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RECYCLED PLASTICS IN CONSTRUCTION: A PATHWAY TO SUSTAINABLE INFRASTRUCTURE

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Abstract
In the present day, the production and disposal of plastic waste pose significant environmental challenges, motivating researchers to explore solutions that will reduce their impact on the environment, including the incorporation of recycled plastics into construction materials. This review paper presents a comprehensive review of the current state of research on the use of recycled plastics in construction, with a particular focus on their use in concrete and other cementitious composites being the focus of this study. As a result of the integration of recycled plastics, there are not only benefits in terms of waste management, but also in terms of material properties and environmental sustainability, as well. In a variety of studies, recycled plastics have been shown to be suitable for use as aggregates or fibers in concrete, affecting properties such as strength, durability, and thermal stability as a result. It was found that a lot of information had been published which categorizes the literature in terms of the type of plastic used and its impact on the mechanical and physical properties of construction materials. In addition, the paper discusses the limitations and future prospects of using recycled plastics in construction, emphasizing the need for further research in order to optimize material performance and ensure long-term sustainability as well. The purpose of this comprehensive review is to provide insight into the potential of recycled plastics as a viable alternative in the construction industry, thereby contributing to the conservation of the environment and the efficient use of resources.
Keywords: Plastic waste, Recycled plastics in construction, Composites, sustainability, Physical properties.

1. INTRODUCTION

The significant environmental complication in the World is elevating amount of PW (plastic waste) generated and their subsequent disposal (Kibria et al., 2023). It is produced in the seas, landfills as well as terrestrial ecosystems. It is distinguished through durability and resistant towards deterioration in the real-word settings. It resulted in the chain reaction and generated negative impacts on the ecological integrity of human health and wild life (Dahiya et al., n.d.). It becomes worse by the sheer quantity of plastic usage. It is powered by adaptability, affordability and their extensive applications in the diverse firms. Also, it signifies the requirements of sustainable as well as innovative strategies for waste management (Alaghemandi, 2024). This necessity encourages both firms as well as researchers to evaluate the alternative strategies that minimize the environmental impact of PW. It maximizes the potential usage of PW as a resource.

The recycled plastics possess beneficiaries of both waste minimisation as well as resource conservation (Cudzik & Kropisz, 2024). The construction sector is a chief industry that utilises numerous raw materials and acts as a major contributor for the environmental degradation. Hence,

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there is an emerging demand for the environmental sustainability and carbon emission reduction (Sizirici et al., 2021). The energy-intensive nature of building materials like concrete and cement, coupled with their dependence on natural resources for production and raises questions about environmental sustainability in the long run. The use of recycled plastics in building materials can decrease the sector's reliance on unrefined resources, lower energy consumption, and reduce its contribution to greenhouse gas emissions (Chen et al., 2024).

An overview is provided of the booming construction market in which recycled plastics play an important role with a particular focus on their use in concrete as well as other cement-based composites. In the contemporary construction industry, concrete is one of the most commonly used building materials. Concrete consists mainly of cement, aggregates, water, and additives, depending on the use. In recent years, there has been an increasing amount of interest in the use of recycled plastics as replacement materials for some or all of the traditional aggregates or as reinforcing fibers within construction materials.

The integration of recycled plastics into concrete addresses numerous challenges and elevates the material performance concurrently (Hamada et al., 2024). The recycling plastics can be utilised to minimise the demand for raw resources in the construction sector. It replaces conventional aggregates such as gravel and sand and keep PW from landfill. The plastic fibers are mixed into concrete mixture to elevate durability and tensile strength and minimises cracking. It is observed to be less expensive compared to prevailing steel reinforcement (Khaleel et al., 2024).

Moreover, the prevailing works on recycled plastics utilised in the construction sector is diverse and encompasses wide research. This study evaluates the effect of plastics on the physical, chemical and mechanical properties of construction debris in order to determine what role plastics play. As part of conventional research, PVC (polyvinyl chloride), PET (polyethylene terephthalate), PE (polyethylene), PP (polypropylene), and other recycled plastics have been examined as possible materials to be used in concrete. Additionally, it comprises PW impact on flexural strength, compressive strength, durability, thermal conductivity, and other critical performance characteristics (Bhagat & Savoikar, 2022). The studies have enumerated the opportunities as well as challenges that necessitates upcoming research on optimisation of material composition and thereby ensuring long term stability in structural characteristic.
Therefore, the review study aims to explore the current research on the recycled plastic utilisation in the construction industry. Its categories the research works on the basis of plastics used, incorporation methods and its impact on the physical as well as chemical characteristics. It integrates results from other studies by highlighting likely benefits, drawbacks and gaps in knowledge within the field. It also discusses the environmental and economic effects of using recycled plastics in construction, including energy usage versus greenhouse gas emissions and cost reduction.

2. BACKGROUND

The unprecedented build-up of PW caused by the global increase in plastic production over the past few decades has resulted in a serious environmental crisis. Plastics are now widely used in consumer goods, packaging, and industrial settings due to their strength, affordability, and versatility (Babaremu et al., 2023). However, the same characteristics that make plastics so advantageous also help to explain why they can endure centuries in the environment without experiencing significant degradation. It is due to the linear "take-make-dispose" model of plastic consumption that contaminated ecosystems, overflowing landfills, and polluted oceans pose major threats to human health, wildlife, and the ecological balance of our planet (Panigrahi & Dash,

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2022).

Increasingly, the building industry is being pressured to reduce its environmental impact and become more sustainable, as it consumes a great deal of raw materials and generates a lot of waste. Metals, concrete, and wood, which are traditionally used as building materials, require significant energy for their extraction, processing, and transportation, resulting in resource depletion and greenhouse gas emissions (Mehra et al., 2022).

The researchers have evaluated the utilization of recycled PW in the construction process as a step towards the reduction of wastages. It guarantees the environmental sustainability for resolving complications. The recycled PW have emerged as a favorable strategy, delivering the method to eradicate PW from landfill and converting them into suitable building debris (Yao et al., 2022). The conventional literatures on the recycled PW in the building materials begun at 1990 (Wang, 2023). The awareness of the PW beneficiary in the construction sector has grown in the field of material science. Researchers have been exploring the possibilities of recycling plastics to use them as aggregates, fibers, or additives in concrete, asphalt, and various other construction materials (Lamba et al., 2022).
Plastic recycling entails a number of procedures, such as gathering waste from the manufacturing or disposal site, sorting, compressing, crushing, and pelletizing it into basic materials. Following these steps, the finished product is processed mechanically, chemically, or thermally (Hahladakis & Iacovidou, 2019). The first step in recycling plastic trash chemically, thermally, or mechanically is automated sorting utilizing methods like spectroscopy, infrared, fluorescence, flotation, and electrostatics (Awoyera & Adesina, 2020).

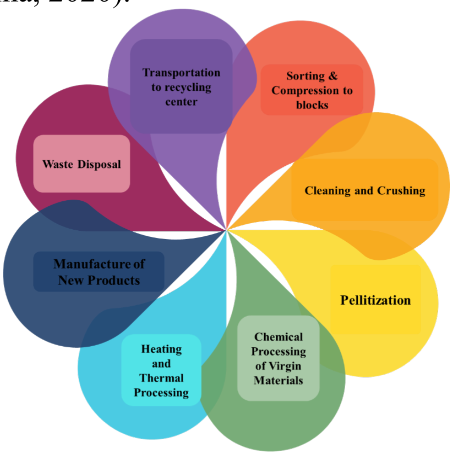

FIGURE 1. Recycling of plastic (Nyika & Dinka, 2022)

During mechanical recycling, PW is broken down by shredding and grinding (Buckshumiyan et al., 2023). However, if the trash composition is complex, incineration is preferred, and the procedure is not (Khoo, 2019). PWs undergo chemical recycling, where they are broken down into monomers or shorter chains and transformed into virgin raw materials for new product creation. Thermal procedures include melting PW at high temperatures and then remanufacturing new items using the resulting mould. The steps involved in recycling plastics are outlined in Fig. 1.

[1]. Although the incorporation of recycled plastic into construction materials holds a great many potential advantages, challenges exist in material performance, durability, and cost. The physical properties of recycled plastics also differ based on the plastic type, waste source, and processes utilized. Long-term performance and environmental implications of recycled plastic construction materials also need to be explored. In spite of these difficulties, the future of recycled plastics in shaping the construction sector is promising. By encouraging the use of recycled plastics in

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construction, the sector can decouple its dependence on virgin materials, lessen its contribution towards waste generation, and support a more sustainable and circular economy.

3. THE USE OF RECYCLED PLASTIC IN CONSTRUCTION

Thermosets and thermoplastics are the primary classification systems for plastics, which can be remolded to their original form after being exposed to heat (Desidery & Lanotte, 2022), but some hard PW categories have been given recycling opportunities. The list of substances that can be found includes PVC, PS, PP, PET, and HDPE. In their study on the recyclability potential of PWs, Eriksen and Astrup (2019) found that their features have an impact on technological developments. PET was the least sorted and PVC easily accessible. PVC had a lower recycling capacity than PET, PS and HDPE, while PET had the lowest relative to these materials in terms of ability to recycle properly.

Materials for construction and building can be made from plastic trash. According to Jawaid et al. (2023), these developments are more environmentally friendly ways to handle trash. Based on current empirical research, different applications of PW in the building and construction industry are examined in this context. Furthermore, attention is drawn to the particular PWs and how they are processed. Bricks, tiles, and blocks have been made from a variety of PWs (Tawab et al., 2020). To increase the finished product's strength, the polymers are combined in several proportions with new building constituents such foundry sand, recycled glass, clayey sand, and construction and destruction waste.

In the construction industry, plastics can be used solely to manufacture different types of building materials. The PWs are used in a number of different contexts in which they can be utilized as a range of materials, and not only as sand or cement, but as aggregates and additives as well. In order to quantify the quality of the product, a range of analyses are performed, including tests on the thermal conductivity, tensile strength, durability, bulk density and soundness of the product, as well as comparisons with products that do not contain PW. With the use of plastics for the production of tiles, blocks, and bricks, they achieve superior compressive strength and condensed thermal conductivity, which makes them excellent materials for the construction of buildings and other structures (Mohan et al., 2021). The discovery of the recycling of PW instead of its disposal led to the development of bricks that are long lasting and resilient as a result of being recycled instead of being disposed of.

Recent studies underscore significant progress in the valorization of plastic waste for construction applications. Alaghemandi (2024) reviewed mechanical and chemical recycling techniques, identifying advanced pyrolysis and solvolysis processes that enhance the recyclability of complex plastic waste streams. These technologies not only improve material purity but also reduce energy consumption compared to traditional recycling.

Hamada et al. (2024) demonstrated that incorporating shredded plastic waste into concrete as partial aggregate replacement improved tensile and impact resistance, while reducing concrete density. Similarly, Khaleel et al. (2024) noted that plastic inclusion alters the microstructure of concrete, potentially improving crack resistance under cyclic loading.

Cudzik and Kropisz (2024) proposed the use of post-consumer packaging waste in architectural elements, highlighting the aesthetic and functional properties of composite panels. Their case studies revealed good thermal insulation and load-bearing capabilities. Bhagat and Savoikar (2022) confirmed the enhancement of mechanical performance in thermoplastic-modified cement composites, particularly with controlled particle sizing and surface treatment.

Yao et al. (2022) conducted a life cycle assessment (LCA) comparing conventional and plastic-modified pavements, revealing a 30% reduction in greenhouse gas emissions and significant energy savings. Khoo (2019) corroborated these findings in a Singaporean context, quantifying environmental trade-offs between energy recovery and material recycling.

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Table 1. Application of recycled plastic in construction

Material	Applications	Key finding
Plastic Lumber (Breslin et al., 1998)	Decking, fencing, boardwalks, landscaping	Resistant to decay, insects, and weathering. Low maintenance
Plastic Concrete (Almohana et al., 2022)	Pavements, road construction, and building foundations	Improved durability, reduced carbon footprint.
Recycled Plastic Insulation (Liu et al., 2024)	Insulation for buildings, roofing, and walls.	Lightweight, easy to install, and environmentally friendly.
Plastic Tiles (Ahmed & Ali, 2023)	Flooring, interior walls, and exterior cladding.	Durable, easy to maintain, water-resistant, economical
Recycled Plastic Roof Shingles (Thomas et al., n.d.)	Roofing, especially in residential buildings.	Lightweight, resistant to weather, and easy to install.
Plastic Bricks (Kulkarni et al., 2022)	Wall construction, low-cost housing, and urban developments.	Lightweight, durable, and water-resistant.
Recycled Plastic Aggregates (Hamada et al., 2024)	Concrete structures, pavements, precast elements.	Increased tensile and impact strength
Plastic-Modified Concrete (Khaleel et al., 2024)	Structural concrete in dynamic load environments.	Better crack resistance in concrete
Thermoplastic Cement Composites (Bhagat & Savoikar, 2022)	Load-bearing panels, structural blocks, prefabricated parts.	Improved strength with modification
Composite	Facades,	Aesthetic,

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Panels from Packaging Waste (Cudzik & Kropisz, 2024)	partitions, decorative panels.	insulating, strong panels
Plastic-Modified Pavement (Yao et al., 2022)	Road surfacing, pathways, eco-paving.	30% GHG cut and energy savings
Advanced Recycling-Based Plastics (Alaghemandi, 2024)	Feedstock for high-performance plastic building products	Efficient, high-purity plastic reuse
Plastic Waste LCA Comparison (Khoo, 2019)	Strategic planning for construction recycling processes.	Balanced LCA for recycling options

There are different types of PW that are commonly employed in the production of concrete and are used as a total or partial replacement of aggregate in the construction of roads. As a matter of fact, plastic is also used in the manufacture of fillers and modified bitumen, which are commonly used in the construction of the sub-base and base layers of pavements (Karmakar & Roy, 2021). These pavement types improve their curb appeal, durability, and appearance by improving the role they play in road construction and maintenance. The PW are capable of generating acceptable performance during the construction phase, as they possess resilience modulus, flexibility, as well as other physical properties that far exceed the characteristics of conventional road building materials. The smoothness and bearing capacity are among their best features. As a result of improving the quality of the road surface and the service lifecycle of the road, the disposal of plastic waste can enhance the result of both metric and mechanical characteristics of the road during construction.

Waste plastic has been used to make walling, insulation, door panels, and other building and construction materials, as well as to replace wood (Agarwal & Gupta, 2017). Similar to wood, recycled mixed plastics can be sawn, cut, and nailed for a variety of wood-like applications, including railroad tying, boat docks, benches, and fencing (Cui et al., 2008). Eco-friendly door panels can be made by combining plastic waste pellets or powder with cellulose fiber or wood flour to create a thermo formable wood-plastic matrix. Expanded PS is one type of plastic waste that can be used in construction to create more environmentally friendly insulation materials. In order to create the insulation material, plastic waste is sorted, cleaned, and put through physical and thermochemical processes.

To create the insulation materials, PS can be covered with additional materials like sawdust and leftover PVC. In addition to protecting the environment by lowering the manufacturing costs of such insulation materials, using such wastes lowers their cost (Kalla et al., 2018). However, because of its low density and high flammability and combustibility, the use of such plastic waste for

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insulation is restricted. Recycled plastics can be heated, molded, and compressed into blocks that can be used to partition homes in place of traditional brick and wood walls. In soil reinforcement, plastic wastes have been used to make geogrids and geocells among other geosynthetics with significant strength and at low costs (Palmeira et al., 2021). For example, PET bottles have been utilized as a drainage medium for geotextile filters.

Table 2. PW in road construction (Nyika & Dinka, 2022)

PW	Content of plastic	Significant role
HDPE	0-10%	Aggregate
PET	1-10%	Sand
PP	0-2%	Coarse aggregates
LDPE	0-50%	Sand
PE	5-11%	Binder

4. BENEFITS OF USING RECYCLED PLASTICS

PWs as combinations and ring binder are part of cementitious mixtures when blended with further waste materials (Babatunde et al., 2022). The waste constituents consist of rice husk ash, silica fume, recycled concrete and fly ash. Instinctively recycled plastics blended with these ingredients possess in elevation hardness and stability and can be used as good possessions of cementitious mixtures. The produces are bricks, tiles, blocks and road building resources like plasters and blacktop. In employing PWs by way of aggregates as well as fillers, there is no relevance to the chemical composition of wastes as hydration processes remain unchanged. Resins, PLA, PVC, PS, PET, HDPE, PP and LDPE are some of the plastics employed in the production of cementitious composites and they play two functions (Acuña-Pizano et al., 2022). They can either replace natural aggregates or act as reinforcement materials in concrete by their fibers.

Many plastic layers of equivalent weight and volume are used in direct volume replacement, a method that is commonly used to make cementitious composites (El-Seidy et al., 2023). The utilization of PW as cementitious composite materials results in decreased demand for mining natural aggregates and reduced deadweight due to their lightweight nature. PW from composite materials often decreases the durability of concrete (Sau et al., 2024). Awoyera and Adesina provide a comprehensive account of the outcomes of using PWs as adhesives in mixtures (Ikelle et al., 2023). Considerable factors such as slump, air contented, penetrability, sturdiness, mechanical and compressive strength are evaluated after the use of these trashes.

Table 3. Plastic usage in cementitious composites (Awoyera & Adesina, 2020)

PW	Content of plastic	Significant role
Concrete	PET and PS	10-20% of sand
Lightweight concrete	LDPE	5-30% of fine aggregates
Mortar	PET	30-70% of fine aggregates
Concrete	HDPE and PET	40% of fine aggregates
Mortar	PET and PC	50% of fine aggregates
Concrete	PW mixture	10% of fine aggregates
Mortar	PVC	50% of sand
Plastic	HDPE	80% of sand

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cement		
Lightweight Concrete	PP	50% of sand
Concrete	LDPE	0.4-1% of fine aggregates

The use of PW in construction and building has been commended for its ability to substitute natural materials, lessen industrialized costs, and safeguard the atmosphere from toxic waste (Blaifi et al., 2023). Among the advantages of PW are its light, waterproof nature and its high strength, which make it a durable material suitable for building and construction materials (Ikechukwu & Naghizadeh, 2022). PWs are associated with certain property changes in building and construction products compared to traditional materials (Ahmed, 2023). PET asphalt production was connected to greater fracture resilience than conventional asphalt (Baradaran et al., 2024). PWs can enhance the durability of base and sub-base and mortar by improving their mechanical properties.

In other researches, the plastics are contaminants that lower the thermal conductivity and compressive strength of the resulting mixtures leading to decreased resilience and low-quality yields (Akter et al., 2024). Thus, the results on PWs in buildings and construction materials in terms of sturdiness give mixed findings. The life cycle valuation of PWs versus traditional building materials indicates that the former possesses cost-effective advantages. This proposal may be due to lowered transference, energy, landfill dumping and production of new resources budgets that render PWs reprocessing feasible against the utilization of regular material (Alqahtani et al., 2021). The processes involved in reprocessing the wastes need to be assessed for a cost-benefit examination against processing or regular buildings and constructions material. This life sequence costing might minimize costs related to gathering and categorization of PWs that increase the cost of reprocessing.

5. MATERIAL CHARACTERISTICS AND ENVIRONMENTAL SUSTAINABILITY

Material properties of plastic-modified composites depend on polymer type, size distribution, and matrix compatibility. PET and HDPE are favored for their chemical stability, tensile strength, and thermal resistance. Functional performance can be improved through surface modification (e.g., plasma treatment, compatibilizers) to enhance interfacial bonding with cementitious materials (Jawaid et al., 2023).

Table 4. Material Properties of Common Recycled Plastics Used in Construction

Polymer Type	Key Properties	Common Applications
PET	High tensile strength, good thermal stability	Bitumen modification, insulation
HDPE	Chemical resistance, toughness	Geosynthetics, pipes
LDPE	Flexibility, moisture resistance	Bitumen, filler in composites
PP	High melting point, lightweight	Drainage systems, panels

Environmental sustainability assessments emphasize the importance of circular economy integration. Wang (2023) and Hamada et al. (2024) revealed that plastic-enhanced materials reduce lifecycle GHG emissions and improve construction waste management. Panigrahi & Dash (2022) argue that circular design strategies—such as modular construction and product reuse—further improve systemic efficiency.

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6. CHALLENGES AND LIMITATION

The chief limitations related with the PW utilization for construction sector are elaborately discussed below (Zulkernain et al., 2021):

- The biggest constraints to the utilization of PW is its reaping prior to recycling. These are generally polluted with other forms of plastics when they are gathered from differential streams in the production phase.
- Although in certain constructions low-density materials have an advantage. PWs renders it inconvenient in uses requiring high toughness as well as elasticity modulus. These characteristics also hikes its expense of transportation as the PW needs to be broken down to smaller sizes in order to make it fit in the available area.
- Unlike construction materials like steel, PW consist of various grades of plastic which may lead to a non-isotropic enactment upon the application for building work. Also, the multi-phase makeup of certain plastics like EPS renders the traditional recycling processes not viable for reuse by these types of plastics hence leading to these forms of plastics being dumped to waste and finding their way into places like the marine environment.
- The low surface energy of PW resulted in their incorporation into a composite can cause poor mechanical bonding. The composite's overall mechanical performance can be negatively impacted by poor bonding.
- Contractors' acceptance and use of PW for construction projects have been hindered by the limited understanding of its long-term benefits in relation to recycled plastic.
- Presently, there is no regulation that endorses the PW utilisation in construction industries. Although there have been extensive studies on construction applications, commercial standards are not yet uniformly developed.
- The cost of recycling plastic requires advanced technology, which is currently prohibitive, and this poses challenges for some materials.

7. FUTURE RECOMMENDATION

Clearly, PW has been proved to be a defensible additive as well as partial auxiliary of traditional construction debris. It resolves the dual complications of PW and aids in the footprints minimization caused by construction sectors. Though, a sustainable pathway is ahead prior to the commercial execution of the objective. Several researches are necessitates for the evaluation of opportunities as well as challenges of PW.

Some of the problems to be solved for execution and for further research are:

- Optimal ratios of PW as a component of building materials are needed.
- Safe sanitization processes of PW in order to remove the possible contaminants.
- Public awareness campaigns to inform regarding the environmental as well as economic benefits of PW construction debris are needed for the customer acceptance as well as public at large.
- Carbon life cycle analysis to strengthen the argument for sustainability.

8. CONCLUSION

By using recycled plastics in the construction of buildings, we can contribute to sustainability by reducing our resource consumption and addressing environmental concerns. Numerous uses of this material are mentioned in the literature, such as road construction, insulation materials, structural components, and concrete infused with plastic. It is evident from all these applications that they exhibit excellent durability, cost-effectiveness, as well as thermal properties. In addition to this, the building industry's carbon footprint is also reduced by using recycled plastics, which reduces the amount of plastic that is thrown away, thus reducing the amount of waste generated. Consequently, in order to properly manage these PWs and improve the environment, it is possible to use them for different construction uses. The current study on the utilization of recycled PW for construction has

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been extensively assessed. Based on the results of the study, we can draw the inference that by implementing PW in construction, both the solid waste management issue as well as the subject of exhausting raw materials reserves will be solved. A further advantage of the use of PW in differential construction scenarios is that it supports a circular economy's trend toward sustainable development. The PW can act as a substitute for numerous components in cementitious composites, with a relatively low adverse effect on the performance of the composite when compared to the original component. The utilization of PW in different construction applications will result in diverse revenue streams.

REFERENCES

1. Kibria, M. G., Masuk, N. I., Safayet, R., Nguyen, H. Q., & Mourshed, M. (2023). Plastic waste: Challenges and opportunities to mitigate pollution and effective management. International Journal of Environmental Research, 17(1), 20.
2. Dahiya, A., Kumar, D. Y., Kumar, S. S., Pandey, A. K., & Devi, C. A. (n.d.). Plastic pollution is a serious menace to ecosystem health with special reference to aquatic ecosystems and its associated challenges, opportunities, and mitigations. Aquatic Ecosystems Monitoring, 279–294.
3. Alaghemandi, M. (2024). Sustainable solutions through innovative plastic waste recycling technologies. Sustainability, 16, 10401.
4. Cudzik, J., & Kropisz, K. (2024). Assessment of utilizing hard-to-recycle plastic waste from the packaging sector in architectural design—Case study for experimental building material. Sustainability, 16, 6133.
5. Sizirici, B., Fseha, Y., Cho, C.-S., Yildiz, I., & Byon, Y.-J. (2021). A review of carbon footprint reduction in construction industry, from design to operation. Materials, 14, 6094.
6. Chen, L., Yang, M., Chen, Z., Xie, Z., Huang, L., Osman, A. I., ... & Wu, C. (2024). Conversion of waste into sustainable construction materials: A review of recent developments and prospects. Materials Today Sustainability, 100930.
7. Hamada, H. M., Al-Attar, A., Abed, F., Beddu, S., Humada, A. M., Majdi, A., ... & Tayeh, B. A. (2024). Enhancing sustainability in concrete construction: A comprehensive review of plastic waste as an aggregate material. Sustainable Materials and Technologies, 40, e00877.
8. Khaleel, Y. U., Qubad, S. D., Mohammed, A. S., & Faraj, R. H. (2024). Reinventing concrete: A comprehensive review of mechanical strength with recycled plastic waste integration. Journal of Building Pathology and Rehabilitation, 9, 111.
9. Bhagat, G. V., & Savoikar, P. P. (2022). Durability related properties of cement composites containing thermoplastic aggregates–A review. Journal of Building Engineering, 53, 104565.
10. Babaremu, K., Oladijo, O. P., & Akinlabi, E. (2023). Biopolymers: A suitable replacement for plastics in product packaging. Advanced Industrial and Engineering Polymer Research, 6, 333–340.
11. Panigrahi, B., & Dash, A. K. (2022). Sustainable management for reduction of plastic waste through circular economy. In Sustainable Management of Urban Plastic Waste Through Circular Economic Approaches (pp. 83–103). CRC Press.
12. Mehra, S., Singh, M., Sharma, G., Kumar, S., Navishi, & Chadha, P. (2022). Impact of construction material on environment. In Ecological and Health Effects of Building Materials (pp. 427–442).
13. Yao, L., Leng, Z., Lan, J., Chen, R., & Jiang, J. (2022). Environmental and economic assessment of collective recycling waste plastic and reclaimed asphalt pavement into pavement construction: A case study in Hong Kong. Journal of Cleaner Production, 336, 130405.
14. Wang, Z. H. (2023). A survey of factors and life cycle assessment in selection of green construction materials. Journal of Computational Intelligence in Materials Science, 1, 023–033.

DOI:10.46647/ijetms.2025.v09i03.019 ISSN: 2581-4621

15. Lamba, P., Kaur, D. P., Raj, S., & Sorout, J. (2022). Recycling/reuse of plastic waste as construction material for sustainable development: A review. Environmental Science and Pollution Research, 29, 86156–86179.
16. Hahladakis, J. N., & Iacovidou, E. (2019). An overview of the challenges and trade-offs in closing the loop of post-consumer plastic waste (PCPW): Focus on recycling. Journal of Hazardous Materials, 380, 120887.
17. Awoyera, P. O., & Adesina, A. (2020). Plastic wastes to construction products: Status, limitations and future perspective. Case Studies in Construction Materials, 12, e00330.
18. Nyika, J., & Dinka, M. (2022). Recycling plastic waste materials for building and construction materials: A mini-review. Materials Today: Proceedings, 62, 3257–3262.
19. Buckshumiyan, A., Babu, S. S., Prakash, M., & Arasu, G. A. (2023). Recycling of plastic wastage by die shredder machine. Materials Today: Proceedings.
20. Khoo, H. H. (2019). LCA of plastic waste recovery into recycled materials, energy and fuels in Singapore. Resources, Conservation and Recycling, 145, 67–77.
21. Desidery, L., & Lanotte, M. (2022). Polymers and plastics: Types, properties, and manufacturing. In Plastic Waste for Sustainable Asphalt Roads (pp. 3–28). Elsevier.
22. Faraca, G., & Astrup, T. (2019). Plastic waste from recycling centres: Characterisation and evaluation of plastic recyclability. Waste Management, 95, 388–398.
23. Jawaid, M., Singh, B., Kian, L. K., Zaki, S. A., & Radzi, A. (2023). Processing techniques on plastic waste materials for construction and building applications. Current Opinion in Green and Sustainable Chemistry, 40, 100761.
24. Abdel Tawab, O., Amin, M., Ibrahim, M., Abdel Wahab, M., Abd El Rahman, E., Hassanein, R., ... & El-Badawy, S. (2020). Recycling waste plastic bags as a replacement for cement in production of building bricks and concrete blocks. Journal of Waste Resources and Recycling, 1, 202.
25. Mohan, H. T., Jayanarayanan, K., & Mini, K. (2021). Recent trends in utilization of plastics waste composites as construction materials. Construction and Building Materials, 271, 121520.
26. Breslin, V. T., Senturk, U., & Berndt, C. C. (1998). Long-term engineering properties of recycled plastic lumber used in pier construction. Resources, Conservation and Recycling, 23(4), 243–258.
27. Almohana, A. I., Abdulwahid, M. Y., Galobardes, I., Mushtaq, J., & Almojil, S. F. (2022). Producing sustainable concrete with plastic waste: A review. Environmental Challenges, 9, 100626.
28. Liu, Y., Zhao, Q., Gu, X., Fan, A., Zhu, S., Su, Q., ... & Feng, L. (2024). Research on the application of new building recycled insulation materials for walls. Polymers, 16(15), 2122.
29. Ahmed, S., & Ali, M. (2023). Potential applications of different forms of recycled plastics as construction materials—A review. Engineering Proceedings, 53(1), 5.
30. Thomas, V. A., Pallavi, K., & Jain, R. (n.d.). Study on the scope of recycled plastic roof tiles in the civil construction market. [Unpublished].
31. Kulkarni, P., Ravekar, V., Rao, P. R., Waigokar, S., & Hingankar, S. (2022). Recycling of waste HDPE and PP plastic in preparation of plastic brick and its mechanical properties. Cleaner Materials, 5, 100113.
32. Karmakar, S., & Roy, T. K. (2021). Influence of plastic waste on chemical and mechanical properties of modified bitumen used in the bituminous mix for flexible pavement. Journal of Materials in Civil Engineering, 33, 04020440.
33. Agarwal, S., & Gupta, R. K. (2017). Plastics in buildings and construction. In Applied Plastics Engineering Handbook (pp. 635–649). Elsevier.
34. Cui, Y., Lee, S., Noruziaan, B., Cheung, M., & Tao, J. (2008). Fabrication and interfacial modification of wood/recycled plastic composite materials. Composites Part A: Applied Science and Manufacturing, 39, 655–661.

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35. Kwarteng, A. K.-L. Jnr., Yunana, D., Kamsouloum, P., Webster, M., Wilson, D. C., & Cheeseman, C. (2018). Recycling waste plastics in developing countries: Use of low-density polyethylene water sachets to form plastic bonded sand blocks. Waste Management, 80, 112–118.
36. Palmeira, E. M., Araújo, G. L., & Santos, E. C. (2021). Sustainable solutions with geosynthetics and alternative construction materials—A review. Sustainability, 13, 12756.
37. Babatunde, Y., Mwero, J., Mutuku, R., Jimoh, Y., & Oguntayo, D. (2022). Influence of material composition on the morphology and engineering properties of waste plastic binder composite for construction purposes. Heliyon, 8.
38. Acuña-Pizano, H., González-Trevizo, M., Luna-León, A., Martínez-Torres, K., & Fernández-Melchor, F. (2022). Plastic composites as sustainable building materials: A thermal and mechanical exploration. Construction and Building Materials, 344, 128083.
39. El-Seidy, E., Chougan, M., Sambucci, M., Al-Kheetan, M. J., Biblioteca, I., Valente, M., ... & Aversa, S. (2023). Lightweight alkali-activated materials and ordinary Portland cement composites using recycled polyvinyl chloride and waste glass aggregates to fully replace natural sand. Construction and Building Materials, 368, 130399.
40. Sau, D., Shiuly, A., & Hazra, T. (2024). Utilization of plastic waste as replacement of natural aggregates in sustainable concrete: Effects on mechanical and durability properties. International Journal of Environmental Science and Technology, 21, 2085–2120.
41. Ikelle, I., Olivia, E., & Ogah, O. A. (2023). Innovations for sustainable plastic waste management in Nigeria. Environmental Contaminants Reviews, 6, 66–74.
42. Blaifi, H., Guendouz, M., Belhadj, A.-E., Boukhelkhal, D., & Hadjadj, M. (2023). Sustainable use of recycled plastic and ceramic industrial wastes in eco-friendly construction materials. Environmental Engineering & Management Journal (EEMJ), 22.
43. Ikechukwu, A. F., & Naghizadeh, A. (2022). Utilization of plastic waste material in masonry bricks production towards strength, durability and environmental sustainability. Journal of Sustainable Architecture and Civil Engineering, 30, 121–141.
44. Ahmed, N. (2023). Utilizing plastic waste in the building and construction industry: A pathway towards the circular economy. Construction and Building Materials, 383, 131311.
45. Baradaran, S., Aliha, M., Maleki, A., & Underwood, B. S. (2024). Fracture properties of asphalt mixtures containing high content of reclaimed asphalt pavement (RAP) and eco-friendly PET additive at low temperature. Construction and Building Materials, 449, 138426.
46. Akter, M., Uddin, M. H., & Anik, H. R. (2024). Plant fiber-reinforced polymer composites: A review on modification, fabrication, properties, and applications. Polymer Bulletin, 81, 1–85.
47. Alqahtani, F. K., Abotaleb, I. S., & ElMenshawy, M. (2021). Life cycle cost analysis of lightweight green concrete utilizing recycled plastic aggregates. Journal of Building Engineering, 40, 102670.
48. Zulkernain, N. H., Gani, P., Chuan, N. C., & Uvarajan, T. (2021). Utilisation of plastic waste as aggregate in construction materials: A review. Construction and Building Materials, 296, 123669.