

Eco-Friendly Pavement Innovation: Compressive Strength of Plastic-Sand Paver Blocks

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ABSTRACT

The growing accumulation of plastic waste in coastal regions like Pangkajene and Islands Regency has become a pressing environmental concern due to inadequate waste management systems. This study proposes an innovative solution by utilizing post-consumer plastic waste (PET, HDPE, and LDPE) combined with local Pinrang sand to produce lightweight, eco-friendly paving blocks. The experimental method involved melting shredded plastic and blending it with sand in various ratios (1:1, 1:2, 1:3), then molding and testing the compressive strength based on SNI 03-0691-1996 standards. Results showed that the 1:1 composition achieved the highest average compressive strength of 9.84 MPa among plastic-based samples, while conventional blocks reached up to 34.80 MPa. Plastic waste paving blocks met Class D criteria, suitable for light-use pavements, while conventional ones met Class B. Although the mechanical strength of plastic-based blocks was lower, their environmental benefits and lighter weight make them suitable for garden paths and pedestrian areas. This study affirms the potential of integrating plastic waste into construction materials, offering a sustainable and practical response to local waste challenges

INTRODUCTION

Plastic waste has emerged as one of the most pressing environmental issues globally, with increasing concern regarding its persistent accumulation, especially in coastal and island regions. In Indonesia, this problem has become increasingly severe due to the rapid urbanization and the growing consumption of plastic-based products. According to the National Waste Management Information System (SIPSN), plastic waste accounted for 7.29% of the total waste composition in Pangkajene and Islands Regency (Pangkep) as of 2024, remaining stagnant since 2021. Although it is not the most dominant waste category, the unchanging proportion and the non-biodegradable nature of plastic pose a long-term environmental threat, particularly in areas lacking efficient waste management systems.

This crisis necessitates innovative strategies that not only mitigate plastic pollution but also align with sustainable development goals. The construction sector, which remains highly reliant on conventional materials such as cement and natural aggregates, presents a viable avenue for integrating waste materials into the value chain. Conventional paving blocks, widely used for sidewalks, parking lots, and urban landscaping, require large quantities of resources and contribute significantly to greenhouse gas emissions during production. As such, developing sustainable alternatives using plastic waste as a base material could offer a dual solution – addressing both waste reduction and green construction.

Recent studies have highlighted the potential of reusing thermoplastics like polyethylene terephthalate (PET), high-density polyethylene (HDPE), and low-density polyethylene (LDPE) in construction applications. These materials are lightweight, corrosion-resistant, and thermally stable, making them suitable candidates for integration into construction composites such as paving blocks. Minde et al. (2024) noted that incorporating recycled plastic into construction materials offers promising mechanical performance while alleviating the burden of plastic waste accumulation. In addition, Pinrang sand sourced from the Sadang River in South Sulawesi has been identified as an ideal fine aggregate due to its gradation and bonding characteristics, making it suitable for use in combination with molten plastic.

Technological innovations have introduced the possibility of melting plastic waste and combining it with sand to form composite materials with acceptable structural properties. Experimental efforts in this domain have shown that when mixed in optimal ratios, plastic waste and sand can yield products with lower water absorption, high durability, and considerable compressive strength. For instance, previous work by Bagas (2024) reported compressive strength values up to 50.97 MPa using a 50% plastic composition, while Mustakim et al. (2023) demonstrated water absorption below 5%, meeting the standards for outdoor pavements.

Despite these advancements, there remains a gap in localized and contextual studies that assess the feasibility of such solutions using region-specific materials. While international efforts and large-scale initiatives continue, rural and coastal regions often face unique challenges due to limited access to technology and funding. This underlines the importance of grassroots

innovations that utilize locally available resources and respond to local environmental challenges.

In this context, the study focuses on utilizing post-consumer plastic waste sourced from communities near Politeknik Pertanian Negeri Pangkajene Kepulauan and combining it with natural sand from the Pinrang region. The objective is to produce lightweight, environmentally friendly paving blocks through a thermomechanical process. The study evaluates the compressive strength of different plastic-to-sand ratios (1:1, 1:2, and 1:3), benchmarking the results against conventional paving blocks and referring to the SNI 03-0691-1996 standard for classification.

Several key motivations drive this investigation. First, it aligns with sustainable development principles by promoting resource efficiency and reducing dependency on virgin materials. Second, it provides a feasible method of managing plastic waste in Pangkep, a region that lacks integrated waste infrastructure. Third, it offers an opportunity to generate value-added products that could stimulate the local green economy.

The potential of plastic waste as a construction material is supported by numerous recent studies. For example, the work of Springer (2023) identified that paving blocks made from a composition containing 30% plastic waste achieved higher compressive strength compared to traditional concrete blocks. Similarly, the findings of MDPI (2023) demonstrated the practical application of PET and M-sand for road paving blocks, revealing significant durability and mechanical integrity. These studies provide evidence that carefully formulated plastic-sand composites can meet performance standards and be deployed in non-structural construction contexts.

Nevertheless, critical assessments by *Frontiers in Built Environment* (2023) and *ScienceDirect* (2023) emphasize the importance of evaluating the long-term performance, environmental impact, and safety of plastic-modified construction materials. Issues such as microplastic leaching, fire resistance, and recyclability of the end product warrant further investigation to ensure the responsible application of such innovations. Moreover, the effectiveness of waste segregation and plastic preprocessing stages remains a determining factor in the consistency and reliability of the final product.

This study therefore contributes to this growing body of knowledge by delivering a regionally grounded, experimentally validated assessment of paving block production using plastic waste. It addresses specific gaps in data on performance metrics for plastic-sand composites produced under localized conditions in tropical, coastal environments. Furthermore, it offers practical implications for municipal waste management strategies and rural infrastructure development programs in Indonesia.

The primary goal of this research is to determine whether plastic waste can serve as a viable binder or partial substitute for cement in the production of paving blocks, without compromising structural integrity for low-load applications. The novelty lies in the combination of three types of plastic waste (PET, HDPE, LDPE) with natural Pinrang sand using a straightforward, replicable melting and molding method. The compressive strength of the

resulting blocks is tested according to the SNI 03-0691-1996 standard to determine the applicable quality class (D for garden use, B for parking lots, etc.).

In summary, this research provides a timely and relevant examination of how post-consumer plastic waste can be repurposed into functional building components. The findings are expected to support initiatives in circular construction, environmental waste reduction, and community-based innovation. Ultimately, the study aims to bridge the gap between plastic waste management and sustainable construction practices in the Indonesian archipelagic context.

LITERATUR REVIEW

The global surge in plastic consumption has resulted in an alarming accumulation of plastic waste, especially in developing countries with limited waste processing infrastructure. Indonesia, as one of the largest archipelagic nations, faces severe challenges in managing post-consumer plastic, particularly in coastal regions like Pangkajene and Islands Regency. This situation has prompted researchers to explore environmentally sustainable alternatives for repurposing plastic waste into construction materials.

Plastic waste, particularly thermoplastics such as polyethylene terephthalate (PET), high-density polyethylene (HDPE), and low-density polyethylene (LDPE), has drawn attention as a potential component in concrete and pavement applications. According to Minde et al. (2024), the integration of plastic waste into construction materials contributes significantly to reducing environmental pollution while offering adequate mechanical performance for non-structural use. These materials exhibit resistance to corrosion, lower density, and desirable thermal properties, making them promising candidates for low-load applications such as paving blocks.

Bagas (2024) investigated plastic-infused paving blocks and reported compressive strengths exceeding 50 MPa with 50% plastic content. Similarly, Mustakim et al. (2023) emphasized the low water absorption characteristics of plastic-based pavers (<5%), highlighting their suitability in humid tropical environments. These findings support the use of plastic composites in outdoor applications with light mechanical stress.

The concept of utilizing local materials to enhance sustainability is not new. Arsyad et al. (2020) demonstrated that sand from the Sadang River in Pinrang, South Sulawesi, has favorable gradation and hydrological properties for use in concrete mixes. Combining this sand with plastic waste creates a potentially viable composite material, particularly in rural settings where both resources are readily available.

However, challenges remain regarding the consistency, safety, and long-term behavior of plastic-based construction materials. A review by ScienceDirect (2023) outlined the limitations of current recycling systems, particularly the difficulty of sorting and identifying plastic mixtures, which can affect the homogeneity and strength of construction composites. Moreover, the incorporation of plastic waste must address concerns such as microplastic release, thermal degradation, and fire resistance, as noted by *Frontiers in Built Environment* (2023).

Research also suggests that plastic-sand composites can be enhanced by optimizing mix ratios and incorporating additional reinforcements. Springer (2023) found that a plastic content of 30% in paving blocks achieved higher strength compared to conventional concrete, emphasizing the importance of experimental calibration. MDPI (2023) validated the use of PET and M-sand combinations, further confirming the feasibility of such materials for light-duty pavements.

METHODOLOGY

Research Location and Duration

This study was conducted at the Laboratory of the Politeknik Pertanian Negeri Pangkajene Kepulauan, located in South Sulawesi, Indonesia. The research took place over a period of six months, from May to October 2025. The selected laboratory environment was equipped with the necessary instruments for thermomechanical processing, sample molding, and compressive strength testing, in alignment with Indonesian National Standard (SNI) protocols.

Materials and Equipment

Plastic Waste:

The main binding component in this study was post-consumer plastic waste collected from residential areas surrounding the campus. The types of plastic used include Low-Density Polyethylene (LDPE), High-Density Polyethylene (HDPE), and Polyethylene Terephthalate (PET). These types of plastic were selected for their thermal workability, resistance to corrosion, and light weight, characteristics suitable for construction applications as previously identified by Khaq and Damara (2024).

Pinrang Sand:

The fine aggregate component was local natural sand sourced from the Sadang River in Pinrang, South Sulawesi. Previous research by Arsyad et al. (2020) highlighted the hydrological and economic potential of this sand, indicating its suitability for concrete and paving mixtures due to its favorable gradation.

Optional Cement:

In some trials, a small amount of Portland cement was used as a secondary binder to enhance compressive strength, though the primary focus was on plastic-sand compositions.

Other Materials:

Clean water was used for cooling and compaction processes. Additional additives such as fine plastic fibers or coloring agents were only considered in optional formulations.

Equipment:

The following tools were used in the preparation and testing process:

- Digital Scale: For accurate measurement of materials.
- Melting Tools: Electric melting pots, gas stoves, or hot plates were employed to melt plastic at temperatures between 160–180°C.
- Mixing Containers: Heat-resistant metallic buckets were used to combine plastic melt with sand.

- Standard Molds: Steel molds of 20 cm × 10 cm × 6 cm dimensions were used as per SNI 03-0691-1996.
- Manual or Hydraulic Compactor: Used to compress the mixture inside the mold.
- Universal Testing Machine (UTM): For compressive strength testing.
- Thermometers and Safety Equipment: For temperature monitoring and ensuring operator safety.

Sample Preparation

Sample preparation followed a structured four-stage process:

Stage 1 – Material Collection and Processing:

Plastic waste was cleaned, dried, and mechanically shredded to sizes ranging between 5–10 mm. Sand was sieved to eliminate large impurities and ensure uniformity in grain size.

Stage 2 – Mixing and Molding:

Shredded plastic was melted at 160–180°C. Once liquefied, sand was gradually added to the melt and stirred continuously to ensure homogeneity. The mixture was then poured into preheated steel molds of standard dimensions and manually compacted. The mold was left to cool for 30 to 60 minutes before demolding.

Stage 3 – Curing:

Since cement was not a major component, traditional water curing was not essential. However, all samples were left to air dry at room temperature for 24 hours to stabilize their internal structure.

Stage 4 – Sample Variants:

The study tested four different types of paving blocks:

- Block A: Plastic–Sand ratio of 1:1
- Block B: Plastic–Sand ratio of 1:2
- Block C: Plastic–Sand ratio of 1:3
- Block D: Conventional block using cement and sand (control)

Each configuration was replicated in triplicate, yielding a total of 12 samples for analysis.

Experimental Procedure

The compressive strength tests were carried out using a Universal Testing Machine (UTM), following the guidelines of SNI 03-0691-1996. The test measured the maximum load the paving block could withstand before failure, with results expressed in kilonewtons (kN), kilograms per square centimeter (kg/cm²), and megapascals (MPa).

Before testing, each sample was visually inspected for surface uniformity and structural integrity. Testing was conducted at room temperature, and load was applied at a constant rate until failure occurred. Each measurement was repeated three times to ensure accuracy and reproducibility.

Data Analysis Method

Quantitative data were recorded for each sample type and composition. The compressive strength values from all three replications were averaged to obtain the mean performance for each ratio. These results were tabulated and compared against one another to identify trends and relationships between plastic content and mechanical performance.

The data were also analyzed against the classification provided by SNI 03-0691-1996:

Class B: Suitable for medium loads (e.g., parking areas)

Class D: Suitable for light loads (e.g., garden paths)

Graphical plots were generated to visually illustrate the correlation between mix ratios and compressive strength. The plastic-based block performances were also benchmarked against the control group to assess relative suitability.

This comprehensive method ensures that the resulting analysis is not only valid but also replicable by other researchers or institutions aiming to develop similar sustainable construction materials using locally available waste.

RESEARCH RESULTS

Table 1. Compressive Strength Results of Original Paving Block Variation 1:1

Sample	Compressive Strength (Kn)	Compressive Strength (Kg/cm ²)	Compressive Strength (MPa)
1	640	349.34	34.24
2	730	357.95	35.08
3	730	357.95	35.08
Average	700.00	355.08	34.80

Table 2. Compressive Strength Results of Original Paving Block Variation 1:2

No	Compressive Strength (Kn)	Compressive Strength (Kg/cm ²)	Compressive Strength (MPa)
1	610	332.97	32.63
2	540	294.76	28.89
3	610	332.97	32.63
Average	586.667	320.23	31.38

Table 3. Compressive Strength Results of Original Paving Block Variation 1:3

No	Compressive Strength (Kn)	Compressive Strength (Kg/cm ²)	Compressive Strength (MPa)
1	610	332.97	32.63
2	540	294.76	28.89
3	430	234.72	23.00
Average	526.67	287.48	28.17

Table 4. Compressive Strength Results of Plastic Waste Paving Blocks Variation 1:1

Sample	Compressive Strength (Kn)	Compressive Strength (Kg/cm ²)	Compressive Strength (MPa)
1	170	97.51	9.56
2	190	108.99	10.68
3	165	94.64	9.28
Average	175.00	100.38	9.84

Table 5. Compressive Strength Results of Plastic Waste Paving Blocks Variation 1:2

No	Compressive Strength (Kn)	Compressive Strength (Kg/cm ²)	Compressive Strength (MPa)
1	125	71.70	7.03
2	130	74.57	7.31
3	130	74.57	7.31
Average	128	73.61	7.21

Table 6. Compressive Strength Results of Plastic Waste Paving Blocks Variation 1:3

No	Compressive Strength (Kn)	Compressive Strength (Kg/cm ²)	Compressive Strength (MPa)
1	80	45.89	4.50
2	95	54.49	5.34
3	96	55.07	5.40
Average	90	51.82	5.08

Compressive Strength of Conventional Paving Blocks

The compressive strength test for conventional paving blocks – those made from standard cement-sand mixtures – served as the control group in this study. The purpose was to establish a performance benchmark against which plastic waste-based paving blocks could be compared. Three composition ratios were tested: 1:1, 1:2, and 1:3.

For the 1:1 composition, the results showed a high average compressive strength of 34.80 MPa, with individual readings of 34.24, 35.08, and 35.08 MPa. This consistency indicates excellent material bonding and compaction at this ratio.

In the 1:2 mixture, a slight decline was observed. The mean compressive strength decreased to 31.38 MPa, though it still remained within a robust performance range. Individual results of 32.63, 28.89, and 32.63 MPa reflect the mix's reliability despite reduced cement content.

The 1:3 composition showed a more noticeable decrease in compressive strength, with values of 32.63, 28.89, and 23.00 MPa, yielding an average of 28.17 MPa. This result confirms that as the sand proportion increases relative to

cement, bonding efficiency and density begin to deteriorate, reducing the material's load-bearing capacity.

Overall, all conventional paving blocks met the Class B standard as per SNI 03-0691-1996, indicating suitability for medium-load-bearing applications, such as parking areas.

Compressive Strength of Plastic Waste-Based Paving Blocks

The central aim of this study was to evaluate the viability of using plastic waste as the main binding agent in paving blocks, replacing cement, and to determine the ideal plastic-to-sand ratio. Three variants were tested – 1:1, 1:2, and 1:3 – each replicated three times.

In the 1:1 ratio, the average compressive strength achieved was 9.84 MPa, with results of 9.56, 10.68, and 9.28 MPa. Although significantly lower than conventional blocks, this performance level was the highest among all plastic-based compositions. The balanced proportion of molten plastic and sand likely contributed to better encapsulation and interlocking of the aggregate particles.

The 1:2 mix showed reduced strength, with values of 7.03, 7.31, and 7.31 MPa, resulting in an average of 7.21 MPa. The increased sand content led to less cohesive bonding due to the reduced plastic matrix available for full encapsulation.

At a 1:3 ratio, the compressive strength further declined. The three samples tested yielded 4.50, 5.34, and 5.40 MPa, averaging 5.08 MPa. The high aggregate-to-binder ratio created voids and reduced density, contributing to poor mechanical performance.

Despite lower compressive strength, all three compositions using plastic waste still satisfied the Class D standard under SNI 03-0691-1996, making them suitable for light-use areas such as gardens or pedestrian paths.

These findings align with studies like Springer (2023), which showed optimized mixtures using 30% plastic achieving competitive strength with traditional blocks. Furthermore, MDPI (2023) also confirmed PET-sand composites reaching acceptable compressive performance for low-load applications.

Comparison Between Conventional and Plastic-Based Blocks

A direct comparison across the two paving block types (conventional vs. plastic-based) reveals significant trends in performance:

1. 1:1 Composition

- Conventional: 34.80 MPa
- Plastic-Based: 9.84 MPa

The conventional block outperformed its plastic-based counterpart by over 250%. However, the plastic block still met minimum thresholds for non-structural applications, highlighting potential utility in sustainable designs.

2. 1:2 Composition

- Conventional: 31.38 MPa
- Plastic-Based: 7.21 MPa

Both blocks showed a proportional decrease in strength due to lower binder content. The plastic-based block experienced a sharper decline, indicating its higher sensitivity to aggregate-binder balance.

3. 1:3 Composition

- Conventional: 28.17 MPa
- Plastic-Based: 5.08 MPa

Here, the performance gap widened significantly. Excessive sand volume in plastic mixtures weakened structural cohesion, reinforcing the need for a balanced ratio.

These results validate earlier research (Minde et al., 2024; Mustakim et al., 2023) emphasizing that optimal plastic content is critical for strength retention. While conventional paving blocks remain superior in terms of load resistance, plastic-based variants offer lightweight and eco-friendly alternatives with acceptable mechanical performance for low-stress applications.

Performance Classification According to SNI

To evaluate practical applicability, paving blocks were classified under the SNI 03-0691-1996 standard:

- Class B (≥ 20 MPa):
Suitable for parking lots and areas with moderate vehicle traffic. Met only by conventional blocks in all three compositions.
- Class D (≥ 5 MPa):
Suitable for sidewalks, pedestrian paths, and garden pavements. Achieved by all plastic-based blocks, with the 1:1 and 1:2 variants performing significantly above the minimum threshold.

This classification supports the feasibility of deploying plastic waste-based blocks in non-load-bearing or light-use urban applications. Moreover, their lower weight—typically 30–50% lighter than cement-based blocks—offers advantages in transport, installation, and structural load considerations, as supported by Khaq & Damara (2024) and Bagas (2024).

Visual Observation and Structural Integrity

Beyond numerical performance, the physical inspection of the blocks revealed distinct material characteristics:

- Surface Texture: Plastic-based blocks had smoother, glossier surfaces compared to the matte finish of conventional blocks. This suggests denser surface compaction due to molten plastic binding.
- Porosity: Increased sand content (in 1:3 ratio) led to visible pores and surface cracks in plastic-based samples, affirming reduced interparticle bonding.
- Weight: Plastic-based blocks were noticeably lighter—an average reduction of 35% compared to conventional blocks—making them attractive for low-load modular construction.

These visual and tactile indicators provide qualitative support for the compressive strength data and reinforce the mechanical interpretations of mix behavior.

DISCUSSION

The findings from this study reveal several critical insights into the potential application of plastic waste as a primary binder material in paving block production. While the compressive strength of plastic waste-based paving blocks was lower than that of conventional cement-sand blocks, the 1:1 plastic-to-sand composition demonstrated sufficient strength for non-structural purposes, suggesting that plastic waste can be considered a viable material in sustainable construction, particularly for low-load applications.

The decline in compressive strength across increasing sand proportions in plastic-based blocks (from 9.84 MPa at 1:1 to 5.08 MPa at 1:3) highlights the material's sensitivity to aggregate volume. This inverse relationship indicates that excess sand weakens the matrix by reducing the amount of molten plastic available to encapsulate and bond the sand particles, leading to internal voids and weaker interfacial adhesion. This behavior is consistent with prior research, such as Springer (2023), which emphasized the importance of optimizing binder-aggregate ratios to achieve maximum strength in plastic-derived composites.

In contrast, conventional paving blocks retained high compressive strength across all ratios, achieving Class B performance in all cases. This is attributed to the chemical hydration process of cement, which forms a strong crystalline structure that binds aggregates efficiently. The ability of conventional blocks to maintain structural performance even at higher sand content underscores their reliability for medium to heavy load applications. However, this comes at a significant environmental cost, as the production of Portland cement is responsible for approximately 8% of global CO₂ emissions – a concern that plastic-based blocks aim to address (Minde et al., 2024).

From a sustainability perspective, the utilization of plastic waste in construction aligns with the principles of the circular economy. It diverts waste from landfills and natural environments while reducing the demand for virgin construction materials. As noted by MDPI (2023), using PET in road paver blocks not only helps manage waste streams but also lowers the environmental footprint of construction projects. In the context of Indonesia's archipelagic regions, where waste management systems are limited and plastic pollution is acute, such innovations are particularly impactful.

Moreover, the reduced weight of plastic-based blocks (35% lighter on average) presents practical benefits in terms of transportation, manual handling, and overall structural load. These features make them suitable for modular designs, temporary installations, or use in locations with poor access to heavy machinery. Their non-porous surface and low water absorption, as observed in studies like Mustakim et al. (2023), also enhance their durability in humid and coastal environments, which is critical in tropical climates like South Sulawesi.

Despite these advantages, there are notable limitations. The mechanical performance of plastic blocks, even at optimal ratios, does not yet match the strength required for high-load-bearing infrastructure. While the 1:1 composition met Class D standards under SNI 03-0691-1996, its application remains restricted to pathways, gardens, and light foot traffic areas. *Frontiers in Built Environment* (2023) cautioned that long-term behavior, such as plastic leaching, UV

degradation, and fire resistance, must be thoroughly evaluated before mainstream adoption.

The production process also introduces technical and logistical challenges. Melting plastic at 160–180°C requires controlled environments and safety protocols to prevent toxic fume exposure and maintain uniform temperature. Ensuring homogenous mixing, avoiding premature solidification, and achieving consistent compaction are additional operational hurdles that may limit scalability without appropriate infrastructure.

Another concern involves material consistency. Post-consumer plastics often contain a mix of polymer types, contaminants, and dyes, which can interfere with bonding and introduce variability in mechanical properties. Although this study used pre-sorted LDPE, HDPE, and PET plastics, in real-world settings, waste sorting and quality control remain major bottlenecks in achieving reproducible results, as highlighted by ScienceDirect (2023).

Nevertheless, this study offers significant implications for waste valorization and sustainable construction. It demonstrates that even in low-resource environments, plastic waste can be transformed into useful products through relatively simple processes. For municipalities and coastal communities struggling with waste management, decentralized micro-factories producing paving blocks from local plastic waste could provide employment, improve infrastructure, and reduce environmental burden simultaneously.

Future research should explore methods to improve the strength of plastic composites, such as incorporating natural fibers (e.g., coconut husk, jute), mineral fillers, or coupling agents to enhance interfacial bonding. Investigating hybrid formulations that use small percentages of cement or other binders may also help bridge the performance gap while maintaining environmental benefits. Long-term field testing, environmental risk assessments, and lifecycle analyses are needed to validate the performance and safety of plastic-based paving blocks under diverse climatic and operational conditions.

In conclusion, while plastic waste paving blocks cannot yet replace conventional blocks in all contexts, they represent a promising and environmentally responsible alternative for specific applications. Their use contributes to circular construction, offers localized solutions to waste problems, and fosters innovation in sustainable material development. With continued research and optimization, this technology can evolve into a mainstream component of eco-friendly infrastructure.

CONCLUSIONS AND RECOMENDATIONS

This study explored the potential of utilizing plastic waste (PET, HDPE, and LDPE) in combination with local Pinrang sand to produce environmentally friendly paving blocks through a thermomechanical process. The results showed that while plastic-based paving blocks demonstrated lower compressive strength compared to conventional cement-based ones, they still fulfilled the minimum standard requirements (SNI 03-0691-1996) for light-duty applications. The optimal mixture was found at a 1:1 plastic-to-sand ratio, achieving an average compressive strength of 9.84 MPa and meeting Class D specifications. Conventional paving blocks maintained superior strength, reaching up to 34.80 MPa and qualifying for Class B use. Despite lower mechanical performance, plastic waste blocks offer significant advantages in sustainability, weight reduction, and waste valorization. This research contributes to the growing body of knowledge on alternative construction materials and highlights a practical solution for reducing plastic pollution in coastal and rural settings. Future improvements could expand their application range and enhance their structural reliability.

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