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# Comparative Analysis of Flame Resistant Plastic Tiles with Conventional Tiles

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**ABSTRACT:** This project investigates the viability and benefits of incorporating recycled plastic into the production of paver tiles, offering a sustainable alternative to conventional construction materials. Initially, the study provides an overview of the widespread usage and manufacturing processes of conventional tiles, highlighting their importance in modern construction projects. It then delves into the rationale behind substituting sand with recycled plastic, emphasizing the environmental advantages and sustainability goals driving this innovative approach.

The methodology section presents a detailed account of the production process, from the meticulous preparation of materials to comprehensive testing procedures. Special attention is given to resource optimization and quality control measures, ensuring the creation of durable and high-performance paver tiles. Through a series of rigorous tests, including assessments of water absorption, fire resistance, and compressive strength, the project evaluates the performance characteristics of paver tiles made from recycled plastic.

The results of these tests reveal promising findings, demonstrating exceptional resistance to water penetration, enhanced fire resistance facilitated by melamine coating, and a notable correlation between plastic content and compressive strength. These outcomes underscore the practicality and efficacy of utilizing recycled plastic in tile production, offering a sustainable solution to material demands in the construction industry while mitigating environmental impact.

In conclusion, this project advocates for the widespread adoption of eco-friendly paver tiles made from recycled plastic, emphasizing their pivotal role in promoting environmental sustainability, reducing waste, and contributing to the establishment of a circular economy within the construction sector. Through innovation and conscientious material choices, the project aims to inspire positive change and foster a more sustainable future for construction practices worldwide.

**KEYWORDS:** Recycled plastic, Paver tiles, Sustainable construction, Environmental impact, Resource optimization, Compressive strength, Fire resistance, Water absorption, Circular economy, Waste reduction

## I. INTRODUCTION

Heat-resistant tiles are specialized materials engineered to withstand extremely high temperatures without compromising their structural integrity. These tiles play a critical role in a wide range of applications, including industrial furnaces, kilns, residential fireplaces, power plants, and even space shuttles. Their ability to endure intense heat makes them indispensable in environments where conventional building materials would deteriorate, crack, or lose their effectiveness.

In addition to their heat resistance, these tiles often provide excellent insulation, helping to maintain temperature stability in various settings. This insulation capability enhances energy efficiency by reducing heat loss, leading to lower energy consumption and cost savings. In industrial applications, heat-resistant tiles contribute to worker safety by minimizing exposure to extreme temperatures, thereby reducing the risk of burns or heat-related accidents.

The composition of heat-resistant tiles is a crucial factor in their effectiveness. These tiles are typically made from ceramics, refractory materials, or specially treated composites that have high melting points and low thermal conductivity. Common materials used in their production include alumina, silica, zirconia, and mullite. Some advanced heat-resistant tiles incorporate nanotechnology to further enhance their thermal performance and durability.

The manufacturing processes of heat-resistant tiles involve precise engineering to ensure their strength and efficiency. Methods such as sintering, high-temperature firing, and plasma coating are used to create tiles with enhanced thermal resistance and longevity. Researchers and engineers continue to develop innovative manufacturing techniques to improve the performance and sustainability of these tiles, exploring environmentally friendly materials and energy-efficient production methods.

Moreover, the performance characteristics of heat-resistant tiles under thermal stress must be carefully analysed to ensure their reliability in extreme conditions. Factors such as thermal expansion, resistance to thermal shock, and mechanical strength play a significant role in determining the suitability of these tiles for different applications. Advanced testing methods, including thermal cycling tests and stress analysis, are employed to assess and optimize their durability.

With rapid advancements in material science, the demand for high-performance heat-resistant tiles is growing across various industries. As modern infrastructure and technology continue to evolve, the need for reliable, long-lasting, and energy-efficient thermal insulation solutions becomes even more critical. This project aims to explore the development, properties, and applications of heat-resistant tiles, shedding light on the latest innovations and their potential impact on industrial and residential sectors.

### Scope of the Project

This project investigates the feasibility of using plastic waste as a partial replacement for sand in the production of concrete tiles. It focuses on assessing the mechanical properties of these modified tiles, including parameters like compressive strength and flexural strength. The study also explores the environmental benefits of utilizing plastic waste in construction, particularly in reducing plastic pollution. A comparative analysis will be conducted to evaluate the performance of plastic-based concrete tiles against conventional ones. Furthermore, the cost-effectiveness of incorporating plastic waste into tile production will be examined. The project will also analyze the effect of varying plastic content, such as 20% and 30%, on the physical and mechanical properties of the tiles. Ultimately, the project aims to develop a sustainable and practical approach for integrating plastic waste into construction materials, supporting eco-friendly development

## II. LITERATURE SURVEY

### 2.1 The Addition Of Plastic Waste In Self-Compacted Concrete: A Critical Review by Mahmoud Bashir Alhasanat, Arabi Al qadi

Several studies have explored the use of waste plastic as a partial replacement for fine or coarse aggregates in concrete. For instance, Ghernouti et al. (2011) experimented with plastic bag waste (PBW) replacing sand at 10%, 20%, 30%, and 40% levels. They found that PBW improved workability and density but reduced compressive strength by 10% to 24% when used at 10–20%. Saikia et al. (2012) highlighted the potential of using recycled plastic in concrete and mortar, noting economic and environmental benefits. They observed that while density, tensile strength, and flexural strength decreased, plastic addition improved permeability and chemical resistance, enhancing durability. Rai et al. conducted tests on concrete samples with and without superplasticizers, measuring compressive and flexural strength over 3, 7, and 28 days. They noted a 10–15% improvement in workability with superplasticizer. However, compressive and flexural strength decreased when plastic was used as a coarse aggregate. A consistent result across studies was that plastic reduces the overall weight of concrete. Interestingly, using plastic waste as fibers (1.5–3%) led to a 15.7% increase in compressive strength, while higher amounts (5%) showed no significant benefit.



**2.2 Different types of plastic tiles use in Real estate By Vinay punde<sup>1</sup>, Pooja Hanmante<sup>2</sup>, Rachana Dhamdhare<sup>3</sup>, Gaurav Roztkar<sup>4</sup>, Rahul sawant**

The main goal of this research is to support environmental decontamination by developing eco-friendly roofing tiles. The specific aim is to create sustainable tiles using waste materials, especially plastic and rubber, which are non-biodegradable and harmful to the environment when burned or dumped in landfills. Traditional clay tiles harm farmland, while plastic and rubber waste keeps increasing every year, adding to environmental issues. By utilizing waste plastic to produce tiles, this method helps reduce environmental stress. Tests on physical and mechanical properties showed that tiles made with 40% plastic content perform better than conventional micro-concrete tiles.

**2.3 Comparative Analysis of Recycled Waste Plastic Tiles and Alumina Ceramic Tiles with ANSYS 15 by A. A. Jimoh<sup>1</sup>, O. L. Tazou<sup>2</sup>, H. T. Kimeng<sup>3</sup> and R. O. Rahmon<sup>4</sup>**

This research compares the structural behavior of recycled waste plastic tiles with conventional alumina ceramic tiles. All plastic materials were processed at a melting point of 60°C with controlled cooling. Flexural and compressive strength tests were conducted using a universal testing machine. A 300 x 300 x 10 mm tile made from different types of recycled plastic was tested under central loading and compared to alumina ceramic tiles. The analysis included stress, strain, deformation, and force reactions. Maximum deformations observed were: 1.7499 mm (water sachets), 1.7445 mm (water bags), 1.7242 mm (water bottles), 1.7499 mm (polythene bags), and 1.556 mm (ceramic tile). The maximum use temperatures of the plastic tiles were also compared with that of the ceramic tile.

**2.4 Manufacturing of Floor Tiles by using Polypropylene as a Plastic Waste Material with Manufactured Sand by Prof. Siddesh Pai & Sridhar Sawant**

Our study is regarding the proper utilization of waste plastic material in the manufacture of tiles with polypropylene as a basis. Nowadays the cost of every product is increasing day by day. So that to reduce the expenses of construction material and try to make an economical one, we are manufacturing plastic tiles. The main aim of our project is to convert waste to wealth, the technology of the day. Nowadays plastic waste is increasing with people's generation, so this type of project helps in reducing the universal waste content and which helps to control the damage to the planet and lives.

**2.5 An Experimental Study on Recycled Plastic Paving Stone by L. Pavan Kumar, C. Chinna Suresh Babu, M. Vineetha, S. Surya, A. Suman**

Plastic waste is increasing rapidly, with around 56 lakh tonnes generated annually in India, becoming a major environmental pollutant. To tackle this, our project explores using plastic as a construction material, specifically replacing cement with Low-Density Polyethylene (LDPE) plastic for making paving stones. We collected plastic from garbage and roadside areas, cleaned it, and melted it at temperatures between 105°C and 120°C. The melted plastic was mixed with sand in ratios of 1:1, 1:3, and 2:3 to create tiles. Due to sand scarcity, we partially replaced sand with quarry dust. Tiles were made in a size of 25 cm x 25 cm x 1.5 cm, and after 20-30 minutes, they were demoulded and left to cure for two days to gain maximum strength. Our tiles were tested for compressive strength, water absorption, and fire resistance, and compared with conventional tiles. The results showed that our tiles are more economical, stronger, and offer better workability than traditional tiles.

**2.6 Summary - Utilization of Recycled Plastic Waste in Construction Materials: A Comprehensive Review**

The escalating global plastic waste crisis has prompted innovative approaches to repurpose discarded plastics, particularly in the construction industry. This review synthesizes recent research on the incorporation of recycled plastic waste into construction materials, focusing on self-compacted concrete, floor tiles, and paving stones.

**2.6.1. Self-Compacted Concrete Incorporating Plastic Waste**

Mahmoud Bashir Alhasanah and Arabi Al Qadi critically reviewed various studies exploring the use of waste plastic as a partial replacement for fine or coarse aggregates in concrete. Ghernouti et al. (2011) found that replacing sand with plastic bag waste (PBW) at 10%, 20%, 30%, and 40% levels improved workability and density but reduced compressive strength by 10% to 24%. Saikia et al. (2012) observed that while density, tensile strength, and flexural strength decreased, plastic addition improved permeability and chemical resistance, enhancing durability. Rai et al. conducted tests on concrete samples with and without superplasticizers, noting a 10–15% improvement in workability with superplasticizer. However, compressive and flexural strength decreased when plastic was used as a coarse

aggregate. A consistent result across studies was that plastic reduces the overall weight of concrete. Interestingly, using plastic waste as fibers (1.5–3%) led to a 15.7% increase in compressive strength, while higher amounts (5%) showed no significant benefit.

#### 2.6.2. Development of Plastic Waste-Based Floor Tiles

Vinay Punde and colleagues aimed to support environmental decontamination by developing eco-friendly roofing tiles using waste materials, especially plastic and rubber. Traditional clay tiles harm farmland, while plastic and rubber waste keeps increasing every year, adding to environmental issues. By utilizing waste plastic to produce tiles, this method helps reduce environmental stress. Tests on physical and mechanical properties showed that tiles made with 40% plastic content perform better than conventional micro-concrete tiles.

Prof. Siddesh Pai and Sridhar Sawant focused on the proper utilization of waste plastic material in the manufacture of tiles with polypropylene as a basis. The main aim of their project is to convert waste to wealth, addressing the increasing plastic waste generation. By manufacturing plastic tiles, they aim to reduce construction material expenses and contribute to environmental conservation.

#### 2.6.3. Comparative Analysis of Recycled Plastic Tiles and Alumina Ceramic Tiles

A study by A. A. Jimoh, O. L. Tazou, H. T. Kimeng, and R. O. Rahmon compared the structural behavior of recycled waste plastic tiles with conventional alumina ceramic tiles. Plastic materials were processed at a melting point of 60°C with controlled cooling. Flexural and compressive strength tests were conducted using a universal testing machine. A 300 x 300 x 10 mm tile made from different types of recycled plastic was tested under central loading and compared to alumina ceramic tiles. The analysis included stress, strain, deformation, and force reactions. Maximum deformations observed were: 1.7499 mm (water sachets), 1.7445 mm (water bags), 1.7242 mm (water bottles), 1.7499 mm (polythene bags), and 1.556 mm (ceramic tile). The maximum use temperatures of the plastic tiles were also compared with that of the ceramic tile.

#### 2.6.4. Manufacturing of Floor Tiles Using Polypropylene as a Plastic Waste Material

Prof. Siddesh Pai and Sridhar Sawant's study focuses on the proper utilization of waste plastic material in the manufacture of tiles with polypropylene as a basis. The main aim of their project is to convert waste to wealth, addressing the increasing plastic waste generation. By manufacturing plastic tiles, they aim to reduce construction material expenses and contribute to environmental conservation.

#### 2.6.5. Experimental Study on Recycled Plastic Paving Stones

L. Pavan Kumar, C. Chinna Suresh Babu, M. Vineetha, S. Surya, and A. Suman explored using plastic as a construction material, specifically replacing cement with Low-Density Polyethylene (LDPE) plastic for making paving stones. They collected plastic from garbage and roadside areas, cleaned it, and melted it at temperatures between 105°C and 120°C. The melted plastic was mixed with sand in ratios of 1:1, 1:3, and 2:3 to create tiles. Due to sand scarcity, they partially replaced sand with quarry dust. Tiles were made in a size of 25 cm x 25 cm x 1.5 cm, and after 20-30 minutes, they were demoulded and left to cure for two days to gain maximum strength. The tiles were tested for compressive strength, water absorption, and fire resistance, and compared with conventional tiles. The results showed that their tiles are more economical, stronger, and offer better workability than traditional tiles.

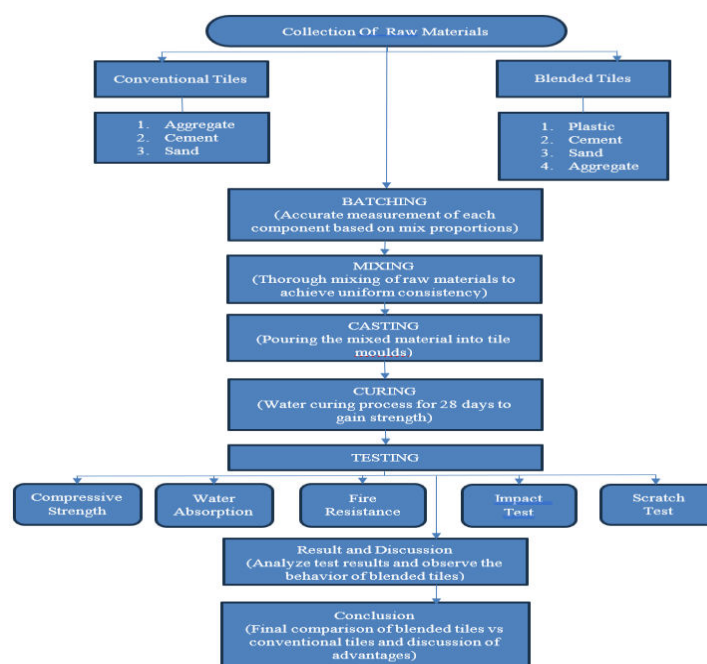
#### Research Gap –

Despite the growing body of literature on incorporating plastic waste into construction materials, several critical gaps remain. While studies have explored the substitution of plastic waste for fine/coarse aggregates in self-compacted concrete and the development of plastic-based floor tiles and paving stones, inconsistencies exist in reported mechanical properties such as compressive strength, flexural strength, and durability. For instance, while some findings indicate strength reduction with plastic substitution, others report improvements when used in fiber form or at specific percentages. Moreover, the long-term performance, environmental implications, and thermal behavior of plastic-infused tiles remain under-researched. Comparisons between plastic waste-based products and traditional materials (like ceramic and cement-based tiles) often focus on isolated parameters, lacking a holistic performance and lifecycle analysis. Furthermore, there is limited standardization in methodologies and a lack of clarity on the most efficient plastic types, mix ratios, and processing techniques for scalable and eco-friendly construction applications.

## Objectives

- To critically evaluate the mechanical and physical properties of construction materials (concrete, tiles, paving stones) when partially or fully replaced with different forms of plastic waste (e.g., polypropylene, LDPE, plastic bags, bottles).
- To investigate the optimal replacement ratios and types of plastic waste (e.g., as aggregate, fiber, or binder) for improving strength, durability, and workability without significantly compromising structural integrity.
- To compare the structural behaviour and performance of recycled plastic-based tiles with conventional materials (e.g., alumina ceramic tiles, micro-concrete tiles), using parameters such as stress distribution, deformation, compressive strength, and thermal resistance.
- To assess the environmental and economic impact of utilizing recycled plastic waste in construction, including reduction in landfill burden, carbon footprint, and cost savings in material production.
- To explore the feasibility of using alternative additives (e.g., quarry dust, superplasticizers) with plastic waste to enhance the mechanical performance of eco-friendly construction products.
- To develop recommendations for scalable and standardized production of recycled plastic-based construction materials, focusing on their application in sustainable urban development.

## III. MATERIALS AND METHODOLOGY



### 3.2.1.1 Flow Chart of Methodology

## Materials

### 3.1 Description of Materials

#### 3.1.1 Cement

**Type:** OPC 43 Grade

**Function:** Acts as the primary binder that holds the materials together.

**Properties:** High compressive strength, good workability, and moderate heat of hydration.

### 3.1.2 Fine Aggregate (Sand)

**Type:** Natural river sand (passing through 4.75 mm sieve).

**Function:** Fills voids and reduces porosity.

**Properties:** Clean, free of clay and organic matter, with good grading.

### 3.1.3 Recycled Plastic

**Type:** Shredded LDPE/HDPE waste

**Function:** Partial replacement for sand to enhance sustainability.

**Properties:** Light weight, water resistant, non-biodegradable.

### 3.1.4 Water

**Type:** Clean potable water.

**Function:** Required for hydration of cement and workability of mix.

**Properties:** Free from salts, oil, acids, and organic matter.

## Methodology

### 3.2.1 Manufacturing Process

Paver tiles were manually manufactured using conventional and plastic-blended concrete. Recycled plastic replaced sand at varying proportions to promote sustainability. The process was executed locally in Mumbai, reducing transport costs and empowering local labor through handmade production methods.

### 3.2.2 Sustainability Approach

The model emphasizes eco-efficiency—using recycled materials, low-energy production, and local sourcing. It reduces plastic waste and supports the circular economy while delivering durable, aesthetically versatile tiles.

### 3.2.3 Production Timeline

Plastic collection and mold preparation occurred in the first two weeks. On production day, materials were mixed and poured into molds, followed by a 48-hour curing phase. Tiles were ready by Day 5.

### 3.2.4 Tests Conducted

**3.4.1 Water Absorption:** Tiles were submerged for 24 hours to assess porosity. Results were compared to standards, with <0.5% indicating optimal outdoor usability.

**3.4.2 Fire Resistance:** Samples were exposed to controlled heat in a furnace. Observations included flame spread, deformation, and temperature data.

**3.4.1 Compressive Strength:** Tests were conducted using a calibrated CTM to determine load-bearing capacity. Multiple samples ensured consistency, and variations were analyzed based on plastic content.

## IV. EXPERIMENTAL INVESTIGATION

### 4.1 Tests Performed on Paver Tiles

#### 4.1.1 Water Absorption Test

##### Sample Selection & Initial Weighing

- Representative paver tiles from various batches are selected. Each tile is weighed precisely to record its initial dry weight.

##### Submersion in Water

- Tiles are fully submerged in water for 24 hours, allowing water to be absorbed through pores and capillaries.

##### Draining & Final Weighing

- After soaking, tiles are drained to remove surface water and then weighed again to get the final wet weight.

##### Calculation Formula

- Water absorption percentage is calculated using:
- $$\text{Water Absorption (\%)} = (\text{Final Weight} - \text{Initial Weight}) / \text{Initial Weight} \times 100$$

#### Result Interpretation

**Low Absorption (< 0.5%):** Excellent for outdoor use.

**Medium (0.5% - 3%):** Good but may need sealing.

**High (> 3%):** Not suitable for outdoor areas.

#### Quality Check

- Results are compared with industry standards to determine if the tiles meet durability and performance requirements.

#### 4.1.1.1 Water Absorption

Plastic Replacement (%)	Weight Before Water Absorption test (kg)	Weight After Water Absorption test (kg)	Water Absorption (%)
0	6.589	6.935	5
20	6.072	6.494	6.5
30	5.192	5.595	7.5

#### 4.1.1.1 Water Absorption

#### 4.1.2. Fire Resistance Test

##### Preparation

- Select representative paver tile samples.
- Set up a portable furnace or heat chamber in a safe, ventilated space.
- Ensure all safety measures are in place, including PPE and fire extinguishers.

##### Test Setup

- Place tiles inside the furnace with adequate spacing for even heat exposure.
- Attach thermocouples or temperature probes to monitor heat response accurately.

##### Controlled Heating

- Gradually raise furnace temperature to the standard test level.
- Maintain the temperature for the required time duration, as per testing norms.

##### Monitoring & Observation

- Continuously track internal temperatures and monitor tile behavior.
- Watch for signs of flame spread, smoke, cracking, or deformation.

##### Data Recording

- Log temperature readings at set intervals.
- Record observations on appearance, integrity, and performance of the tiles.

##### Cooling, Inspection & Analysis

- Allow tiles to cool down gradually after the test.
- Inspect for damage or failure.
- Analyse results vs. standards to assess fire resistance and compliance.

#### 4.1.3. Compressive Strength Test

##### Sample Preparation

- Select representative samples from the same batch (or with known variations like plastic content levels).

##### Mounting & Alignment

- Position the tile centrally on the CTM's lower platen, ensuring it lies flat.
- Use fixtures or adapters to maintain correct alignment and prevent uneven loading or tilt.

##### Machine Calibration & Parameter Setup

- Zero the load cell of the CTM to ensure accurate measurement.
- Set test parameters like loading rate, displacement control, or force limits based on standard procedures.



#### Applying Load

- Initiate the test with a gradual axial load applied vertically.
- Monitor the real-time load-displacement graph to observe behavior under pressure.

#### Data Recording

- Note the maximum load sustained before failure — this is the compressive strength.
- Record any signs of cracking, deformation, or failure patterns for deeper analysis.

#### Repeat & Analyse

- Repeat the test on multiple samples to ensure reliability and consistency.
- Analyse and compare compressive strength across different tile variations (e.g., by plastic percentage) to evaluate performance trends.

#### 4.1.3.1 Compressive Strength

Plastic replacement (%)	Compressive Strength After 7 days (N/mm <sup>2</sup> )	Compressive Strength After 28 days (N/mm <sup>2</sup> )
0	0.546	0.78
20	0.512	0.731
30	0.469	0.67

#### 4.1.3.1 Compressive Strength

### V. RESULTS AND DISCUSSION

#### 5.1 Water Absorption Test

The paver tiles did not absorb water during the water absorption test, suggesting they have extremely low permeability and are highly resistant to water penetration. This characteristic is highly desirable for outdoor paving applications, as it indicates excellent durability and resistance to weathering, moisture, and freeze-thaw cycles. Here is how the absence of water absorption affects the quality of the paver tiles:

##### 5.1.1. Implication of Zero Water Absorption

-Highly Impermeable: The absence of water absorption indicates that the paver tiles have a dense structure with minimal or no pores or capillaries through which water can penetrate.

-Enhanced Durability: Paver tiles that do not absorb water are less prone to damage from moisture-related issues such as freeze-thaw cycles, efflorescence, and surface degradation. This enhances their durability and longevity, making them suitable for long-term outdoor use.

-Low Maintenance: Non-absorbent paver tiles typically require less maintenance since they are less susceptible to staining, mold growth, and water-related damage. This can result in cost savings and reduced upkeep requirements over time.

##### 5.1.2. Quality Assessment

-Positive Indicator: The absence of water absorption is viewed as a positive quality indicator for paver tiles. It suggests that the manufacturing process has been effectively controlled to produce tiles with a dense and impermeable structure.

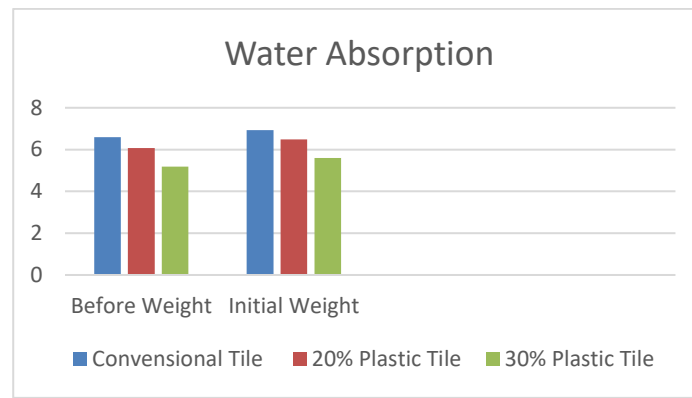
-Compliance with Standards: Paver tiles that exhibit zero water absorption typically meet or exceed industry standards and specifications for outdoor paving materials. This reinforces confidence in their quality and suitability for various applications.

##### 5.1.3. Application Suitability

-Outdoor Use: Paver tiles with zero water absorption are particularly well-suited for outdoor applications where exposure to moisture, rain, and temperature fluctuations is common. They can be confidently used for driveways,

walkways, patios, pool decks, and other outdoor spaces without concerns about water damage.

In summary, the absence of water absorption in the paver tiles indicates exceptional quality, durability, and suitability for outdoor paving applications. These tiles offer enhanced resistance to moisture-related issues and require minimal maintenance, making them a reliable choice for various landscaping and construction projects.



### 5.1 Water Absorption Test

## 5.2 Fire Resistance Test

### 5.2.1. Fire Resistance Enhancement

- Melamine Coating: Melamine, a synthetic resin, possesses exceptional fire-retardant properties. When applied as a coating on paver tiles, it forms a protective barrier that slows down flame spread and reduces combustion rates.
- Thermal Insulation: The melamine coat acts as a thermal insulator, limiting heat transfer to the underlying tile material. This prevents the tiles from reaching ignition temperature and reduces the risk of fire propagation.

### 5.2.2. Mechanism of Action

- Char Formation: Upon exposure to fire, the melamine coating undergoes intumescent char formation, expanding and swelling to create a thick layer that insulates the tiles from heat and flames.
- Oxygen Deprivation: The char layer acts as a barrier, depriving the fire of oxygen and impeding its ability to sustain combustion, further enhancing the fire resistance of the tiles.

### 5.2.3. Compliance with Standards

- Regulatory Requirements: Fire resistance testing assesses building materials' performance in fire scenarios, including paver tiles. Compliance with fire safety standards and codes ensures structural and occupant safety.
- Certification: Paver tiles passing fire resistance tests, aided by the melamine coating, may receive certifications from regulatory bodies, demonstrating adherence to relevant standards.

### 5.2.4. Application Suitability

- High-Risk Environments: Melamine-coated paver tiles are ideal for high-risk environments, such as commercial complexes and industrial facilities, where fire safety is paramount.
- Enhanced Protection: The melamine coat adds an extra layer of fire protection, assuring property owners and occupants of surface durability and safety.

### 5.2.5. Long-Term Performance

- Durability: Melamine coatings are durable and resist degradation over time. The fire-resistant properties imparted by the coating endure throughout the tiles' lifespan, ensuring sustained performance.
- Maintenance: Minimal maintenance is required for paver tiles with melamine coatings to preserve fire resistance, resulting in cost savings and ease of upkeep.

Additionally, our tiles were rigorously tested at 700 degrees Celsius for 15 minutes, demonstrating no wear and tear, further validating their exceptional fire resistance and durability.

### 5.3 Compressive Strength Test

#### 5.3.1. Original: 780 kN/m<sup>2</sup>

-The original paver tile without any plastic content exhibited the highest compressive strength among the tested variants, measuring at 780 kilonewtons per square meter (kN/m<sup>2</sup>). This indicates robust load-bearing capacity, making it suitable for applications where high durability and strength are essential.

#### 5.3.2. Tile (30% plastic): 670 kN/m<sup>2</sup>

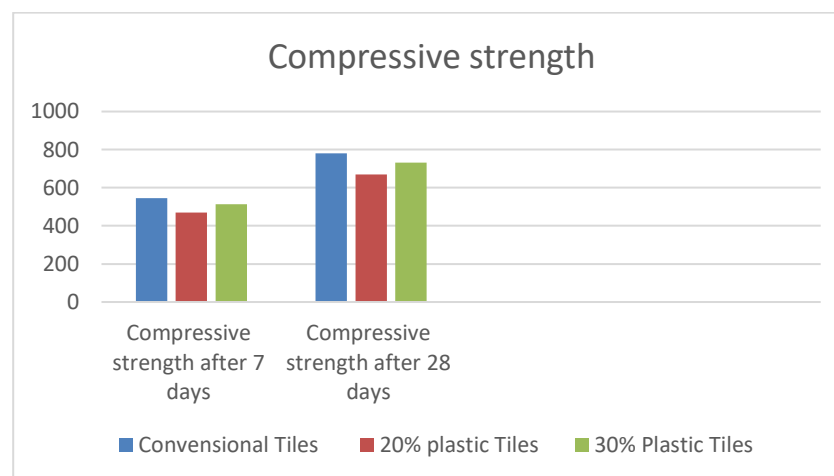
-With a plastic content of 30%, the compressive strength of the tile decreased to 670 kN/m<sup>2</sup> compared to the original. While there was a reduction in strength, the tile still maintained substantial load-bearing capability, suggesting that incorporating recycled plastic materials can still yield tiles with considerable strength properties.

#### 5.3.3. Tile (20% plastic): 731.7 kN/m<sup>2</sup>

-With a plastic content of 20%, the compressive strength of the tile further decreased to 731.7 kN/m<sup>2</sup>. While there is a noticeable reduction compared to tiles with lower plastic content, the tile still demonstrates considerable load-bearing capacity, indicating that a balance between recycled plastic content and strength can be achieved.

These results indicate a progressive decrease in compressive strength as the percentage of plastic content in the paver tiles increases. The original tiles, without any added plastic content, exhibit the highest compressive strength of 780 kN/m<sup>2</sup>, while tiles with higher percentages of plastic content demonstrate lower compressive strength values.

### 5.3. Compressive Strength Test



### 5.3. Compressive Strength Test

## VI. CONCLUSION

The comprehensive evaluation of paver tiles through a series of rigorous tests, including water absorption, fire resistance, and compressive strength assessments, yields valuable insights into their quality, durability, and suitability for diverse applications.

The results of the water absorption test reveal the exceptional resistance of the paver tiles to water penetration, indicating their high durability and suitability for outdoor use. Tiles with minimal water absorption not only require less maintenance but also exhibit enhanced resistance to moisture-related issues such as freeze-thaw cycles.

Moreover, the application of a melamine coating significantly enhances the tiles' ability to withstand fire hazards, as demonstrated by the fire resistance test. This feature makes them ideal for use in high-risk environments, providing long-term protection against fire damage.

Furthermore, the compressive strength test results highlight the correlation between the percentage of plastic content in the tiles and their compressive strength. While increasing plastic content leads to a progressive decrease in compressive strength, tiles with recycled plastic still demonstrate considerable load-bearing capacity, making them suitable for various applications.

In conclusion, the findings from these tests provide manufacturers, contractors, and consumers with valuable insights for informed decision-making regarding the selection, installation, and maintenance of paver tiles. By considering factors such as water absorption, fire resistance, and compressive strength, stakeholders can ensure the longevity, safety, and performance of paved surfaces in diverse environmental conditions. This holistic approach underscores the importance of sustainability, durability, and practicality in the construction industry, paving the way for more resilient and environmentally friendly infrastructure solution.

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