

Hazardous Waste Management Through Plastic Brick

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Abstract: Waste which is toxic in nature, chemically active, or some of its characteristics causes potential hazard to human or environment and which cannot be stored, transported, treated or disposed without special precautions is known as hazardous waste. The latest report suggests that, in 2017-18 alone India has consumed 16.5 million tons of plastic which is worse according to industrial bodies. The main reason behind the slow degradation of plastic is its chemical structure which helps it to resist natural process of degradation and cause of plastic pollution in recent days. So in this paper we mainly discussed that rather keeping these plastic wastes in environment and wait for its degradation these plastic wastes can be recycled by producing bricks from it which can be used for construction purpose and can open up a new era in industry.

Keywords: Plastic Bricks, Polyethylene, Sand compacted bricks

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I. INTRODUCTION

Plastic is the most widely used material in world due to its compactness and light weight. Mostly used plastic items are packages, bottles, bags, and containers and due its large use it creates the problem of disposal. Non-biodegradable polymer chemicals make them in disposable when they are buried. Apart from its rigidity, robustness, and flexibility, its non-disposable property makes plastic harmful for the atmosphere. The quantity of plastic under municipality solid waste is increasing day by day. An estimation has been made that the quantity is increasing at a double rate in every 10 years. This is happening due to rapid rate of urbanization, population growth and development activities in daily lifestyle. As these materials are non-biodegradable, they can live on the earth surface for more than 4500 years without degradation. Right now, INIDA generated approximately forty million tons of municipal solid waste annually with a growing rate of 1.5 to 2% each year. Recycling is the processing of used materials to new products to minimize its potentiality of create waste. Now days research is going on using of environment friendly lightweight building materials in civil industry. This ignites the investigation on waste plastic to convert them into environment friendly lightweight building material. The use of waste plastic to produce bricks and to minimize the method to solve the problem of storing waste plastic materials can also minimize the cost to produce building materials. In recent globalization banning the use of plastic is quite impossible but reusing of plastic waste in building construction and industrial application will open a new era for the engineers.

II. OBJECTIVE

Objective of this work is to recycled waste plastic by producing plastic brick from them to control land and water pollution caused by these plastics. As is can be reused into a cost-effective product. With this also a comparison of strength, cost comparison has been made between the normal clay bricks and recycled plastic bricks by varying the percentages of plastic content into the recycled bricks. To find out the optimum percentage of plastic that gives us good result in both the above-mentioned category.

III. SPECIFICATIONS

Materials that are used to produce plastic brick are listed below with their physical properties.

A. Sand

River sands are used as fine aggregates for the construction, the properties are determined according to the tests as per IS 2386 (Part I). And it has been observed that the sand is confirming Zone III as per IS: 383-1970:

TABLE 1

Sl. No	Properties of sand	
	Name of the test	Observations
1.	Specific Gravity	2.63
2.	Bulk Desnsity	1687 kg/m ³
3.	Fineness Modulus	2.89

B. Waste Plastic

Due to the widespread of the plastic material the waste generated from their needs a proper end life management. The highest amount of plastic is found in bottles, packaging of materials, cups etc. they are also found in tires, building materials, furniture, and in medical goods. Main reasons behind the diversity use of plastic is its ease of processing, lower density, high chemical restiveness, and insulating properties both in thermal and electrical criteria.

TABLE 2

Sl. No	Origin of Waste Plastic		
	Categorization of Waste Plastic	Availability form	% recycled
1.	PETE (Polyethylene Terephthalate)	Bottles (Drinking water, fruit juice) and oil container etc.	Only US recycled 25% of PET bottles
2.	HDPE (High-Density Polyethylene)	Cleaning agents bottles and shampoo gel bottles	35% of HDPE has been recycled
3.	PVC (Polyvinyl Chloride)	Piping, windows, and medical instrument	1% of PVC has been recycled
4.	LDPE (Low-Density Polyethylene)	Shopping bags, crushed bottles	-
5.	PP (Polypropylene)	Tupperware Containers, medicine bottles	-

IV. MIXING AND METHODOLOGY

Manufacturing process of plastic brick is consisting of four steps. Batching, mixing, moulding and curing. 1:3 and 1:2 these two proportions of plastic have been mixed with sand for experimental work to find out the right blend of mixing.

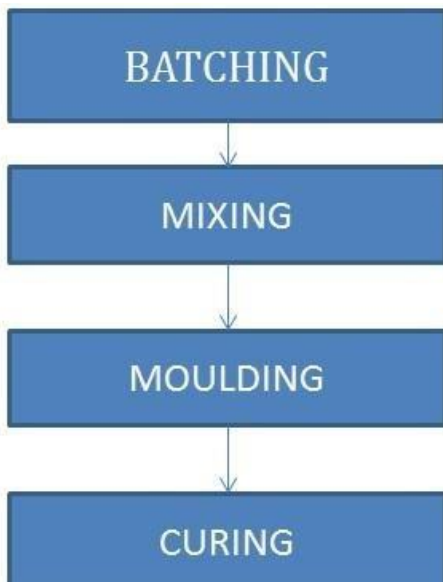


Fig. 1. Plastic Brick Manufacturing Process

A. Batching

Collected waste plastic are washed and dried before use and then they are weighted. Sand is sieved through 600 μ

sieve. After that, the sand and the plastic were weighted at different proportions with 1:2 (i.e. 1 kg of plastic is mixed with 2 kg of sand)and 1:3 (i.e. 1 kg of plastic is mixed with 3 kg of sand) ratio between them plastic will be used for burning process.

B. Burning

Burning is one of the most crucial steps in manufacturing process, but these waste plastics will emit lot amount of CO₂ during the process, so it is recommended to use a closed pit for the burning process. Steps that should be followed are arrangements of stone for the pit and the drum for the plastic to be burned. During this process we should keep in our mind that the plastic should be elastic state. Application of more heat will convert these plastics into crystalline particle.

C. Mixing

The weighted plastic bags are added into the closed pit for burning process. When the plastic has reached to molten state they should taken off from the closed pit. According to the mixing ratio molted plastic will be mixed with sieved sand, the mixing process should not be more than 5 to 6 minutes. Precaution should be taken during the mixing.

D. Moulding

Then the plastic mix is poured into a normal sized brick mould (19X9X9 cm) and compacted by tampering rod so that all the voids can be removed.

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V. EXPERIMENTAL DATA

After moulding the plastic bricks are kept there for 24 hours to get dried. This will help to make a strong bond between plastic and sand. After that some experimental test has been done on the plastic bricks to find out it's property and behaviours. The test which are conducted on plastic bricks are listed below.

- A. Compression Strength Test
- B. Hardness Test

The results are discussed below.

A. Compression Strength Test

The brick specimens are placed in to CTM (Compression Testing machine) and gradually load is applied to the specimen. And the loads are applied gradually without any shock.

TABLE 3

Sl. No	Compression test Data	
	Plastic Sand Ratio	Compressive Strength (N/mm ²)
1.	1:3	6.43
2.	1:2	8.72

B. Hardness Test

Two methods have been used to measure the resistance of the plastic bricks against plastic deformation. A steel rod has been used to make scratch on the brick surface and the bricks are also subjected to free fall from 6ft and 10ft.

TABLE 4

Sl. No	Hardness test Data		
	Plastic Sand Ratio	Height	Damage
1.	1:2	6 ft	No Damage
2.	1:3	10 ft	No Damage

Apart from these tests fire resistance and soundness test also have carried on these bricks. In case of fire resistance the bricks do not show a very good result and it starts to crack at 100 to 120°C. After 2days of manufacturing when the bricks are made to hit each other metallic sound get produced this shows its better quality also

VI. CONCLUSION

- Each plastic bricks cost near about 2/- INR which can be a useful material for construction.
- Recycling of waste plastic abolish the problem related to plastic dumping.
- Recycled Plastic bricks possessed good properties both in strength, and water absorption criteria.
- Plastic bricks consumed less natural resources rather compared to normal clay bricks
- The manufacturing cost of plastic brick can be reduced by replacing river sand with industrial waste like fly ash or GGBS.
- These plastic bricks can be used for wall construction (e.g. compound wall, parapet wall etc.)
- Further research will help us to improve the fire resistance properties of plastic bricks.

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