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Review On Eco-Brick: A Sustainable Solution for Plastic Waste.

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Abstract - Traditional waste management methods like incineration and landfilling are no longer sustainable solutions because they result in greenhouse gas emissions, toxic gas release, soil degradation, and groundwater contamination. As a result, innovative and environmentally responsible alternatives are desperately needed. The rapid accumulation of non-biodegradable plastic waste has become a critical global environmental issue due to its long-lasting nature, harmful ecological effects, and difficulties associated with its disposal. Plastic materials persist in the environment for hundreds of years, causing land, water, and marine water pollution.
Eco-bricks offer a workable, affordable, and environmentally responsible way to combat plastic pollution.Eco-bricks are solid building blocks made from plastic bottles that have been tightly packed with dried and cleaned non-recyclable plastic waste. This process turns waste into useful building materials while also keeping plastic out of the environment. Because of their high compressive strength, longevity, and thermal insulation qualities, eco-bricks can be used for a variety of non-load-bearing construction projects, including furniture, garden structures, pavement blocks, and partition walls. This study looks at the steps involved in making Eco-bricks, such as gathering, cleaning, sorting, and compacting plastic waste.
It also assesses their practical limitations, environmental benefits, and mechanical performance. The study also emphasizes how Eco-bricks, which turn waste into useful building materials, support the circular economy and encourage sustainable building methods. All things considered, the results show that Eco-bricks can greatly lower the production of plastic waste while promoting the growth of sustainable infrastructure and neighborhood-based waste management programs.
Keywords: Eco-brick, Plastic waste management, Sustainable construction, Waste recycling, Environmental sustainability, Circular economy, Low-cost building materials.

I. INTRODUCTION

Plastic has become an indispensable material in modern society due to its versatility, durability, and cost-effectiveness. However, its extensive use has led to one of the most pressing environmental problems of our time—plastic pollution. Millions of tons of plastic waste are generated annually across the globe, and a significant portion of this waste ends up in landfills, oceans, and other ecosystems. The non-biodegradable nature of plastics causes them to persist in the environment for hundreds of years, posing severe threats to wildlife, soil fertility, and human health.

Traditional methods of managing plastic waste, such as landfilling, open burning, and incineration, have proven to be environmentally hazardous and economically unsustainable. These techniques often release toxic gases, contribute to greenhouse gas emissions, and occupy valuable land resources. Recycling remains an effective strategy but is limited by high processing costs and the low recyclability of certain plastic types. Hence, there is an urgent need for innovative, cost-effective, and eco-friendly solutions that can manage plastic waste while promoting sustainable development.

One such innovation is the concept of the **Eco-brick**—a simple yet powerful approach that transforms non-recyclable plastic waste into useful construction materials. An Eco-brick is essentially a plastic bottle tightly packed with cleaned and dried plastic waste to form a solid building block. This technique not only diverts plastic waste from landfills but also provides an affordable and sustainable alternative to conventional bricks used in construction. Eco-bricks are particularly valuable in low-income and rural communities, where access to conventional building materials is limited.

From an engineering perspective, Eco-bricks possess several advantageous properties such as high compressive strength, good thermal insulation, and water resistance. They are suitable for non-load-bearing structures like garden walls, seating arrangements, pavements, and decorative installations. Furthermore, the production process of Eco-bricks does not require energy-intensive machinery or chemical treatments, making it a low-carbon and community-friendly solution. Researchers and engineers are now exploring ways to enhance their structural stability and performance through hybrid systems and binders.

Beyond their physical and functional benefits, Eco-bricks also play a vital role in promoting environmental awareness and behavioral change. By encouraging individuals and communities to collect, segregate, and repurpose their plastic waste, this concept fosters active participation in sustainable waste management. Educational institutions, NGOs, and environmental organizations have adopted Eco-brick initiatives to engage citizens in addressing plastic pollution at the grassroots level.

In conclusion, Eco-bricks represent a sustainable, inclusive, and innovative approach to mitigating plastic waste. They bridge the gap between environmental conservation and practical construction needs, aligning with global sustainability goals such as waste minimization, circular economy, and climate resilience. As research and community participation continue to grow, Eco-bricks hold the potential to revolutionize waste management practices and promote eco-friendly construction worldwide

II. LITERATURE REVIEW

This chapter presents a critical review of previous research related to *"Eco-Brick: A Sustainable Solution for Plastic Waste."* Various studies have been analyzed to understand the use of plastic waste in producing eco-bricks, their mechanical and thermal properties, and their environmental significance. The literature highlights that eco-bricks are effective in managing non-biodegradable plastic waste while offering acceptable strength for non-load-bearing construction. Researchers have experimented with different materials, packing densities, and additives to improve performance. The review concludes that although eco-bricks provide a promising low-cost and sustainable alternative to conventional bricks, further research is needed to standardize manufacturing methods, enhance strength, and ensure long-term durability for broader structural applications.

1. J. Patil (2025) [1] emphasized the use of eco-bricks, which is one of the sustainable and inexpensive measures to address plastic waste management using NSS efforts. The research focused on the community involvement, environmental consciousness and how eco-bricks can efficiently limit plastic pollution.

2. Mohammad Saif1, P. Shree Varshini, Sampath Vaishnavi, Mohammad Ghouse, S. Vinod Reddy, Mavoori Pratussha. (2025) [2] researched eco-bricks as a new and sustainable method to handle plastic wastes. It wasted that they could be used as an alternative construction material with several advantages to the environment, waste reduction, and contribution to a green and more sustainable future.

3. Om A Kalushe, Om G Wasu, Arnav S Aslkar, Prem S Gulhane, Rohit M Pise, Pratiksha R Shambalkar. (2025) [3] investigated the development of ecological bricks using plastic waste as a raw material. The study reported that the reuse of plastic waste in brick production helps reduce environmental pollution while producing bricks with acceptable strength and durability for construction applications.

4. Ms. Divya R. Jain, Ms. Pragati P. Mute, Mr. Anurag B. Dhawale, Prof. K.V. Bhandakkar, Prof. R.S. Kedar. (2021) [4] introduced a thorough review of eco-bricks, their materials, production, and use in the building. The paper has identified eco-bricks as a more sustainable brick to the normal bricks, as it reduces plastic waste and protects the environment.

5. Rajat Jatav and Devendra Dohare (2022) [5] examined how the plastic waste could be used to make eco-bricks and compared their characteristics with traditional bricks. The researcher determined that the eco-bricks have similar strength and lifespan with the plus of less weight and management of plastic waste.

6. Prof. Reena Gautam, Sarthak Ghorpade, Pranav Gosavi, Harsh oyal, Shubham Gharge, Raghavendra Kadam (2025) [7] researched on the production of bricks by means of casting plastic waste. The study revealed that plastic waste bricks are light, strong, and eco-friendly, thus they can be an alternative to curbing plastic pollution through the use of the product in construction.

7. Swaraj Bankar1, Shubham Chavan, Yash Anera (2025) [8] centred on producing eco-bricks with plastic waste as an environmentally friendly construction material. The researchers indicated that the environmental pollution caused using plastic waste in bricks production is minimized and that the eco-bricks made are very strong and durable to be used in construction.

8. Investigated the manufacture of eco-bricks through the use of industrial waste. The findings indicated that eco-bricks made using industrial wastes are economical, environmental friendly, and fit to be used in sustainable construction techniques.

9. Pruthviraj Gund, Sandesh Sanjay Pawar, Anil Laxman Patil, Shubham Premnath Sakpal. (2023) [9] examined the application of waste plastic in the manufacturing of bricks demonstrated that EcoBricks are an environmentally friendly construction material that minimizes pollution by plastics and provides acceptable structural performance when used in the production of non-load-bearing structures.

10. Prof. Shahrukh Kureshi, Mohit Gedam, Pratik Shahare ,Ujwal Barapatre, Arya Gajbhiye (2024) [10] investigated the topic of eco-friendly building of bricks with the help of different waste materials. The research concluded that such bricks are environmentally friendly, they mitigate environmental pollution and can be used in place of normal bricks in the building process.

11. Geena George and U. S. Akhilesh (2024) [11] studied

eco-lite bricks made out of the waste plastic powder and waste glass powder. The research found that these waste products are better incorporated to enhance sustainability besides making the product lightweight eco-friendly bricks which are applicable in construction projects and effective in managing wastes.

12. George and Akhilesh (2024) [12] studied the production of eco-lite bricks by utilising waste material plastic powder and waste material glass powder. This paper has demonstrated enhanced sustainability and less impact on the environment, with the joint waste of plastic and glass giving lightweight, environment-friendly bricks, which can be used in construction.

13. The article by Rishabh Kumar, Mohit Kumar, Inder Kumar, Deepa Srivastava. (2021) [13] has reviewed the use of plastic waste in the production of bricks. The paper focused on the durability enhancement and waste minimization, and the conclusion of the study was that the plastic bricks modified offer valuable input to the sustainable construction behavior.

14. In their study, Purumani and Lavanya (2022) [14] examined plastic waste applications in the production of bricks. The researchers came to the conclusion that bricks made of plastic materials have good strength and durability, so they are one of the options in the fight against traditional bricks.

15. The eco-bricks as the sustainable structural element were thoroughly assessed by Md. Asif Ahammed, Md. Mahir Shahriar, Abdul Wahid Sibly, Md. Mehedi Hassan (2025).[15] Their environmental benefits, potential to reduce waste and their appropriateness to be used in construction as a sustainable energy source were identified in the study.

III. PROPOSED METHODOLOGY

The proposed methodology for plastic brick production begins with the collection of HDPE plastic waste from sources such as factories, hospitals, industries, and food packaging, followed by segregation and cleaning to remove impurities. (Figure 1)The cleaned plastic is then batched, cut into small pieces, and melted at the required temperature before being mixed uniformly with cement and sand. The prepared mixture is placed into moulds to form bricks, which are later demoulded after initial setting. Finally, the bricks undergo a curing process in water for 28 days to achieve the desired strength and durability.

Figure 1: - Flowchart of the proposed methodology for plastic brick production.

1. COLLECTION OF PLASTIC MATERIALS

Plastic materials are collected from factory waste, hospital waste, industrial waste, food packaging materials, and plastic bottles. These collected materials mainly belong to the HDPE plastic category, which is suitable for eco-brick production.

2. BATCHING OF PLASTIC

Batching refers to the process of measuring materials required for brick manufacturing. After collecting the plastic waste, different types of plastics are segregated. All unwanted impurities are removed, and the samples are checked to ensure that no moisture content is present. Once this process is completed, the plastic waste is taken for cutting.

3. CUTTING OF WASTE PLASTIC

The plastic waste is sorted into small pieces after the batching process. Caps made of plastic are cut with a scissor. The cut plastic pieces are kept at a size of between 2 mm to 3 mm so that they can mix well. (Figure 2)

Figure 2: - Manually cut plastic waste pieces ready for mixing in brick production.

4. MIXING

The combination of resources is very important in the attainment of uniformity and strength of the brick. Appropriate mixing provides a homogenous mix with equal colour consistency. Mixing can be done through two ways, hand mixing and mechanical mixing. Hand mixing is adopted in this project. The required amount of plastic is added in bits, and cement, sand and plastic are well mixed with the help of a trowel and left to dry (Figure 3)

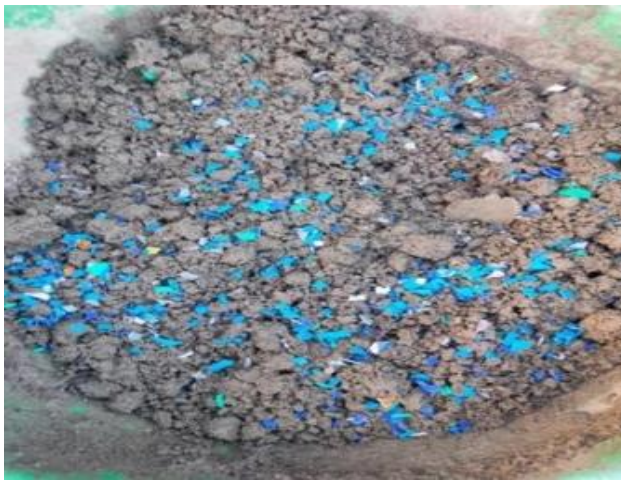

Figure 3:- Manual mixing of plastic waste with cement and sand for brick production.

5. MOULDING

Once the right mixture has been attained, the mixture is poured into the necessary mould. The use of standard brick moulds in this project is of size 19 x 9 x 9 cm. After two days the bricks are taken out of the mould and then left to be cured. (Figure 4)

Figure 4 :- Brick mould used for shaping the prepared plastic–cement mixture.

6. CURING

The test specimens are dried after moulding and allowed to dry in 24 hours. The bricks are then put in curing tank and allowed to cure taking a period of 28 days to achieve the required strength.

7. TEST CONDUCTED ON PLASTIC BRICKS

1) Compressive strength test
2) Water absorption test
3) Sound test of brick
4) Crushing test

Figure 5: - Plastic bricks after 28 days of curing, prepared for strength testing.

CONCLUSION

The utilization of plastic waste in the production of eco-bricks presents a multifaceted opportunity to advance sustainable construction practices while addressing environmental pollution caused by non-biodegradable plastics. The findings of this review, synthesizing research from laboratory experiments, field applications, and community-driven initiatives, highlight that eco-bricks can offer distinct advantages in terms of both material performance and ecological conservation.

Experimental results indicate that properly compacted eco-bricks exhibit satisfactory compressive strength for non-load-bearing applications, with higher packing densities generally producing greater strength. Water absorption and durability tests demonstrate that these units can withstand environmental exposure adequately, though they are not suitable for structural load-bearing walls without additional reinforcement or mortar encasement. The thermal and sound insulation properties of eco-bricks further suggest potential for energy-efficient construction in residential and community projects.

While studies consistently demonstrate the potential of eco-bricks to divert plastic waste from landfills and reduce reliance on conventional fired bricks, variability in plastic type, compaction, and filler composition necessitates careful standardization in manufacturing practices. Optimal packing density, proper sorting of plastics, and occasional addition of fillers or external coatings

are critical to achieving uniform performance and long-term durability.

This review underscores that successful implementation of eco-bricks requires a holistic understanding of material properties, fabrication techniques, and construction practices. Large-scale adoption depends on integrating community participation, municipal support, and policy incentives to streamline collection, production, and utilization of plastic waste in construction.

In conclusion, eco-bricks represent a viable and sustainable approach to mitigating plastic pollution while providing a low-cost alternative for non-load-bearing construction. By strategically leveraging discarded plastics, the construction industry can conserve natural resources, reduce environmental impact, and contribute to circular economy principles. Achieving widespread adoption will depend on continued research, standardization, and collaboration among researchers, industry professionals, and policymakers to ensure consistent quality, structural safety, and sustainable application of eco-brick technology.

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