wastes have been generated in India from agricultural sources alone. The Quantity of wastes generated from agricultural sources are sugarcane baggage, paddy and wheat straw and husk, wastes of vegetables, food products, tea, oil production, wooden mill waste, coconut husk, jute fiber, groundnut shell, cotton stalk etc. In the industrial sector inorganic solid waste could are coal combustion residues, bauxite red mud, tailings from aluminum, iron, copper and zinc primary extraction processes. Generation of all these inorganic industrial wastes in India is estimated to be 290 million Tons per annum. In India, 4.5 million tons of hazardous wastes are being generated annually during different industrial process like electroplating, various metal extraction processes, galvanizing, refinery, petrochemical industries, pharmaceutical and pesticide industries.

2. MATERIALS USED

2.1 SAND

Common river sand having specific gravity of 2.56 and fineness modulus of 2.805 is used.

2.1a PROPERTIES OF FINE AGGREGATE

TABLE 3:Physical Characteristics of Fine Aggregate

Particulars	**Test Results**
Specific gravity	2.56
Apparent Specific gravity	2.7
Water Absorption	1.98
Bulk Density	1.497Kg/L
Fineness Modulus	2.805

2.2 LOW DENSITY POLYETHYLINE

When exposed to ambient solar radiation the plastic procedure two greenhouse gases, methane and ethylene. Due to its low-density properties (branching) it breaks down more easily over time, leading to higher surface areas. The supply of glasses shall be of diagonal gases from virgin LDPE increase with surface area or time, with rates at the end of a 212day incubation of 5.8 nmol g-1 d-1 of methane, 14.5 nmol g-1 d-1 of ethylene, 3.9 nmol g-1 d1 of ethane and 9.7 nmol g-1 d-1 of propylene. In case of air it was incubated, LDPE releases gases in air by ~2 times and ~76 times higher in comparison to water for methane and ethylene, respectively.

Low density polyethylene, obtained from waste plastic bags, packaging materials, plastic bottles having density of 0.91- 0.94 g/cm3, melting point at about 115 degree centigrade is used.

Table of Properties of Plastic Polyethylene

Sl. No.	Experiments	Results
1	Density at 23°C	.958
2	Elasticity Modulus	9
3	Tensile Creep Strength	8
4	Bending Creep Modulus	1
5	Tensile strength at 23°C	2
6	Elongation at break (%)	>600
7	Thermal Conductivity	0
8	Ignition Temperature	3

3. METHODOLOGY

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

3.1 Collection of Plastic Materials

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 plastic type

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.

3.3 Burning of waste plastic

After completion batching the plastic waste was taken for burning in which the plastic bags are drop one by one into the container and allowed to melt. These would be done in closed vessel because to prevent the toxic gases released into atmosphere. These will be at the temperature of 120-150 degrees centigrade.

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. Generally, there are two types of mixing, Hand mixing and mechanical mixing. 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.

3.5 Moulding

After completion of proper mixing we place mix into required mould. In these projects we use the normal brick sizes (19x9x9 cm). After 2 days remove the brick from the mould and then done curing.

3.6 Curing

The test specimens after moulding were allowed to dry for a period of 24 hours. The specimens were kept in curing tank and allowed to cure for a period of 28 days.

Mould of Plastic Brick

4. TESTING OF SPECIMEN

4.1 Compressive Strength Test:

This test is done to know the compressive strength of brick. It is also called the crushing strength of brick. Generally, 3 specimens of bricks are taken to laboratory for the testing and tested one by one. In this test, a brick specimen is put on compressive strength is put on Compressive Strength testing machine and applied pressure at a constant arte till it breaks. The ultimate pressure at which brick is crushed is taken into account. All three brick specimens are tested one by one and average result is taken as bricks compressive/crushing strength. The Compressive Strength of the brick is calculated by the formula = (max load taken before failure/ Area of the Brick surface) $N/mm^{2.}$

Compressive Strength Test of Plastic Brick

4.2 Water Absorption Test:

In this the bricks first weighted in dry condition and they are immersed in water for 24 hours. After that they are taken out from water and they are wiping out with cloth. Then the difference between the dry and wet bricks percentage are calculated. They weight of the three plastic bricks has been taken and then the average weight of the bricks is calculated.

5. RESULT AND DISCUSSIONS

5.1 WATER ABSORPTION

This test is carried out to determine the amount of water absorbed by the brick. As per IS:3495-Part 2-1992 , after immersed in cold water for a period of 24 hours, water absorption shall not be more than 20 % for up to class 12.5and 15 % of weight for higher classes. Initially 5 bricks were taken and removed all the loose particles. Dry the bricks in a ventilated oven at a temperature of 110℃ till the brick attain substantially constant weights. Cooled the bricks at room temperature and taken weight of each sample W1; then immersed the bricks in clean water at temperature of 25 ℃ to 29 ℃ for 24 hr and removed the specimen after 24 hr. wipe our water with damp cloth & weight each sample W2. Finally the percentage of water absorbed for each brick was calculated by the following formula. Water Absorption = [(W2-W1)/W1)] x 100, W2= weight of soaked brick W1=weight of dry brick.

The specimen was tested for water absorption and the specimen had very low water absorption of 1.5%.

5.2 COMPRESSIVE STRENGTH

Bricks should have a specified minimum compressive strength so that they can be used in construction works. The compressive strength determined using compression testing machine for the specimens and the results have been shown in the table below.

Compressive Strength of Plastic Brick (MPa)			
Sample 1	**Sample 2**	**Sample 3**	**Avg Strength (MPa)**
5.5	4.5	4.5	5

The specimen was tested for compressive strength and the specimen had average compressive strength of 5Mpa.

5.3 WEIGHT OF SAMPLE

The weight of the 3 dry samples is taken and then the average weight is calculated.

Weight of Plastic Brick (gm.)			
Sample 1	**Sample 2**	**Sample 3**	**Avg Weight (gm.)**
2250	2195	2155	2200

The specimen had average weight of 2200 gm.

6. CONCLUSION

On the basis of the results obtained, it can be concluded that:

I. Plastic bricks can a very good alternative of traditional earthen bricks.

II. Plastic bricks can be used for partition walls and exterior walls; however they must not be used in load bearing walls.

III. Cost of manufacturing per unit plastic brick is significantly lower than traditional earthen bricks, hence they are cheaper alternative.

IV. Plastic bricks are water resistant, hence can be used in underwater structures.

V. Re using plastic will reduce environmental pollution.

7. REFERENCE

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