International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 11 | Nov - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

The Properties of Bricks Made from Recycled HDPE

Shital Navghare , Gopal Rathod, Mandar Juware

Abstract: Plastic waste, particularly high-density polyethylene (HDPE), poses significant environmental challenges due to its non-biodegradable nature. Recycling HDPE into building materials, such as bricks, offers a sustainable solution to mitigate these impacts. This study investigates the properties of bricks made from recycled HDPE, focusing on their compressive strength, water absorption, and durability. The results indicate that HDPE bricks exhibit superior mechanical properties, including higher compressive strength and lower water absorption compared to traditional clay bricks. These bricks are lightweight, cost-effective, and demonstrate excellent durability, making them a viable alternative for sustainable construction. The research highlights the potential of recycled HDPE bricks in reducing plastic waste and promoting environmental sustainability. The intensifying generation of plastic waste presents a significant environmental challenge worldwide. Plastic waste, due to its non-biodegradable nature, contributes to land and water pollution, requiring the exploration of sustainable waste management solutions. Recycling plastic waste into building materials, such as bricks, offers a potential solution to mitigate environmental impacts. This research aimed to investigate the integration of plastic waste into building materials through a comprehensive study using experimental testing, software analysis, and structural design. The ETAB analysis demonstrated that the HDPE model exhibited lower bending moments and axial loads compared to the concrete model, suggesting superior mechanical properties and load-carrying capacity. This research contributes to the understanding of the behaviour and performance of plastic bricks in structural applications, enabling the development of sustainable and efficient building designs that incorporate plastic waste materials.

Key Words: Plastic Waste, Environmental Challenge, Non-Biodegradable, Sustainable Solutions, Experimental Study, Plastic Bricks, Alternative Building Materials, Methodology, Comparable Strength, Plastic Waste Crisis.

1. INTRODUCTION :

The continuous increase in plastic waste, particularly high-density polyethylene (HDPE), poses significant environmental challenges due to its non-biodegradable nature. Recycling HDPE into building materials, such as bricks, offers a sustainable solution to mitigate these impacts. This study investigates the properties of bricks made from recycled HDPE, focusing on their compressive strength, water absorption, and durability. The results indicate that HDPE bricks exhibit superior mechanical properties, including higher compressive strength and lower water absorption compared to traditional clay bricks. These bricks are lightweight, cost-effective, and demonstrate excellent durability, making them a viable alternative for sustainable construction. The research highlights the potential of recycled HDPE bricks in reducing plastic waste and promoting environmental sustainability. Recycling plastic waste into plastic bricks presents a potential solution to this issue. However, certain plastics, like HDPE and PTE, are highly hazardous, and particles smaller than 50 microns adversely affect soil fertility. The challenging to decompose, plastic is extensively utilized in various daily applications, necessitating the exploration of sustainable waste management solutions. Researchers have investigated incorporating plastic waste into building materials, like bricks, to mitigate environmental impacts and reduce waste. While conventional building materials remain in high demand, the integration of waste materials in construction can alleviate environmental concerns, including greenhouse gas

emissions and the excessive use of clay and cement. Exploring plastic bricks as an alternative building material offers a promising avenue to effectively tackle plastic waste and its environmental consequences.

2. MATERIAL USED

2.1 Plastic

Plastics are made up of synthetic or semi-synthetic materials with a polymer as the primary chemical component. Plastic is created mostly as a result of plastic products such as plastic bottles, one-time-use plastics, multi-layer plastics, and other similar items, which clog our environment and have a significant impact on human and wildlife habitat on the planet. Due to its low density, when plastic garbage is exposed to sun radiation, it releases two particularly dangerous greenhouse gases known as methane and ethylene. Generally, there are seven types of plastics available on our earth name as, PET - Polyethylene Terephthalate, HDPE - High Density Polyethylene, LDP - Low Density Polythene, PVC - Polyvinyl Chloride, PS – Polystyrene, PP – Polypropylene, and other remaining plastics.

2.2 Sand

Sand is a granular substance made up of small rock and mineral particles that have been coarsely split. Its size distinguishes it from gravel and silt, being finer than gravel and coarser than silt.

3. METHODOLOGY

There are various methods which are used by several authors, some of them just use low density plastic, by cutting it in small pieces and mix it with the mixture of cement sand and aggregate. Some of them burn plastic and then mix it with iron chips, bitumen, rice husk and several other materials.

Here we melt plastic and then mix sand with it. The types of plastic which we are using are Low density Polyethylene (LDPE), Polystyrene (PS), High density polyethylene (HDPE), Polyphenylene ether (PPE). For making this plastic brick, these four types of plastic got collected and we have to clean it with the help of water to remove impurities and after washing, put it to dry naturally. We cannot use there plastic in the form in which it is available, we have to shred it or cut it into small piece. If we directly put these plastic in its shape then it takes time to melt, so we reduce it's surface area so that it can easily melt. Plastic and sand are mixed in the various proportions as 1:1, 1:2, 1:3, by weight.

Then the plastic is melted in a container when got fully dry. After melting we will mix sand into it and then mix it thoroughly, after proper mixing we will put the mixture into the brick mould. Then we will put it into water after 3-4 minutes and after 10 to 15 minutes we will try to remove brick from that mould.

3.1 **Collection and Sorting: -**

Collection: Gather HDPE waste from sources like households, industries, and recycling centres. This can include plastic bottles, containers, and packaging materials.

Sorting: Separate HDPE from other types of plastics and materials to ensure purity.

3.2 Cleaning and Shredding: -

Cleaning: Remove any contaminants such as labels, adhesives, and residues. This can be done using water and mild detergents.

Shredding: Shred the cleaned HDPE into small, uniform pieces to prepare for melting.

3.3 Proportion of plastic and sand:-

In order to make plastic brick, different ratio of sand and plastic must be taken, the ratios are 1.1 ,1:2,1:3 by weight.

3.4 Procedure for casting of brick

Melting:-

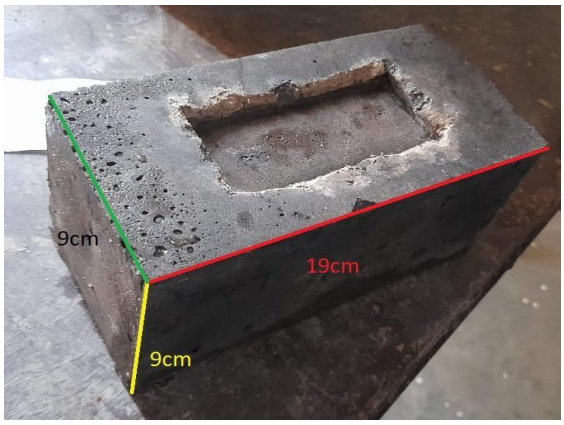
Heat the shredded HDPE in an industrial-grade extruder or melting machine until it reaches a molten state**.** To begin, set up the container, as well as the firewood, stove, heater or extruder. If a heater is to be used, the container must first be adequately heated to remove the moisture. After that, place the little cut pieces of plastic (chips) in the container and melt them. Remember, all the plastic which will be used should be fully in dried condition, no moisture should be present in the plastic so that it can be easily get melted without releasing excessive smoke.

Mixing:-

The sand is incorporated into the container while the temperature of the melted plastic remains about 180°C to 220°C. The molten plastic and sand are constantly stirred to ensure that they are properly blended and bound.

Moulding:-

Pour the mixture into brick moulds. The moulds can be custom-designed to meet specific size and shape requirements. Compression moulding is often used to ensure the mixture is compacted properly and evenly. Apply the oil on the inside surface of the mould to make it easier to remove the bricks. If no oil is used the plastic and sand combination has solidified, the brick will be difficult to remove. As a result, appropriate oiling is required prior to pouring the mixture into the mould. The prepared mixture is poured into the metallic mould and tamped down with a rod to ensure adequate compaction and filling.



4.EXPERIMENT ON PLASTIC BRICK

The bricks should be examined before being used to ensure that they are suitable for the job. The following tests are commonly used to evaluate bricks:-

Compressive strength test:-

The compressive strength test of brick may be determined by placing them in a compression testing machine. After that, load is given to these plastic bricks. Note the value of the failure load, and then multiply the highest load at failure by the area of the bricks to get the compressive strength of the bricks.

OBSERVATION 1:

Plastic : Sand = 1:1

S.NO.	SAMPLE	AREA(A) MM^2	FAILURE LOAD(P) KN	P/A (N/MM^2)
1	Brick 1	17200	250	15.5
2	Brick 2	17200	245	12.86
3	Brick 3	17200	255	13.97

Average = 15.5+12.86+13.97/3 = 14.11N/mm2

OBSERVATION 2:

Plastic : Sand = 1:1.5

S.NO.	SAMPLE	AREA(A) MM^2	FAILURE LOAD(P) KN	P/A (N/MM^2)
1	Brick 1	17200	280	17.01
2	Brick 2	17200	245	15.34
3	Brick 3	17200	267	19.00

Average = 17.01+15.34+19.00/3 = 17.11N/mm2

OBSERVATION 3:

Plastic : Sand = 1:3

S.NO.	SAMPLE	AREA(A) MM^2	FAILURE LOAD(P) KN	P/A (N/MM^2)
1	Brick 1	17200	165	8.11
2	Brick 2	17200	130	5.94
3	Brick 3	17200	145	6.67

Average = 8.11+5.94+6.67/3 = 6.91N/mm2

Result:-

Sample 2, ratio (1:1.5) has the highest compressive strength of the brick.

5.RESULTS

Since plastic is commonly available worldwide, we can find plastic everywhere as a waste and we collect it to make bricks. It is a low-cost building material. The use of plastic in bricks benefits the environment since the best method to dispose of plastic is to reuse/recycle it, and land and other hazardous effects could be stopped or cannot be damaged.

Plastic bricks are more cost-effective, have stronger compressive strength, have negligible water absorption, and are lighter in weight.

Plastic is a non-biodegradable and unsustainable substance that has a negative impact on the environment. However, because plastic is a versatile material with varied properties (lasting, strong, and easy to mould), it may be used as a green material and is the greatest answer for minimising pollution.

These plastic bricks are appropriate for all countries, but especially for those who have difficulty disposing of plastics. Although plastics have the disadvantage of generating pollution, they also offer various positives such as providing superior insulation, low porosity, being inexpensive and readily accessible, and so on. As a result, it's utilised in bricks, which improves its overall quality.

6. REFERENCES

1] https://www.heraldgoa.in/Edit/Opinions/Plastic-waste-management-182262.

2] https://www.coursehero.com/file/143204472.

3] Kumar P., et.al., (2017), “Production of Construction Bricks by Partial Replacement of Waste Plastics”, Journal of Mechanical and Civil Engineering, 14, 9-12.

4] Naveen P., et.al., (2020), “Performance evaluation of plastic brick composites”, International Research Journal of Engineering and Technology, 07, 1521-152.

5] https://cpcb.nic.in/uploads/plasticwaste/LCA_Report_15.05.2 018.pdf