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Original Article

Sustainable Plastic-Sand Composite Bricks Using Recycled Plastic Waste

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Abstract: *The mounting accumulation of plastic waste has emerged as a significant environmental issue on a global scale, resulting in resource depletion and pollution. The objective of this project is to create sustainable plastic–sand composite bricks that utilize recycled plastic waste as a binding material. The primary goal is to transform non-biodegradable plastic into durable construction materials in an environmentally friendly manner. In this process, plastic waste is collected, cleaned, and melted. The melted plastic is then mixed with sand in the appropriate proportions to create composite bricks. In order to attain the desired shape and strength, these bricks are cooled and moulded. The bricks' compressive strength, water absorption, durability, and cost-effectiveness are assessed in the investigation. Plastic–sand bricks demonstrate increased resistance to water and decreased weight when contrasted with traditional clay bricks. Furthermore, they contribute to the conservation of natural resources such as clay and the reduction of landfill waste. The project demonstrates the effective reuse of recycled plastic in construction, thereby promoting circular economy practices and sustainability. Consequently, plastic–sand composite bricks provide a sustainable and innovative solution to the demands of contemporary construction.*

Keywords: *Recycled Plastic, Plastic and Sand Bricks, Plastic Waste Use, Strong Bricks, Water Resistant*.

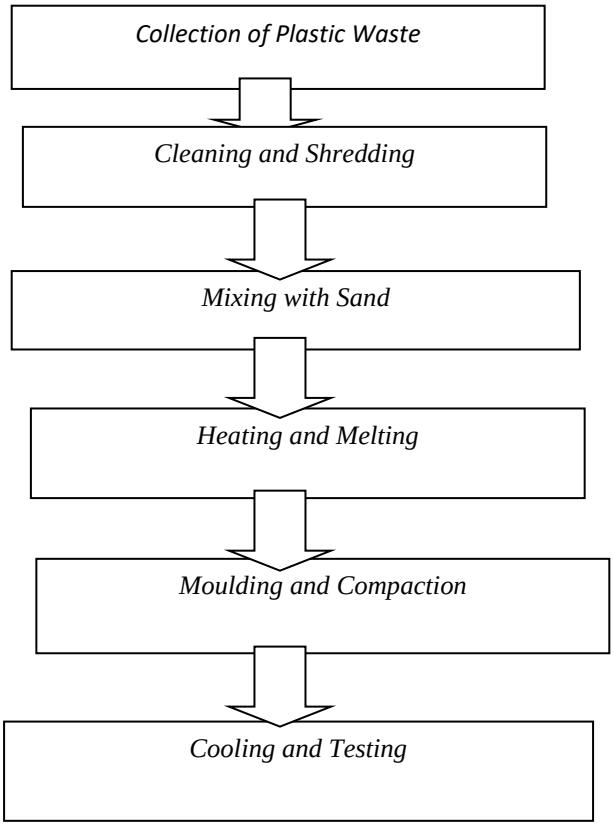
I. INTRODUCTION

Plastic waste has become one of the most pressing environmental challenges worldwide due to its persistence and extensive use. Each year, vast quantities of plastic refuse are produced, much of which accumulates in landfills, oceans, and natural habitats, causing significant ecological harm. Conventional disposal methods such as landfilling and incineration present drawbacks including toxic emissions and long-lasting environmental damage. Therefore, it is essential to explore innovative and sustainable approaches for efficient plastic waste management. In the building sector, traditional materials like clay bricks necessitate the consumption of large amounts of natural resources and energy, contributing to environmental degradation. The extraction of clay results in soil erosion and loss of fertile land, while the brick firing process releases substantial greenhouse gases and demands high energy input. This has driven researchers to seek alternative construction materials that are both environmentally friendly and economically viable. One promising alternative involves the creation of composite bricks by combining recycled plastic with sand. In this mixture, melted plastic serves as a binding agent, removing the need for cement or other additives. These composite bricks are lightweight, durable, and exhibit resistance to water absorption. Additionally, they can be produced using relatively simple manufacturing techniques, making them accessible for both small- and large-scale production. This project aims to develop plastic–sand composite bricks by optimizing the mixture proportions, analyzing mechanical performance, and evaluating the environmental advantages. By repurposing plastic waste into useful building materials, this initiative helps reduce pollution and supports sustainable development goals. Ultimately, plastic–sand composite bricks offer a novel and eco-friendly construction material that addresses the dual challenges of plastic waste disposal and resource conservation. This approach advocates for efficient resource utilization and contributes to a more sustainable and greener construction industry.

II. LITERATURE REVIEW

According to Saikia and de Brito's (2012) research on the use of plastic waste in building materials, plastic can be utilized as a binding material to increase durability and decrease water absorption. In an experimental study on plastic-sand bricks, Kumar et al. (2017) found that increasing the plastic component increases compressive strength to an ideal level. After analyzing plastic waste bricks, Patel et al. (2018) came to the conclusion that they are appropriate for non-load bearing construction applications due to their low water absorption.

III. METHODOLOGY



IV. MATERIALS USED

Fine aggregate (sand) and recycled plastic waste are the components used to make plastic-sand composite bricks. After being cleaned and shredded, the plastic waste—which was primarily composed of polyethylene (PE) and polypropylene (PP)—was gathered from nearby sources and utilized as a binding material. To guarantee enough bonding and strength, clean river sand that had passed through a 4.75 mm filter was utilized as fine aggregate. Water was not used in the brick-making process; it was only used to clean the plastic debris.

Table 1: Mix proportions for plastic bricks

MATERIALS	PERCENTAGE (%)
Plastic Waste	25% - 35%
Sand (Fine Aggregate)	65% - 75%

V. EXPERIMENTAL PROCEDURE

Using recovered plastic trash, plastic-sand composite bricks are made as part of the experimental process. Plastic garbage was first gathered from nearby sources and carefully cleaned to get rid of contaminants like labels and grime. After being cleaned, the plastic was dried and shredded into tiny bits. These bits of shredded plastic were heated between 150°C and 200°C until they melted. To accomplish the right bonding, the necessary amount of sand was added to the molten plastic after it had melted and well mixed. After that, the heated material was put into brick moulds and crushed to eliminate any air spaces. After cooling at ambient temperature, the moulded bricks were taken out of the moulds. The prepared bricks were then put through a compressive strength and water absorption to evaluate their performance.

VI. RESULT AND DISCUSSION

Compressive strength and water absorption tests were used to assess the experimental findings of the plastic-sand composite bricks. It was discovered that the prepared brick has a compressive strength of 5 N/mm^2. This number shows that the brick is strong enough for non-load-bearing uses like pavements and partition walls. However, its usage in structural

parts is limited due to its relatively lesser strength compared to traditional clay bricks. The brick's water absorption was found to be a very low 0.685%. This suggests that the brick has less porosity and good moisture resistance. Reduced water absorption increases durability and reduces the likelihood of water-related damage and cracks.

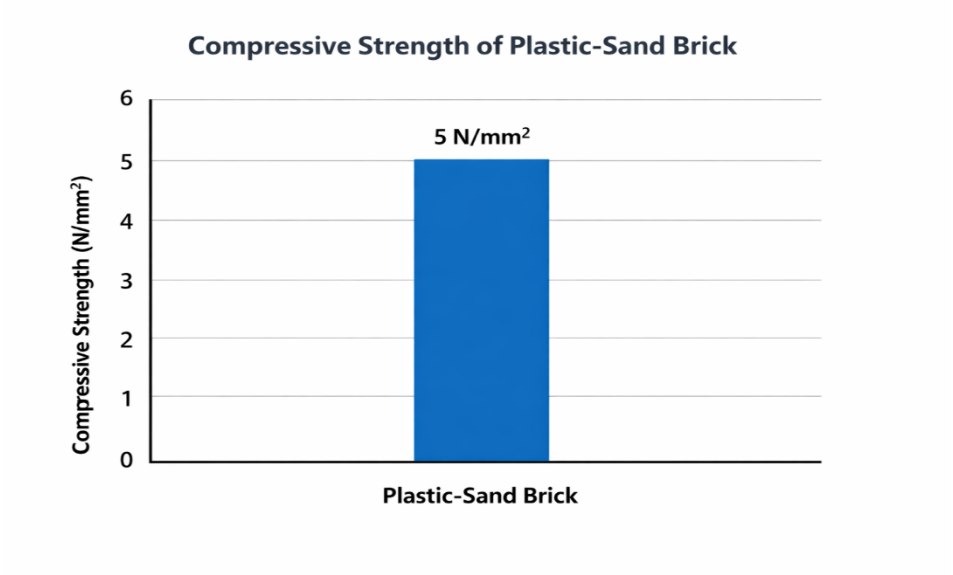


Table 3: Water Absorption Results

S. No	Mix Type	Water Absorption (%)
1	Empty weight	0.681
2	24 hours	0.685

VII. CONCLUSION

This study concludes that plastic–sand composite bricks can be effectively produced using recycled plastic waste. The bricks showed a compressive strength of 5 N/mm^2, which is suitable for non-load bearing applications. The water absorption value of 0.685% indicates good resistance to moisture and improved durability. Hence, these bricks can be considered as an eco-friendly and cost-effective alternative to conventional bricks, helping to reduce plastic waste and promote sustainable construction practices.

VIII. REFERENCES

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