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Use of Waste Plastics as Building Materials- A New Step in Sustainable Construction Technology

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Short Research Article

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ABSTRACT

The dangerous problem in the contemporary world is plastic trash. This problem represents the biggest danger to civilization. These plastic wastes have a negative impact on the aquatic life, and they also cause the sea water's quality to decline. We look for practical answers to the problem of plastic pollution. Consequently, action is done to create the plastic bricks from waste plastic. It is the most economical option presently being used in the construction industry. It is also advantageous for the environment. In our research, we gathered waste plastic from the neighbourhood municipality, mixed it with the appropriate amount of sand (0.8 kg of plastic and 3.2 kg of sand), and burned it correctly in a pit so that the plastic melted easily. We then poured this mixture into a brick

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mould and let it sit for a few hours. It is demoulded and kept available for laboratory tests after three to four hours. The water absorption test result and compressive strength result given in Table 2 indicates that the plastic brick is definitely an alternative solution of clay brick and from Table 3 it is also concluded that plastic bricks are economical for use.

Keywords: Plastic trash; plastic pollution; plastic bricks; civilization.

1. INTRODUCTION

Plastic is a material that is used by everyone in the world today. Plastic is convenient and lightweight, which has many advantages. Plastic is commonly used for packaging food, bottles, bags, and containers. How to correctly dispose of plastic is the main problem. Plastic is made from polymer materials, which are not biodegradable. This suggests that plastic won't degrade when interred. Plastic is a substance that is strong, stiff, and flexible, but it is also waste that pollutes the environment after use. Bricks made from recycled plastic bottles are a great way to reduce the expense of manufacturing building materials and the problem of storing waste. In this research, plastic waste that has been collected by the local government will be combined with sand to produce plastic bricks. The blocks' compressive strength and water absorption will then be evaluated.

2. LITERATURE SURVEY

1. Review on plastic and sand bricks: One of the most typical masonry components used in construction is brick. Due to the demand, several waste products have been looked into for incorporation into the bricks. Between the supply of traditional building materials and demand, there has recently been a significant imbalance. On the other hand, plastic garbage is widely available, and disposing of it is a major difficulty because only a small percentage of plastic waste is recycled and repeated recycling of PET bottles could result in the creation of a dangerous material [1]. Because traditional recycling methods are expensive, there is a greater need for cutting-edge, creative solutions to efficiently recycle these materials. This essay discusses the materials utilised, the production process, and the testing procedure for plastic sand bricks [2].

2. Manufacturing and Testing of Plastic Sand Bricks: The ecosystem is contaminated by plastic, a non-biodegradable material that takes thousands of years to degrade and pollutes both land and water. Municipal Solid Waste (MSW) is quickly increasing in the amount of plastic waste it contains. Every ten years, according to estimates, the rate of utilisation doubles. Polyethylene is one of the most prevalent types of plastic waste due to its high consumption rate (PE) [3]. Resources were depleted and the environment was harmed by the use of earth-based clay materials. The project efficiently makes use of these waste plastics in order to lessen the amount of land needed to dump these wastes because the amount of clay needed to make bricks is enormous. By doing this, several hazardous diseases can be prevented. To create high-strength bricks with thermal and acoustic insulation capabilities, polyethylene (PE) bags are cleaned and mixed in with fine aggregate at different ratios. One of the best methods to stop plastic garbage from accumulating is by doing this. Additionally, it lowers the overall cost of building and helps with energy conservation, so in this project an effort is made to create plastic sand bricks using discarded plastics [4].

3. "Fabrication and testing of Plastic sand bricks" by S S Chauhan, Bhusan Kumar, Prem Shankar Singh, Abuzaid Khan, Hrithik Goyal, Shivank Goyal (2019). For a mould dimension of (230*100*75 mm), they mixed river sand and PET plastic (in molten form) in the following ratios: 1:2, 1:3, and 1:2, respectively, finding that the ratio of 1:2 produced bricks with the highest compressive strength. These bricks' water absorption was found to be less than 5%, which is lower than the 15-20% of traditional clay bricks.

4. "Utilization of plastic waste in manufacturing of plastic sand bricks." By Arvind Singhal, Dr. Om Prakash Netula (2018). In a normal brick mould, they used a 3:7 mixture of plastic and stone dust that had been melted down and sieved through a 4.75 mm mesh using sieve analysis. Plastic sand bricks have a 5.6 N/mm^2 compressive strength at a 96 KN compressive force.

5. "Plastic in Brick Application." By Siti Nabilah Amir & Nur Zulaikha Yusof (2018). The experiments demonstrated the potential for using plastic as a binder in place of cement with

the help of a catalyst and PET depolymerization. It was found that when the binder was replaced with PET refuse to a greater than 50% extent, compressive strength significantly decreased. The softening point of the bricks produced increased along with the quantity of PET used. They used models of various sizes, such as (150*150*150) and (200*100*100), among others. However, they were unable to sustain the bricks' fire resistance.

6. "Study of plastic dust brick made from waste plastic" by Ronak Shah, Himanshu Garg, Parth Gandhi, Rashmi Patil, Anand Daftardar (2017). They heated plastic dust to a temperature of 220°C and used it as the primary component of waste material. Plastic dust is a by-product of many industrial goods, including PVC pipes. When the compressive strength of the finished plastic dust product was measured, it was found to be 6.66 N/mm^2, which is greater than the compressive strength of standard bricks (3-5 N/mm^2).

3. OBJECTIVES

a) To create a method that is efficient and uses waste plastics effectively.
b) To decrease the use of natural resources, such as clay, in the production of bricks.
c) To prevent land and water degradation and the associated pollution risk, it is important to reduce and reuse the production of waste plastic on land and in water.
d) To create materials that are affordable for the average person.
e) To save non-renewable resources by reducing the amount of plastic in waste streams.

4. METHODOLOGY

Plastic is mixed with sand and several tests have been performed in laboratory like specific gravity of plastic and sand. Once laboratory tests were done, we easily obtained the density of the materials. We consider the standard size of brick (0.23x0.114x0.076) m and 800gm plastic and 3.2kg sand have taken for our research work and cost analysis is also done along with the different strength tests of plastic brick. For this research work plastic is collected from municipality and shredded into small pieces. Pit is created for burning the mix of plastic and sand at proper temperature and adequate amount of wood and fuel are bought from market. This test is done taking full measurement so that the environment does not pollute [5-8].

5. MATERIALS PROPERTIES

Table 1. Materials properties

Sl no	Materials	Sp. Gravity	Density (Kg/m^3)
1	Plastic	1.1	1100
2	Sand	2.67	2670

Fig. 1. Plastic and sand mix are burnt

Table 1 represents the specific gravity and density of both plastic and sand. Plastic and sand mix are burnt with exact proportions and that is shown in Fig. 1.

6. RESULTS AND DISCUSSION

Table 2. Laboratory test results

Sl NO	Test conducted	Result
1	Water absorption test	11%
2	Compressive strength test	8.9N/mm^2

So, from the observation of Table 2, it is clear that the test results of plastic bricks are very satisfactory compared to that of traditional bricks and it can be used in construction as building material.

Fig. 2. Prototype of plastic brick

7. COST ANALYSIS OF PLASTIC BRICK

Table 3. Rate analysis of each plastic brick

SL NO	Items	Rate of each item (Rs)	Material required per brick	Cost (Rs)	Total cost (Rs)
1	Waste Plastic	0.00	0.8 kg	0.00	
2	Sand	2/Kg	3.2kg	6.50	
3	Fuel	3/hour	NA	3	
4	Labour Cost	Rs.500 for 500 bricks (Included 2 labours	NA	2	
5	GST	12%	NA	1.38	12.88

From Table 3 it is observed that the rate of each plastic brick is almost same as rate of one clay brick or traditional brick or clay brick which is used in construction area. So, implementation of plastic brick instead of clay brick will decline the dumping of waste materials which will increase the positive impact of our society as well as the waste materials will be recycled and reused.

8. CONCLUSIONS

- Plastic brick enhances satisfactory compressive strength result. So, it can be used as building construction material.
- From Table 3 it is evident that manufacturing of plastic bricks will be cost effective and economical.
- Use of waste plastic as building material will reduce the adverse effects of plastic on human life.
- Plastic brick is generally light weighted than traditional brick from Table 1 we can conclude. So it will be easier to transport.
- Use of plastic brick will signify the 3R's principle- Recovery, Recycle, Re -use of waste materials.
- It can also be used as substitute of fly ash bricks in construction industry.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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