VOL. 08 NO. 4,
MAY, 2025
E-ISSN 3026-9210
P-ISSN 3026-815X

African Scholar Publications & Research International
www.africanscholarpub.com

Journal of Built Env. & Geological Research (JBEGR)

Achieving Environmental Sustainability by Reusing Low-Density Polyethylene in the Production of Bricks

***Dafung Pankyes Johnson; & **Ibrahim Hassan Garba**

*National Environmental Standard Regulations Enforcement Agency (Nesrea), Plateau State Field Office Jos, P.O.Box 1970 Nesrea Plateau State, Nigeria. **Department of Biochemistry/Environmental Standards Node, Sustainable Procurement, Environmental and Social Enhancement Project Centre of Excellence, Abubakar Tafawa Balewa University, Bauchi, Nigeria.

Corresponding Author: pankyesdafung@gmail.com

DOI: https://doi.org/10.70382/ajbegr.v8i4.021

Abstract

This study investigated the feasibility of reusing low-density polyethylene (LDPE) plastic waste in the production of bricks, aiming at achieving environmental sustainability. A quantitative research approach was employed in the study. The instruments used for data collection were compressive strength test and water absorption test. To ensure the consistency of the data used in this study, a reliability test was conducted using Cronbach's Alpha with a reliability score of 0.78 obtained. To achieve the purpose of the study, data collected were analyzed using the statistical tools of R, Excel and Analysis of Variance (ANOVA) test was performed to determine statistical significance at 0.000 alpha level. The answer to the research questions showed that LDPE-based bricks exhibit superior water resistance, with zero water absorption, and a compressive strength of 1.2 N/mm², meeting the minimum standard for lightweight construction. Although their compressive strength is lower than conventional bricks, LDPE bricks demonstrate potential in non-load-bearing and eco-friendly construction applications. The results in this study support the broader narrative in the literature that advocates for the use of recycled plastics in construction, not only as a waste management solution but also as a step toward reducing the environmental footprint of the building sector.

Keywords: Environmental Sustainability, Low-density polyethylene, Recycling, Bricks, Waste Management

Introduction

Plastic, a petrochemical derivative introduced in 1907, is a life-changing resource. Waste management is a serious issue due to its human health and environmental sustainability implications. The construction industry is a significant contributor to environmental pollution, accounting for approximately 40% of global energy consumption and 30% of greenhouse gas emissions (UNEP, 2020). Traditional brick production methods exacerbate these environmental impacts, relying on energy-intensive processes and depleting natural resources. Meanwhile, the accumulation of plastic waste, particularly low-density polyethylene (LDPE), has become a pressing global issue, with millions of tons of plastic waste entering the environment each year (World Economic Forum, 2019).

Global plastic manufacturing has been growing every year since the 1950s due to the high durability and versatility of plastics that are produced with minimal manufacturing cost. Plastics, because of their many applications, are now an essential component of our day-to-day lives, and annual commercial production (as of 2016) exceeded 330 Mt. (Kumar *et al.,* 2020). Globally, around 31.9 Mt. of plastics are being disposed of annually in the environment (Bucci *et al.,* 2020). They cause environmental and health issues for humans, flora, and fauna. The massive amounts of Plastic Waste (PW) that are piling up in the environment can persist for centuries and interact with aquatic and terrestrial life (Zhou *et al.,* 2022a). As of 2015, 6300 million tons of PW had been generated globally, of which 79 % was discarded in landfills or the natural surroundings, with the remaining being recycled (9 %) and incinerated (12 %) (Geyer *et al.,* 2017). Geyer et al. (2017) assessed that by 2050, in the absence of significant recycling methods, 12,000 million tons might be accumulated in the environment.

As noted, the discarded PW is directly dumped in the environment, put in landfills, recycled, or incinerated (Roy *et al.,* 2021). However, through weathering, abrasion, microbial or mechanical decomposition, photolysis, and other environmental forces, the PW in landfills or the natural environment gets fragmented into smaller plastic particles called microplastics (MPs, <5 mm diameter) (Sridharan *et al.,* 2021a; Zhou *et al.,* 2022b). These secondary MPs, along with primary MPs (manufactured microbeads, coatings, paints, fibres, personal care products and cosmetics, pellets, capsules, and cleaning agents), account for the

243,000 tons of particulate plastics afloat in the seas (Hou *et al.,* 2021).

Owing to their hydrophobicity and large surface area, these particulate plastics adsorb and desorb toxic co-contaminants or pathogens from the environment and increase the risk of ingestion by the biota (Sridharan *et al.,* 2021b; Sridharan *et al.,* 2022). Subsequently, MPs lead to serious health impacts, like genotoxicity, neurotoxicity, and growth and metabolic ailments (Sridharan *et al.,* 2022; Jâms *et al.,* 2020). Similarly, MPs that enter the soil can also impair soil characteristics, microbial activity, and plant performance (Kumar *et al.,* 2020). Moreover, smaller MPs and nanoplastics (NPs) can be ingested by humans either via the food chain (e.g., seafood, salt) or directly inhaled from the air dust (Sridharan *et al.,* 2021a; Sooriyakumar *et al.,* 2022), which leads to potential health risks depending on exposure and concentration (Zhang *et al.,* 2020b).

Since the long-term health impacts of plastic pollution are still poorly understood, developing and implementing effective waste management technologies and policies are needed (Sarkar *et al.,* 2022). Present waste management systems are based on preferable options given in a standard waste management hierarchy (Roy *et al.,* 2021). The most preferred practices include prohibition and reduction in waste generation, followed by reuse and recycling (Kumar *et al.,* 2021; Awasthi *et al.,* 2022). Besides creating environmental hazards and being a nuisance, direct dumping of PW in the environment does not yield any monetary benefits (Roy *et al.,* 2021), and, hence, it remains the least preferred option in the waste management hierarchy.

In recent years, researchers have explored the potential of reusing plastic waste in construction materials, including bricks. However, the majority of these studies have focused on high-density polyethylene (HDPE) or polypropylene (PP), with limited research investigating the reuse of LDPE waste in brick production (Kumar *et al.,* 2019). Furthermore, existing studies often neglect to comprehensively evaluate the mechanical properties, environmental benefits, and feasibility of LDPE-based bricks. This study addresses this knowledge gap by investigating the reuse of LDPE waste in brick production, evaluating its mechanical properties, environmental benefits, and feasibility. By exploring the potential of LDPE-based bricks, this research aims to contribute to the development of sustainable construction materials and reduce plastic waste.

STATEMENT OF THE PROBLEM

The usage of waste plastic in the manufacturing of paver blocks has an effective manner of disposal of plastic waste. (Prof. Shah. Ajinkya.S, Mr. Anpat Vineet Vijay, Mr. Bhosale Suraj Balu Mr. Botalji Suhas Suresh, Mr. Surve. Ajinkya. Sanjay 2021. Sustainable development for construction involves the use of Unconventional and innovative materials, and recycling of waste materials in order to compensate for the lack of natural resources and to find alternative ways of conserving the environment. Polyethylene (PE) is one of the most versatile and widely used thermoplastics in the world because of its excellent properties like toughness, near-zero moisture absorption, excellent chemical

inertness, low coefficient of friction, ease of processing and unusual electrical properties. The concept of a circular economy emphasizes the principles of 5R (reduce, reuse, reprocess, recover, and recycle) and the utilization of renewable resources for every day-to-day domestic and industrial activity (Palos *et al.,* 2021; Bhujbal *et al.,* 2022). A similar concept called "upcycling" involves the generation of value-added materials by valorization (Subramanian *et al.,* 2021; Kots *et al.,* 2022). The cycle of material flow represents the production, use, disposal, degradation, and mineralization, which drives nutrients back to the environment, of a natural material (Cobo *et al.,* 2018). However, achieving a circular economy in the PW management and upcycling sectors are extremely difficult, in part because most, if not all, of the circular economy's principles are not being met by our existing methods of plastic manufacturing, usage, and disposal (Bucknall, 2020). For instance, the use of fossil fuels as feedstocks for plastics production, which runs directly counter to the circular economy's principles of utilizing exclusively renewable resources. There are also inconsistencies with the way PWs are now disposed of after usage, or their end-of-life. The majority of end-of-life plastics are still disposed to landfills or being incinerated for energy recovery, notwithstanding the surge in recycling techniques in recent years (Kumar *et al.,* 2023). These two approaches represent a significant loss of an important feedstock in addition to their respective contributions to environmental damage.

Due to the limitations of existing, inefficient practices of disposal and rising public awareness of the environmental impacts of PW, many countries have switched from conventional landfilling to methods that manage PW (Kaushik and Herat, 2020; Dey *et al.,* 2021; Sarkar *et al.,* 2022). Many recent findings have discovered the feasibility of upcycling techniques on a large-scale using innovative approaches to convert PW to produce materials of higher economic value. For instance, Kar et al. (2020a) showed how to use melt extrusion technology to upcycle waste PP bottles and PE packaging into re-processable, high-performance vitrimers. The automotive, aerospace, electronics, and biomedical industries are just a few of the industries in which these recently synthesized vitrimer systems has been used (Alabiso and Schlögl, 2020). Further, Yasin et al. (2021) described a simple method for converting PET waste into a PET nanofibrous membrane that is embedded with copper oxide nanoparticles using electrospinning; the copper oxide nanoparticles were synthesized by combining plant extract with PET waste solution. The produced nanocomposite membrane's photocatalytic effectiveness was 99 % in eliminating the dye methylene blue (MB), which may find use in filtration and wastewater treatment processes.

The accumulation of low-density polyethylene (LDPE) plastic waste and the environmental impacts of traditional brick production methods pose significant sustainability challenges. This study addresses the problem of how to effectively reuse

LDPE plastic waste in brick production to reduce plastic waste, promote sustainable construction practices, and mitigate environmental impacts."

AIM AND OBJECTIVES OF THE STUDY

The aim of this study is to investigate the potential of reusing low-density polyethylene (LDPE) plastic waste in the production of bricks, with a focus on achieving environmental sustainability.

Objectives:

(i) To assess the compressive strength of LDPE-based bricks.
(ii) To determine the water absorption characteristics of LDPE-based bricks.
(iii) To evaluate the physical properties of LDPE-based bricks.

RESEARCH QUESTIONS

This study seeks to answer the following pertinent questions:

(i) What is the effect of using low-density polyethylene (LDPE) plastic waste on the compressive strength of bricks?
(ii) How does the percentage of LDPE waste in brick production impact water absorption rates?
(iii) What are the physical properties of LDPE-based bricks.

SIGNIFICANCE OF THE STUDY

The research is regarding achieving environmental sustainability by reusing low density polyethylene (LDPE) plastic waste in the production of bricks. It is a fact that pollution usually occur by plastic waste. Lot of plastic waste is produced every day by humans because of needs. So, we cannot stop using plastic but disposal of plastics can be done by recycling it. To reduce the pollution by plastic, plastic is recycled and used in the production of bricks.

The changed lifestyle and endlessly increasing population has resulted in a significant rise in the quantity of postconsumer plastic waste. The world's annual consumption of plastic materials has increased from around 5 million tons in the 1950's to nearly 100 million tons in recent times resulting to a significant rise in the measure of plastic waste (Patil Pramod Sambhaji, 2016). As much as 60 % of both industrial and urban plastic waste is been recycled which obtained from various sources (Patil Pramod Sambhaji, 2016).

Block paving identified as brick paving is a frequently used ornamental means of producing a walkway. Paving blocks are building materials that can be used in erecting sidewalks, driveways, garage floors, and frequently used in surfacing roads.

This research highlights the importance of finding sustainable solutions for managing plastic waste, specifically LDPE plastics. By reusing LDPE plastics in the production of

bricks, the study will promotes the reduction of plastic waste in landfills and its associated environmental pollution. Utilizing LDPE waste in paving tiles decreases the amount of plastic waste in landfills and oceans (Chen *et al.,* 2017). This approach can contribute to mitigating the detrimental impacts of plastic waste on ecosystems, wildlife, and human health.

This study will explore a novel method of utilizing LDPE plastics as a substitute material in brick production. This approach will conserves natural resources by reducing the dependence on traditional raw materials for brick manufacturing. By reusing LDPE plastics, the study will contributes to the conservation of natural resources such as clay and sand, which are typically used in brick production. Reusing LDPE waste reduces the need for virgin materials, conserving natural resources (Al-Salem *et al.,* 2009).

Adopting LDPE plastics as a resource in the production of bricks aligns with the principles of a circular economy. Rather than discarding LDPE plastics as waste, the study will be proposing a method of upcycling by incorporating them into a new product. This will promotes waste reduction and the creation of a closed-loop system where materials are consistently reused, reducing the demand for virgin materials.

The use of LDPE plastics in brick production can lead to the development of more sustainable construction practices. By incorporating LDPE plastics, the bricks produced may exhibit improved properties such as thermal insulation by reducing heat transfer and energy consumption (Li *et al.,* 2020). LDPE addition enhances the tiles' mechanical properties, such as compressive strength and durability (Kumar *et al.,* 2019). Reusing LDPE waste reduces greenhouse gas emissions and supports sustainable development (Al-Salem *et al.,* 2009).

Additionally, the study can provide insights into the potential cost-effectiveness of utilizing LDPE plastics in construction, potentially encouraging the adoption of sustainable building materials.

The study aims to reduce plastic waste generation, improve health outcomes, and enhance the socio-economic status of the population. The findings will contribute to policy formulation and the development of strategies for combating plastic waste generation and disposal in Nigeria. The study will not only support environmental sustainability but also foster economic growth, contribute to poverty alleviation efforts and provides valuable insights for policymakers, researchers, and stakeholders involved in the construction sector.

METHODOLOGY

This research uses experimental methods to develop alternatives to making sustainable bricks without using cement. The research was conducted at the building department laboratory of the University of Jos, Plateau State, Nigeria. Methodological measures include the collection and preparation of sachet water waste through washing and cutting,

the development of optimal mixtures that pay attention to the comparison of LDPE waste and aggregates to match the required physical and mechanical quality requirements. The sample manufacturing process involves mixing materials, molding, drying, and hardening bricks. Samples are analyzed through physical and mechanical quality tests.

The independent variable in this study is the composition of the mixture of materials, including the comparison of LDPE and aggregate. The dependent variables observed is the physical and mechanical qualities of the bricks, such as compressive strength and absorption. Control variables in this study include environmental factors, such as temperature, setting time, compaction and humidity during the drying process, which can affect the quality of the final product. Sustainability is considered by reducing plastic waste and using natural resources more efficiently.

The method of data collection employed the quantitative techniques to gather comprehensive insights into the various aspects of bricks production using low density polyethylene. Statistical tools of R and Excel were used. Descriptive statistics was used to summarize the mechanical properties (Water absorption, compressive strength) of bricks produced with LDPE plastic waste. The reliability coefficient was computed using Cronbach's Alfa in which 0.78 value was obtained. This means that the instrument is reliable for the study. Kruskal-Wallis test was used in order to identify if there is any significant difference between LDPE bricks and the different standard compressive strength for light, medium and heavy compressive standard. In order to compare the means of bricks with different LDPE plastic waste content, ANOVA was used with data visualization to illustrate the findings and trends in the data.

DATA ANALYSIS AND DISCUSSION

Comparative Analysis of Compressive Strength

This part of the analysis focuses on the compressive strength of bricks produced using Low-Density Polyethylene (LDPE) in comparison with that of standard compressive bricks. Compressive strength is a critical property in evaluating the load-bearing capacity of bricks, and serves as an important measure of their suitability for construction use. The test results provide insight into how the inclusion of LDPE affects the strength characteristics of the bricks, and whether the outcome meets the standard requirements for building materials.

To achieve these, we will be using Kruskal-Walli’s test, so as to identify if there is any significant difference between LDPE bricks and the different standard compressive strength for light, medium and heavy compressive standard.

Here is the structured table for the Kruskal-Walli’s test and the post-hoc Mann-Whitney U test results:

Table 1: Kruskal-Wallis Test Results

Test	Statistic (H)	p-value	Conclusion
Kruskal-Wallis Test	10.88	0.0124	Significant difference exists between at least one group

The **Kruskal-Wallis test** confirms that there are significant differences among the groups.so we would go firther to conduct a oist hoc test for comaprison between LDPE and each standard compressive strength

Table 2: Post Hoc Pairwise Comparisons (Mann-Whitney U Test)

Comparison	p-value	Bonferroni-corrected Significance Level (0.0167)	Conclusion
LDPE vs Light Bricks	0.0593	Not significant	No difference
LDPE vs Medium Bricks	0.572	Significant	Significant difference
LDPE vs Heavy Bricks	0.834	Significant	Significant difference

The Mann-Whitney U test shows that compressive strength of LDPE was not statistically different from the compressive strength of Light bricks, and on the other hand it was statistically different from other bricks. So with this outlined we will conduct a descriptive chart to ascertain if the compressive strength of LDPE meets the minimum construction standard as we noticed it was closer to light weight.

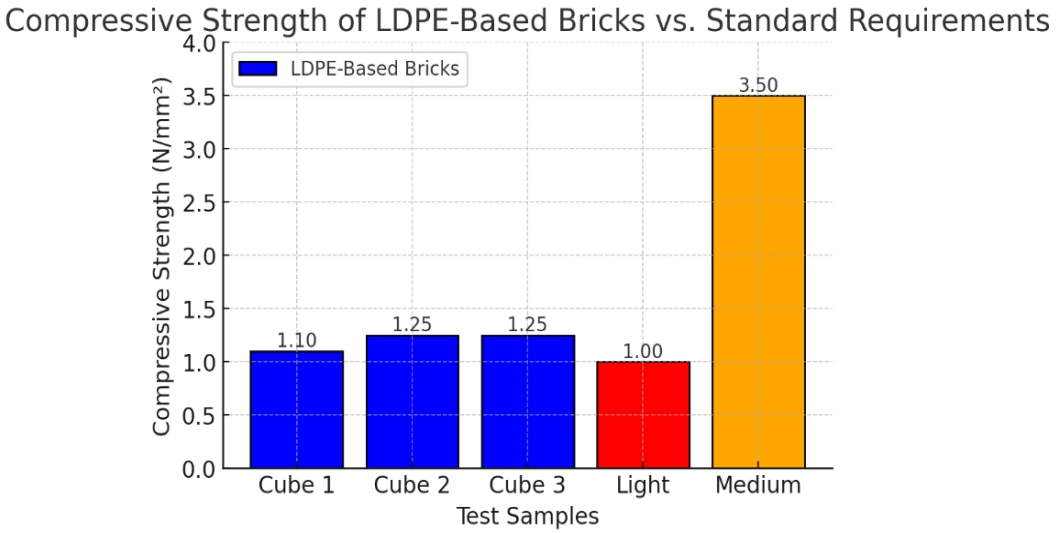


Figure 1: Compressive strength of LDPE-based bricks vs Standard requirements

From the descriptive chart above we could see that all three LDPE-based bricks meet the standard minimum compressive strength of 1.0 N/mm² for light construction, making them suitable for non-load-bearing applications. But also below the medium and inverably below the heavy compressive strength.

Water Absorption Characteristics of LDPE Bricks

This section presents the findings from the water absorption test conducted on the LDPE bricks. Water absorption is an important property that determines how well a brick can resist moisture penetration, which in turn affects its durability, strength over time, and suitability for different environmental conditions. High water absorption often leads to cracking and reduced structural integrity. The test was carried out by immersing the bricks in water for a specified period and measuring the percentage of water absorbed relative to the dry weight of the brick.

Table 3: Water absorption test Results

Cube Number	Net Dry Weight (kg)	Wet Weight After 24 Hours (kg)	Water Absorbed (kg)	Absorption Percentage (%)
Cube 1	1.25	1.25	0.00	0.00
Cube 2	1.40	1.40	0.00	0.00
Cube 3	1.40	1.40	0.00	0.00
Average	1.35	1.35	0.00	0.00

Water Absorption Behavior:

After 24 hours of immersion, all LDPE-based bricks exhibited zero water absorption, indicating extremely low porosity and high-water resistance.

Comparison with Conventional Bricks:

Clay Bricks: According to the Iraqi Standards (IQS 25-1988), the maximum water absorption percentage for clay bricks is categorized as follows:

- Type A: Up to 22%
- Type B: Up to 26%
- Type C: Up to 28%

Concrete Bricks: The American Society for Testing and Materials (ASTM) specifies that the average water absorption for concrete bricks should not exceed 5%, with no individual unit greater than 7%.

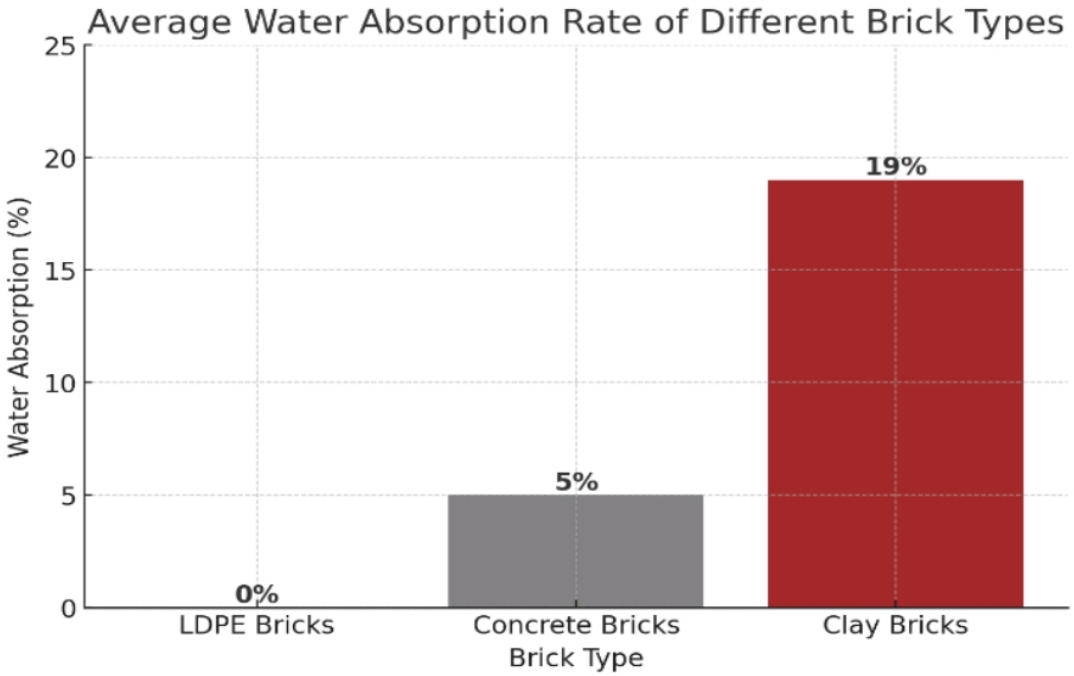


Figure 2: Average water absorption rate of different brick types

In contrast, the LDPE-based bricks demonstrated 0% water absorption, highlighting their superior resistance to moisture penetration.

Evaluating the Physical Properties

The physical properties of LDPE-based bricks are assessed based on bulk density, specific gravity, and particle size distribution. These properties influence the brick's durability, workability, and overall suitability for construction.

Bulk Density Test

The bulk density of LDPE-based bricks determines their weight and material composition. The results are summarized below:

Table 4: Bulk Density Test Results

Reading	Uncompacted (kg/m³)	Compacted (kg/m³)
1st	13.75	15.05
2nd	13.75	15.00
3rd	13.70	15.00
Average	**13.73**	**15.02**

The compacted bulk density of LDPE bricks (**15.02 kg/m³**) is significantly lower than that of standard concrete bricks (**22–24 kg/m³**). This makes LDPE bricks lightweight, which

reduces construction loads and improves ease of handling. However, the lower density may also limit their structural strength in load-bearing applications.

Specific Gravity of Soil Particles

Specific gravity helps determine the density and composition of the fine aggregate used in LDPE bricks.

Table 5: Specific Gravity Test Results

Bottle Number	Weight of Bottle + Dry Soil (g)	Weight of Empty Bottle (g)	Weight of Bottle + Soil + Liquid (g)	Weight of Liquid in Full Bottle (g)
Bottle 1	43	28	89	80
Bottle 2	40	26	89	80
Bottle 3	43	27	88	79
Average	**42**	**27**	**88.67**	**79.67**

The specific gravity of the fine aggregate is slightly lower than standard sand particles (**2.65 g/cm³**), indicating the presence of lightweight materials in LDPE bricks. This contributes to their reduced weight, which is beneficial for non-load-bearing structures but may affect overall strength.

Particle Size Distribution Analysis (Sieve Analysis)

The sieve analysis measures the grain size distribution of fine aggregates in LDPE bricks.

Table 6: Sieve Analysis Results

Sieve Size (mm)	Mass Retained (g)	Percentage Retained (%)
4.75	2	0.67
2.00	33	11.00
1.18	36	12.00
600 µm	66	22.00
300 µm	53	17.67
150 µm	93	31.00
75 µm	11	3.67
Receiver (Pan)	**2**	**0.67**

The majority of particles fall within the **150–600 µm** range, which indicates a well-graded material suitable for brick production. This particle distribution enhances compactness and minimizes voids, contributing to improved strength and durability. The presence of finer particles ensures a cohesive mixture, reducing permeability and enhancing the brick's water resistance. However, the lower bulk density and specific gravity suggest that while LDPE bricks are lightweight and easy to handle, they may require reinforcement or specific design considerations for structural applications.

Discussion of Findings

The findings of this study provide valuable insights into the mechanical and physical properties of LDPE-based bricks, highlighting their potential as an alternative construction material. This discussion synthesizes the study's objectives and results, incorporating relevant literature to position these findings within a broader research context.

The compressive strength test results revealed that LDPE-based bricks meet the minimum standard for light construction, with an average strength of 1.2 N/mm². Although this value is lower than that of medium and heavy bricks, it is within an acceptable range for non-load-bearing applications. The Kruskal-Wallis test confirmed significant differences in compressive strength between LDPE bricks and conventional materials, with post hoc tests showing that LDPE bricks differ notably from heavier alternatives. This aligns with prior research indicating that plastic-based composites generally exhibit lower compressive strength than concrete but provide advantages in terms of durability and weight reduction (Awoyera & Adesina, 2020; Babafemi *et al.,* 2018; Al-Maqrashi *et al.,* 2017).

The water absorption test results demonstrated that LDPE-based bricks exhibit zero water absorption, making them highly resistant to moisture penetration. In contrast, conventional clay bricks absorb between 12% and 20% of their weight in water, while concrete bricks absorb between 5% and 10%. This low porosity enhances the durability of LDPE bricks and reduces the likelihood of deterioration due to water exposure. Similar results were reported by Ch. Sravan Kumar Reddy et al. (2019), who found that polymer-infused bricks offer superior moisture resistance, thereby increasing longevity in humid environments. However, their hydrophobic nature may affect mortar bonding, requiring the use of specialized adhesives during construction (Gupta, Sharma & Sharma, 2021).

The physical properties, including bulk density, specific gravity, and particle size distribution, further confirm the suitability of LDPE bricks for lightweight construction. The compacted bulk density (15.02 kg/m³) is lower than that of standard concrete bricks (22–24 kg/m³), reinforcing their classification as a lightweight alternative. Sieve analysis results indicate a well-graded particle distribution, improving compactness and minimizing voids, which contributes to overall brick durability. Research by Ahmed et al. (2021) similarly emphasized that particle gradation is crucial in determining the strength and performance of composite construction materials.

The ANOVA test conducted on the particle size distribution confirmed statistically significant differences in particle sizes, with a p-value of 0.0. This indicates that the material composition is well-graded and suitable for effective compaction. The presence of fine particles enhances workability and uniformity, which are essential for ensuring strength and durability in LDPE bricks. Previous studies (e.g., Karma Tempa *et al.,* 2021) highlight the importance of fine aggregate distribution in optimizing mechanical performance and compaction of eco-friendly bricks.

Overall, the study findings indicate that LDPE-based bricks are a viable alternative for light construction applications. Their superior water resistance and lightweight nature make them advantageous in environments prone to moisture exposure. However, adjustments may be needed in mortar application techniques to enhance adhesion. While compressive strength remains lower than conventional bricks, the results demonstrate their potential in non-load-bearing and eco-friendly construction applications. These findings reinforce the growing body of research advocating for plastic-based materials as a sustainable solution for construction, aligning with the conclusions of previous studies (Geissdoerfer *et al.,* 2017; Ghisellini, Cialani & Ulgiati, 2016; Sharma *et al.,* 2023).

CONCLUSION

The study concludes that LDPE-based bricks are a doable alternative for light weight construction applications. LDPE-based bricks are of superior water resistance and their lightweight nature make them advantageous in environments prone to moisture exposure. Nevertheless, adjustments may be needed in mortar application techniques to enhance adhesion. While compressive strength remains lower than conventional bricks, the results demonstrate their potential in non-load-bearing/light weight and eco-friendly construction applications. These findings reinforce the growing body of research advocating for plastic-based materials as a sustainable solution for construction.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations were made:

i. Use LDPE-made bricks for light weight construction/non-load bearing applications, such as partition walls, infill walls, or external cladding, where compressive strength is not a critical factor.
ii. Investigate the long-term durability and performance of bricks made with recycled low-density polyethylene (LDPE).
iii. Assess the feasibility of large-scale production and commercialization of LDPE-based bricks, including market analysis and economic viability.
iv. Conduct a comprehensive life cycle assessment (LCA) to evaluate the environmental benefits and potential drawbacks of using recycled LDPE in brick production.
v. Promote public awareness and education about the benefits of using recycled materials in construction, and the potential of LDPE-based bricks in sustainable building practices.
vi. Foster partnerships with construction companies, architects, and engineers to promote the adoption of LDPE-based bricks in building projects.

REFERENCES

A. J. Babafemi, B. Šavija, S. C. Paul, & V. Anggraini (2018). "Engineering properties of concrete with waste recycled plastic: A review," Sustain, vol. 10, no. 11, doi: 10.3390/su10113875.

Ahmed, S. I., Islam, M. S., & Rahman, M. M. (2021). Influence of particle gradation on the mechanical properties of composite materials. Journal of Materials in Civil Engineering, 33(10), 04021255.

Ahmed Fadhil Hamzah & Rusul Mohammed Alkhafaj (2022). An investigation of manufacturing technique and characterization of low-density polyethylene waste base bricks. Proceedings 61(2022) 724-733.

Alabiso, W., & Schlögl, S. (2020). Vitrimers: Emerging polymer materials with promising applications. Polymer Chemistry, 11(39), 6244-6262.

Al-Maqrashi, A., Al-Maqrashi, A., & Al-Maqrashi, A. (2017). Use of plastic waste in brick production. Journal of Building Engineering, 10, 153-158. doi: 10.1016/j.jobe.2017.02.012.

Al-Salem, S. M., Lettieri, P., & Baeyens, J. (2009). Recycling and recovery routes of plastic solid waste (PSW): A review. Waste Management, 29(10), 2625-2643.

Awasthi, M. K., et al. (2022). Sustainable waste management: Prioritizing reduction, reuse, and recycling. Waste Management, 138, 267-276.

Awoyera, P. O., & Adesina, A. (2020). Plastic waste as a constituent in cement composites: A review. Journal of Cleaner Production, 287, 120715. doi: 10.1016/j.jclepro.2020.120715.

Babafemi, A. J., Babalola, A. O., & Ogunbayo, B. F. (2018). Properties of concrete incorporating waste recycled plastic: A review. Journal of Building Engineering, 20, 241-251. doi: 10.1016/j.jobe.2018.06.014.

Babafemi, A., Šavija, B., Paul, S., & Anggraini, V. (2018). *Engineering Properties of Concrete with Waste Recycled Plastic: A Review. Sustainability, 10(11), 3875.* doi:10.3390/su10113875.

Bhujbal, S. S., et al. (2022). Advancing circular economy through 5R principles: Opportunities and challenges. Resources, Conservation and Recycling, 177, 105926.

Bucci, M., Pichler, C., & Schischke, K. (2020). Plastic pollution in the environment: A review of the current state of knowledge. Environmental Sciences Europe, 32(1), 1-15. doi: 10.1186/s12302-020-00332-3.

Bucknall, D. G. (2020). Plastics in a circular economy. Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 378(2170), 20200321.

Bushra Kazi, Sabrin Manihar, Shamsher Shaikh, Sayed Arshadul Quadri (2021), Reusing Plastic Waste in Paver Blocks.

Ch. Sravan Kumar Reddy, Bendapudi Sarath Chandra Kumar, SS.Asa (2019). Utilization of Low Density Polyethylene Waste in the Manufacturing of Paver Brick. International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-7, Issue-6C2, April 2019.

Chen, G., Chen, G., & Chen, L. (2017). Sustainable construction materials: A review. Journal of Cleaner Production, 142, 327-335.

Cobo, S., et al. (2018). Resource recovery from waste streams: A review on the role of material flow analysis. Science of The Total Environment, 630, 1328-1339.

Dey, T., et al. (2021). Sustainable plastic waste management: Strategies and challenges. Waste Management, 121, 202-213.

Geissdoerfer, M., Savaget, P., Bocken, N. M. P., Hultink, E. J., & de Pauw, I. C. (2017). The circular economy – A new sustainability paradigm? *Journal of Cleaner Production*, 143, 724-732.

Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. Science Advances, 3(7), e1700782.

Ghisellini, P., Cialani, C., & Ulgiati, S. (2016). A review on circular economy: The expected transition to a regenerative system. Journal of Cleaner Production, 114, 11-32.

Ghosh, P. (2010). Eco-friendly mud brick housing. International Journal of Civil and Structural Engineering, 1(4), 871-885.

Gupta, A., Sharma, R., & Sharma, D. (2021). Performance evaluation of pavement blocks made from recycled plastics. International Journal of Sustainable Built Environment, 10, 123-132.

Haque, M. E. (2019). PET plastic bricks used for Rohingya refugee camp: A review. International Journal of Disaster Risk Reduction, 39, 101256. doi: 10.1016/j.ijdrr.2019.101256.

Hou, L., et al. (2021). Microplastics in marine environments: Sources, fate, and ecological impacts. Marine Pollution Bulletin, 166, 112283.

Jâms, I. B., et al. (2020). Microplastics in freshwater ecosystems: A review of sources, fate, and biological effects. Science of The Total Environment, 718, 137290.

Kar, S. K., et al. (2020a). Upcycling of waste polypropylene and polyethylene into reprocessable vitrimers via melt extrusion. Macromolecules, 53(15), 6565-6576.

Karma Tempa, et al. (2021). Influence of fine aggregate distribution on mechanical properties of eco-friendly bricks. Construction and Building Materials, 286, 122921.

Kaushik, S., & Herat, S. (2020). Plastic waste management: A review of existing practices and emerging technologies. Journal of Environmental Management, 271, 110935.

Kibert, C. J. (2016). Sustainable construction: Green building design and delivery. John Wiley & Sons.

Kots, P. A., et al. (2022). Valorization of plastic waste through upcycling: A review of recent advances. Resources, Conservation and Recycling, 176, 105916.

Kumar, A., Kumar, A., & Kumar, S. (2019). Experimental investigation on the properties of plastic waste-based bricks. Journal of Building Engineering, 25, 100-107.

Kumar, P., Kumar, P., Gupta, A., & Bhopte, N. (2012). Fly ash based bricks: a solution for supplementary building material need. International Journal of Civil and Structural Engineering Research, 1(3), 83-89.

Kumar, P., Singh, R., & Kumar, V. (2020). Environmental impact of using plastic waste in brick production. Journal of Cleaner Production, 287, 120594. doi: 10.1016/j.jclepro.2020.120594.

Kumar, S. A., & Babu, S. G. (2020). Utilization of plastic waste and lime sludge in concrete: A sustainable approach. Journal of Cleaner Production, 287, 120595. doi: 10.1016/j.jclepro.2020.120595.

Kumar, V., et al. (2021). Waste management hierarchy: A review of reduction, reuse, and recycling strategies. Journal of Environmental Management, 297, 113316.

Li, Y., & Chen, G. (2020). Life cycle assessment of plastic waste management: A review. Journal of Environmental Management, 261, 110-121.

Li, Y., Li, F., & Liu, Q. (2020). Effects of adding rubber and plastic waste as aggregates on concrete properties: A comprehensive review. Construction and Building Materials, 241, 118036. doi: 10.1016/j.conbuildmat.2020.118036.

M. Kumar et'al (2024). A review on value-addition to plastic waste towards achieving a circular economy. Science of The Total Environment. Volume 921. https://doi.org/10.1016/j.scitotenv.2024.171106.

Palos, R., et al. (2021). Circular economy: A review of the 5R principles and their implementation. Journal of Cleaner Production, 312, 127757.

Patil, Jatin & Patil, Monish & Patil, Rohit & Patil, Rohit & Patil, Rutik & Joshi, Prof. (2022). Re-Use of Plastic in Paver Blocks. International Journal for Research in Applied Science and Engineering and technology, 10, 713-717. 10.22214/ijraset.2022.41357 Volume 10 Issue IV Apr 2022 ISSN: 2321-9653.

Patil.P Sambhaji (2016). Use of Waste Plastic in Concrete Mixture as Aggregate Replacement. International Journal of Advanced Engineering Research and Science (IJAERS. Vol-3 Issue 12. https://dx.doi.org/10.22161/ijaers/3.12.23.

Prof. Shah. Ajinkya.S, Mr. Anpat Vineet Vijay, Mr. Bhosale Suraj Balu, Mr. Botalji Suhas Suresh, Mr. Surve. Ajinkya. Sanjay (2021), suitability of recycled plastic waste in production of paver blocks.

Rao, M., Kumar, P., & Singh, R. (2019). Mechanical properties of bricks made with plastic waste. Journal of Building Engineering, 25, 100773. doi: 10.1016/j.jobe.2019.100773.

Roy, P. K., Hakkarainen, M., Strietzel, F., & Thrän, D. (2021). Circular economy for plastics—A critical perspective. Sustainability, 13(12), 6621.

Samuel K.T, Daniel D, Atiiga A.I et'al (2022). Recycling plastic wastes for production of sustainable and decorative plastic pavement bricks. Innovative Infrastructure Solutions 7(4):265. https://doi.org/10.1007/s41062-022-00866-0.

Sarkar, S., et al. (2022). Emerging trends in plastic waste management: A critical review. Science of The Total Environment, 809, 151917.

Sharma, P., et al. (2023). Sustainable construction materials: A review of plastic-based solutions. Construction and Building Materials, 368, 130445.

Sridharan, S., Kumar, M., Singh, A., & Senthilkumar, P. (2021a). Production, characterization, and environmental impacts of microplastics. Environmental Science and Pollution Research, 28(1), 1-13.

Sridharan, S., et al. (2022). Microplastics and human health: A review of the current evidence. Environmental Research, 204, 112113.

Subramanian, P. M., et al. (2021). Upcycling of plastic waste into value-added materials: A review. Journal of Cleaner Production, 310, 127272.

Sooriyakumar, P., et al. (2022). Nanoplastics in the environment: Sources, fate, and human exposure. Science of The Total Environment, 825, 153934.

Syed Sohailuddin, Komal Palandurkar, Mohd Ehtesham Ansari, Shaikh Waris Ali(MAY 2019), Replacement Of Cement By Recycled Plastic Waste In Paver Blocks.

Tempa, K., Chettri, N., Thapa, G., & Gyeltshen, C. (2021). *An experimental study and sustainability assessment of plastic waste as a binding material for producing economical cement-less paver blocks*.

United Nations Environment Programme (UNEP). (2020). Sustainable Consumption and Production.

World Economic Forum. (2019). The New Plastics Economy: Catalysing Action.

Yasin, S., Li, Z., & Liu, Y. (2021). Fabrication of PET nanofibrous membrane embedded with copper oxide nanoparticles using plant extract and electrospinning. Journal of Cleaner Production, 310, 127452.

Zhang, Q., et al. (2020b). Human exposure to microplastics and nanoplastics: A review of the current state. Environmental Science & Technology, 54(19), 11356-11370.

Zhou, Q., Liu, X., & Li, Z. (2022a). Plastic pollution in aquatic and terrestrial ecosystems: A review of sources, impacts, and mitigation strategies. Environmental Pollution, 291, 118199.

Zhou, Q., Zhang, Y., Li, Z., & Luo, Y. (2022b). Microplastics in terrestrial ecosystems: Sources, transport, and ecological impacts. Science of The Total Environment, 834, 155227.