COMPARATIVE STUDY ON LOCALLY MANUFACTURED ECO-FRIENDLY BRICKS AND TRADITIONAL BRICKS.

Sonargaon University

"COMPARATIVE STUDY ON LOCALLY MANUFACTURED ECO-FRIENDLY BRICKS AND TRADITIONAL BRICKS."

By

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A Thesis

Submitted for partial fulfillment of the Undergraduate Degree in Civil Engineering

(Bachelor of Science) to the Department of Civil Engineering,

Sonargaon University.

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COMPARATIVE STUDY ON LOCALLY MANUFACTURED ECO-FRIENDLY BRICKS AND TRADITIONAL BRICKS.

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DECLARATION

I, Jofar Shihab et al, hereby declare that the work presented herein is original work done by and has not been published or submitted elsewhere for the requirements of a Civil Engineering programme. Any literature data or work done by others and cited within this thesis has been given due acknowledgement and listed in the reference section.

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Dedicated

To

“Our Parents”

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ABSTRACT

This study investigates the production of eco-friendly bricks using microplastics and sand as alternative construction materials. Microplastics were collected from homes, offices, courts, and municipal dumping sites, then cleaned, melted, mixed with sand in specific proportions, and molded into bricks. The manufactured bricks were tested for water absorption, compressive strength, and abrasion resistance. The results show a low water absorption rate of 4.06% (ASTM-67), significantly lower than conventional bricks (15–20%). The compressive strength reached 15.17 MPa (ASTM-67), exceeding the minimum requirement for first-class bricks of 10.5 MPa. Abrasion resistance, tested using AASHTO T-96, was 21.04%, well below the allowable limit 30%. These findings demonstrate that microplastic-sand bricks are durable, sustainable, and suitable for applications such as sidewalks, parking areas, and building basements, contributing to eco-friendly construction and effective microplastic waste management.

LIST OF ABBREVIATIONS

MPa = Megapascal

PE = Polyethylene

PP = Polypropylene

MS = Mild Steel

CTM = Compression Testing Machine

LA = Los Angeles

AASHTO = American Association of State Highway and Transportation Officials

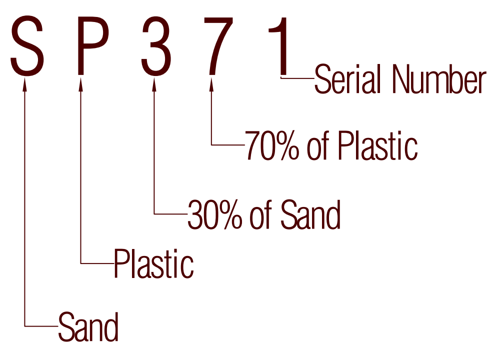
ASTM= American Society for Testing and Materials.

HDPE = High Density Polyethylene

PET = Polyethylene Terephthalate

FTIR = Fourier Transform Infrared Spectroscopy

SP000 = Sand, Plastic, Sand Ratio, Plastic Ratio, Serial Number



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CHAPTER -1

INTRODUCTION

1.1 Background of the Study

Bangladesh is a developing country. In this country, 18 crore people use a lot of plastic, polythene or plastic bottles in their daily lives but they are not thrown away in the right place. Due to which all these plastics, polythene or plastic bottles fall into the drains of the city due to which waterlogging is created in the city, causing endless suffering to the people. These plastic polythene or plastic bottles fall into the rivers through the drains, resulting in pollution of the rivers, fish death, and pollution of the environment. To solve all these problems, we have taken an initiative through which we will agree to remove plastic from the environment and create a new environment through recycling.

1.2 Problem Statement

While working here, many problems are faced. It is worth noting that plastic cannot be completely cleaned 100%, due to which it cannot be completely melted during the melting process, resulting in grains remaining inside. And after mixing the sand, when we pour it into the form, the upper part of the form comes into contact with air, and the upper plastic dries quickly, due to which the air inside cannot come out. As a result, the upper layer that comes into contact with the air falls and air bubbles accumulate under this layer, due to which we do not finish the upper surface completely, therefore some air accumulates under the upper layer and a gap is formed there. In addition, when we mix colors with these bricks to give them different colors, as a result of mixing these colors, the bonding of our brick plastic with sand can be observed to some less extent.

1.3 Objective of the Study

The primary objective of this study is to develop and analyze eco-friendly bricks produced from waste plastic and sand as a sustainable and cost-effective alternative to traditional clay and cement bricks. This research focuses on transforming non-biodegradable plastic waste one of the most pressing environmental challenges of the modern era into a valuable construction material that supports both environmental protection and economic growth.

Specifically, the study seeks to achieve the following objectives:

To design and produce eco bricks by utilizing different proportions of waste plastic and sand in order to determine the most effective composition for achieving optimum strength and durability. To evaluate the physical and mechanical properties of the produced eco bricks, including compressive strength, density, water absorption, thermal resistance, and long-term durability under varying environmental conditions. To compare the quality, cost, and performance of the produced eco bricks with conventional clay and cement bricks, identifying their respective advantages and limitations.

1.4 Significance of the Study

This study is significant because it addresses two critical global concerns: the growing accumulation of plastic waste and the need for sustainable construction materials. Plastic pollution has become one of the most alarming environmental issues due to its non-biodegradable nature and harmful effects on soil, water, and wildlife. Simultaneously, the construction industry continues to consume vast natural resources for producing traditional bricks and cement, leading to deforestation, soil degradation, and increased carbon emissions.

By converting waste plastic into eco bricks, this study offers a practical and innovative solution that aligns with the principles of a circular economy and sustainable development. The findings of this research have far-reaching implications for environmental management, construction technology, and socio-economic growth.

The significance of the study can be outlined as follows:

1.4.1. Environmental Significance:

Reduces the volume of plastic waste that ends up in landfills and oceans. Minimizes environmental pollution and greenhouse gas emissions associated with traditional brick manufacturing. Promotes recycling and waste management practices that contribute to a cleaner and greener environment.

1.4.2. Social Significance:

Raises community awareness about plastic waste management and environmental sustainability. Offers potential employment opportunities, particularly in underdeveloped areas with high plastic waste generation. Contributes to affordable housing solutions through the use of low-cost, durable, and lightweight bricks.

In summary, this study not only provides a means to tackle plastic pollution but also introduces an innovative, eco-friendly construction material that supports the global agenda for sustainable development and environmental protection.

1.5 Scope and Limitations

In a populous country like Bangladesh, a large amount of plastic, polythene, and plastic bottles are used every day. Waste plastic is available in large quantities and is easily available at a low price.

However, it has some limitations, such as not all plastics are recycled, and they are mixed. Most of the plastics end up in the drainage water and are difficult to collect from there. After collection, they cannot be cleaned thoroughly.

1.6 Organization of Thesis

The thesis is organized into five chapters, each dealing with a distinct aspect of the study. A brief outline of the chapters is presented below.

Chapter 1: Introduction

This chapter presents the background and motivation of the research, highlighting the problems associated with plastic waste in Bangladesh and its impact on the environment. It also outlines the objectives, significance, scope, and limitations of the study.

Chapter 2: Literature Review

This chapter reviews previous research and studies related to waste plastic and sand composite bricks. It summarizes the findings of earlier works, identifies the existing research gaps, and establishes the rationale for the present study.

Chapter 3: Methodology

This chapter explains the materials and methods adopted to produce eco-friendly plastic-sand bricks. It includes details of material collection, preparation, proportioning, mould design, casting procedures, and various laboratory tests conducted to evaluate the brick properties.

Chapter 4: Results and Discussion

This chapter presents the experimental results obtained from different tests such as water absorption, compressive strength, abrasion resistance, thermal conductivity, and cost analysis. It also discusses the environmental benefits and overall performance of the produced plastic-sand bricks.

Chapter 5: Conclusion and Recommendations

This chapter summarizes the key findings of the research, draws conclusions based on the experimental results, and provides suggestions for future studies to further improve the use of recycled plastics in construction materials.

-CHAPTER -2

LITERATURE REVIEW

2.1 Introduction

Plastic waste poses a major environmental challenge due to its non-biodegradable nature and increasing global production. The construction industry offers a sustainable solution by incorporating plastic waste into building materials such as plastic sand bricks and blocks. Research shows that these materials can achieve high compressive strength, low water absorption, and improved durability compared to conventional bricks. Although challenges remain regarding long-term performance and standardization, plastic-based construction materials present a promising approach for waste management, resource conservation, and sustainable development.

2.2 Existing Studies on Waste Plastic and Sand Composite Bricks

Abu Supian Gazi et al. (2025) explores the use of high-density polyethylene (HDPE) plastic waste in the production of eco-friendly plastic-sand bricks as a sustainable alternative to traditional clay bricks. HDPE waste was collected, shredded, and mixed with sand and cement in varying proportions (0%, 5%, 10%, and 15% by weight). The mixture was melted, molded, and tested for compressive strength, water absorption, hardness, and soundness.

Results showed that the inclusion of plastic waste improved the compressive strength, reduced water absorption, and made the bricks lighter and more durable compared to conventional ones. The study concludes that reusing plastic waste in brick manufacturing is a cost-effective and environmentally responsible solution that helps reduce pollution, conserve resources, and promote sustainable construction practices. (1)

Sangita Nayak et al. (2025) investigates the use of plastic waste (HDPE, PET, and plastics below 50 microns) in brick manufacturing to address environmental pollution. By mixing 30–50% plastic waste with river sand, the researchers produced lightweight and economical bricks. Tests such as compressive strength, hardness, water absorption, and soundness showed that plastic bricks have low water absorption, good strength, and high durability compared to conventional ones. The results demonstrate that reusing plastic in brick production is an eco-friendly and cost-effective solution for reducing plastic waste and promoting sustainable construction. (2)

Kundan Yadav et al. (2024) explores the use of plastic waste in brick production as a sustainable solution for the construction industry. It examines the manufacturing process, material properties, environmental benefits, challenges, and case studies of plastic bricks. The study shows that plastic bricks can reduce waste, carbon emissions, and resource use while maintaining good structural strength and cost efficiency. The manufacturing process involves melting or shredding plastic at 180–220 °C and mixing it with other materials to form bricks. The paper concludes that plastic bricks offer great potential for circular economy applications, though more research is needed to improve durability, performance, and public acceptance. (3)

Ujjval Yadav et al. (2024) examines the use of plastic waste in construction materials as a sustainable solution to environmental pollution and resource depletion. It discusses how plastic waste can replace or modify traditional materials such as cement, sand, and aggregates in the production of bricks, tiles, concrete, and roads. The study highlights that incorporating plastic waste improves certain properties like durability and water resistance while reducing landfill waste and raw material consumption. The research categorizes prior studies into two main areas brick and tile production and road construction using plastic-modified concrete—demonstrating the growing potential of plastic waste in sustainable infrastructure. (4)

Kameshwar Sahani et al. (2022) investigates the production of plastic-sand bricks as a sustainable alternative to clay bricks. Bricks were prepared using plastic-to-sand ratios of 1:3, 1:4, and 1:5, with tests such as thermal resistance, split tensile strength, penetration, and FTIR analysis conducted to evaluate performance. Results showed that the optimal strength was achieved at a 1:4 ratio, while all bricks exhibited zero water absorption and no efflorescence. The study concludes that plastic-sand bricks are environmentally friendly, durable, and strong, making them a viable substitute for conventional bricks. (5)

Mohammad Sultan et al. (2020) investigates the production of plastic-laterite composite bricks using PET plastic waste, laterite quarry soil, and 2–10% bitumen. The mixture was melted, molded, and air-dried to form bricks of size 20 × 10 × 10 cm. These bricks displayed smooth finishing, low water absorption, and good compressive strength, comparable to laterite stone. The research highlights that utilizing plastic and quarry waste in construction materials supports sustainability, waste reduction, and circular economy principles, providing a viable alternative to conventional building materials. (6)

Mukesh Chavan et al. (2019) explores the production of plastic-sea sand pavement blocks to reduce plastic pollution. Waste plastics were shredded, melted (250–260 ºC), and mixed with sea sand in ratios of 1:1, 1:2, and 1:3. Tests showed that the blocks have good strength suitable for footpaths and parking areas, with the optimal plastic-to-sand ratio providing maximum durability. The research highlights a practical method for recycling plastic waste into construction materials, promoting environmental sustainability. (7)

2.3 Limitation

There are many shortcomings in the previous research. Most of the research has been done with old plastic bottles, which is not done with all types of plastic, which is a rare aspect of this research. Moreover, the process in which the research was done was not done properly. The method in which the plastic was melted and mixed with sand in the right proportion and poured into the form did not give the proper strength to the brick. After pouring the melted plastic into the form, the top layer dries quickly when it comes into contact with air, and the air inside cannot come out. The air inside cannot provide proper strength.

2.4 Summary

Recent studies demonstrate that incorporating plastic waste (HDPE, PET, and other plastics) into brick and block manufacturing significantly improves compressive strength, reduces water absorption, and lowers weight compared to traditional clay bricks. Various mixing ratios and manufacturing methods (melting, shredding, and molding) show that plastic–sand and plastic-composite bricks are durable, cost-effective, and environmentally friendly. Overall, the literature confirms that recycling plastic waste in construction materials helps reduce pollution, conserve natural resources, and supports sustainable and circular construction practices.

CHAPTER -3

METHODOLOGY

3.1 Introduction

To make bricks from old plastic, plastic waste is first collected and sorted, then shredded into small pieces. The shredded plastic is heated until it becomes molten and mixed with materials such as sand, which acts as a binder. This mixture is then compressed into molds to form the desired brick shape. Once cooled, the bricks harden into a strong, lightweight, and durable building material.

3.2 Collection of Materials

"In this study, the primary raw materials consisted of fine aggregate and plastic waste. Good-quality sand was procured from local shops and dealer points, ensuring it was well-graded and free from clay, silt, and other impurities. At the same time, plastic waste was collected from multiple sources, including households, offices, municipal bins, roadside points, drainage channels, water bodies, and recycling centers. By combining carefully sourced sand with a diverse mix of plastics such as bottles, packaging, and bags, we ensured that the materials reflected real urban waste conditions while providing the strength and durability needed for the final product.

3.2.1 Fine Aggregate

To procure fine aggregate, we collaborated with multiple sand suppliers, including local sand shops and dealer points, to ensure a consistent supply of good-quality sand. The sand was carefully sourced to meet the required grading standards, free from impurities such as clay, silt, or organic matter, to achieve the desired strength and durability in the final product.

Figure 1: Fine Aggregate (Sand Collection)

3.2.2 Binding Material

Plastic waste was collected from a variety of sources to ensure a representative sample for the study. These sources included residential households, commercial offices, municipal dustbins, and roadside disposal points. Additionally, plastics were collected from drainage channels, city water bodies such as ponds and canals, and plastic cutting or recycling centers, where leftover scraps are often discarded. Collecting from such diverse locations allowed us to obtain different categories of plastic waste, including single-use materials, bottles, food containers, bags, etc. This comprehensive collection process not only reflected the actual plastic disposal scenario in urban areas but also ensured that the raw materials used in the study closely represented the mixed nature of community plastic waste.

Figure 2: Chopped Plastic

3.3 Proportion and Preparation

The proportions of sand and shredded plastic were measured according to the specific experimental requirements. For this study, mixtures were prepared with varying Sand contents of, 30%, 40%, 50%, and 60% by weight, in order to investigate the effect of plastic content on the strength and performance of the Bricks. Each combination was subjected to load tests to determine its compressive capacity and to evaluate the optimum proportion for practical applications.

The preparation process involved heating the shredded plastic until it reached a molten state, after which sand was gradually introduced and thoroughly mixed to produce a uniform composite material. This careful mixing ensured that the molten plastic fully coated and bound the sand particles, enhancing cohesion within the mixture. The hot composite was then poured into molds of the desired dimensions, and allowed to cool under controlled conditions. This procedure was critical for achieving dimensional stability, adequate compressive strength, durability, and resistance to environmental factors such as moisture and temperature fluctuations.

Through this method of material preparation and processing, the resulting blocks provide a sustainable alternative to conventional pavement materials. The incorporation of waste plastic not only reduces the environmental burden associated with non-biodegradable plastic disposal but also decreases reliance on cement and other costly binders. Consequently, the final product contributes simultaneously to effective waste management, environmental conservation, and the development of low-cost, durable construction materials.

3.4 Preparation of Brick Mould

We designed interlocking bricks of size 9.5” × 4.5” × 2.75” in SketchUp to visualize their appearance and verify accuracy. Based on this design, we fabricated molds in the workshop using Mild Steel (MS) sheets, chosen for their ability to withstand the heat of molten plastic. The molds were assembled with precision to ensure durability and accurate brick formation.

3.4.1 Mould Design

We first determined the brick size (9.5” × 4.5” × 2.75”) and designed an interlocking system to allow the bricks to fit together easily. The design was created in 3D using SketchUp, enabling us to visualize how the bricks would look in real life and to verify the accuracy of the dimensions.

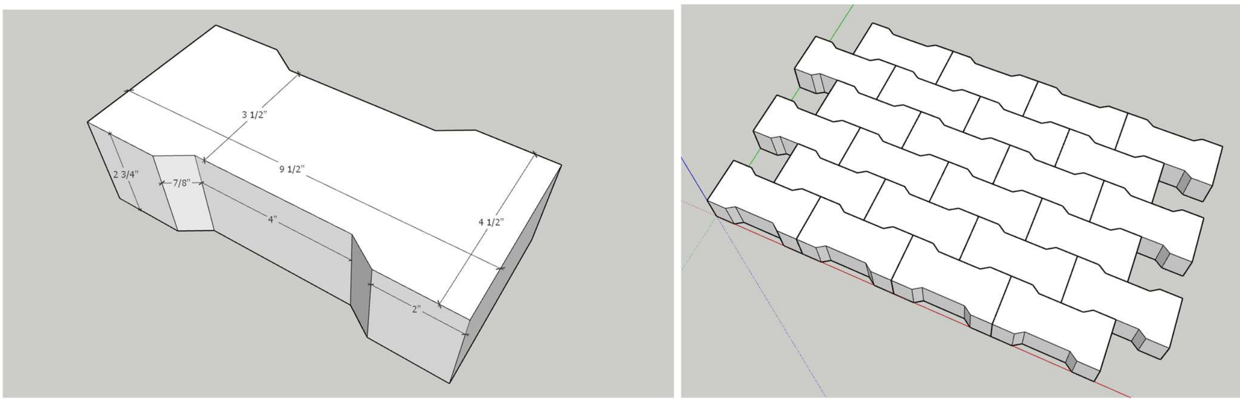

Figure 3: 3D Brick Design & 3D Brick Interlocking Bonding.

3.4.2 Mould Making

After completing the design in SketchUp, we proceeded to the fabrication stage. Mild Steel (MS) sheets were purchased from the local market, as these sheets are commonly used to withstand the heat of molten plastic. Using these MS sheets, we constructed the brick molds in our workshop according to the dimensions finalized during the design stage (9.5” × 4.5” × 2.75”). The molds were carefully assembled to ensure durability and precision.

Figure 4: Brick Forma, made of Mild Steel Sheet

3.5 Ready to Materials

This study used well-graded natural Coarse Sand as the fine aggregate and waste plastic as the primary binding material. Sand FM are 2.4 – 2.6. The sand was sieved to remove oversized particles and impurities, ensuring better bonding, strength, and dimensional stability of the pavement bricks. Waste plastic, mainly polyethylene (PE), polypropylene (PP), and other thermoplastics, was collected from domestic and industrial sources, cleaned, and shredded into fine granules for uniform mixing with sand. While sand provided interlocking and compressive resistance, the molten plastic acted as a binder, reducing environmental pollution and minimizing the dependence on cement or other costly binders.

3.5.1 Sand

This study used well-graded natural river sand as the fine aggregate. The sand was first sieved to remove oversized particles and impurities such as clay, silt, and organic matter. Clean sand is essential, as it ensures better bonding with molten plastic and enhances the overall strength and durability of the pavement bricks. Additionally, sand helps achieve the desired shape, surface texture, and dimensional stability of the finished bricks. Its angular grains provide good interlocking, while its mineral composition improves the compressive resistance of the bricks.

Figure 5: Quantitative Measurement of Sand

3.5.1.1 Sand Drying

Before using sand in the production of pavement bricks, it is essential to dry it thoroughly. Moisture present in natural sand can significantly affect the mixing process and the quality of the final product. If the sand contains water, steam may form when it comes into contact with molten plastic, leading to poor bonding, void formation, and reduced brick strength.

Drying is typically carried out by spreading the sand under direct sunlight for several hours until all moisture is removed. In some cases, oven drying is used, where the sand is heated to a controlled temperature to ensure complete elimination of water content. The dried sand is then stored in airtight containers or clean bags to prevent reabsorption of atmospheric moisture before use.

Properly dried sand ensures better adhesion to molten plastic, uniform mixing, and reduced shrinkage. This step is critical for achieving higher compressive strength, durability, and dimensional stability in the finished pavement bricks.

Figure 6: Sand is being placed in an oven to dry.

3.5.2 Waste Plastic

Cleaning plastic is a crucial step in preparing raw materials for paving bricks production. Waste plastic collected from domestic and industrial sources often contains dirt, dust, food residues, paper labels, adhesives, and other impurities. If not properly removed, these contaminants can interfere with melting, reduce the bonding ability of plastic with sand, and weaken the structural properties of the bricks.

Figure 7: Wast Plastic

3.5.2.1 Cleaning Process

The cleaning process begins with manual sorting to remove unusable materials such as metal, glass, and non-thermoplastics. The selected plastics are then thoroughly washed with clean water to remove surface dust, soil, and organic matter. In some cases, a mild detergent solution is used to eliminate oil or grease. After washing, the plastics are dried in sunlight or in a hot air oven to remove any remaining moisture, as water during heating can produce vapor, bubbles, or voids in the mixture.

Properly cleaned and dried plastics improve the homogeneity of the plastic-sand composite, ensure strong adhesion, enhance surface finish, and increase the durability of the paving bricks. This step also promotes hygiene and safety, since uncleaned plastics can release harmful gases when heated. Therefore, plastic cleaning is considered an essential pre-treatment in the sustainable use of plastic waste for bricks production.

Figure 8: Washing Plastic

3.6 Procedure of Casting Plastic Sand Brick

The production of plastic-sand bricks involves several key steps. First, the sand is dried and the plastic is cleaned and shredded. The shredded plastic is then melted in a heating vessel, with continuous stirring to maintain uniformity and prevent overheating. Dried sand is gradually added to the molten plastic and mixed thoroughly to form a homogeneous composite. The hot mixture is poured into oiled iron molds, compacted mechanically or manually to remove air voids, and trimmed as needed. After cooling, the hardened blocks are demolded, inspected for defects, and stored in a dry place for further testing and use.

3.6.1 Preparation of Materials

The required amounts of sand and shredded plastic are measured according to the selected mixing ratios. The sand is properly dried to remove moisture, while the plastic is cleaned and shredded into small granules to ensure uniform melting. In some cases, additives are incorporated to enhance the strength of the mixture, resulting in bricks that are harder, more durable, and better suited for practical applications.

Figure 9: The stove and pot are being prepared to light the fire in the stove.

3.6.2 Plastic melting

The pre-shredded plastic is placed in a heating vessel or furnace according to the specified proportions and gradually heated until it reaches its melting point. Continuous stirring is performed to prevent overheating and ensure a uniform molten plastic mass. Care is taken to maintain the temperature within a safe range to avoid the release of toxic fumes.

Figure 10: Heat is being applied and our Team

Figure 11: Pouring waste plastic into containers and melting the plastic.

3.6.3 Sand Mixing

Once the plastic is fully melted, the previously dried sand is gradually added to the molten plastic in the specified proportion, while stirring continuously. This ensures that the sand particles are uniformly coated with plastic. Mixing is continued until a homogeneous composite mixture is obtained, with the sand thoroughly integrated into the molten plastic.

Figure 12: Sand

Figure 13: Adding Sand to melted Plastic

3.6.4 Moulding & Compaction

The hot composite mixture is immediately poured into pre-prepared iron molds. Any excess material that extends beyond the mold is trimmed off using a scraper. The molds are pre-oiled to facilitate easy removal of the blocks after casting. Mechanical or manual compaction is applied to the mixture within the molds to eliminate air voids and enhance the density of the blocks. Proper compaction is essential to ensure high strength and dimensional stability of the final product.

Figure 14: The mixer is pouring into the mold

3.6.6 Cooling and Demolding

After compaction, the filled molds are allowed to cool at room temperature or in a controlled cooling system. In some cases, the molds may be rapidly cooled by immersion in cold water. Once the mixture has sufficiently hardened, the bricks are carefully removed from the molds.

Figure 15: Leave to Cool

3.6.7 Storage

The demolded bricks are inspected for shape, dimensions, and surface defects. Any excess material is trimmed, and the bricks are stored in a dry place for further testing and evaluation.

Figure 16: Open Brick from mold after Drying

CHAPTER -4

RESULTS AND DISCUSSION

4.1 Introduction

We produced bricks using environmentally friendly recycled plastic and conducted several performance tests on them. The key tests included the compressive strength test using a CTM machine, the water absorption test after 24 hours of soaking, and the Los Angeles abrasion test. These tests allowed us to evaluate the fundamental properties of the bricks, such as compressive strength, water absorption capacity, and durability.

Since the compressive strength and water absorption tests were performed on bricks with different mix ratios, we were able to identify which ratio produced the most favorable results. This information will help guide future production by indicating the optimal mix ratio for improved strength and performance.

4.2 Material Property

In this project, we produced bricks using discarded plastic waste as the primary binder. These plastics commonly found blocking drains, contaminating soil, reducing soil fertility, polluting rivers, and degrading the natural environment pose a severe threat to ecological sustainability and human well-being. To address these issues, we initiated an experimental study to convert environmentally harmful plastic into a useful construction material.

In our brick formulation, plastic waste was used as the main binding agent, while sand was added to improve durability and enhance overall strength. By combining melted plastic with sand, we developed a new type of composite brick that offers potential environmental benefits. This approach not only helps mitigate plastic pollution but also repurposes waste materials that would otherwise accumulate in the environment.

4.3 Water Absorption Test

For the water absorption test, first, we will measure the bricks we have made on a weighing scale and mark the weight of each brick, and keep it in a notebook. We will soak the weighed bricks in a container of clean water for 24 hours. After 24 hours, we will remove the bricks from the water and remove the excess water from the bricks with a dry cloth. After removing the excess water from the bricks, we will measure the bricks again with a weighing scale. After measuring, we will compare the weight before wetting with the weight we had before wetting and how much weight we have after wetting. This is the increase in weight before and after wetting. After that, we will find out the percentage through the formula for water absorption, and we will be able to understand how much percent of our bricks absorb water. And depending on this water absorption capacity, we can know how your bonding will be, how empty the stomach is, how the brother's bubble is, how durable the brick will be, etc. We can know many more things. Generally, we know that the water absorption capacity of a site made of soil is below 20%, which is considered standard.

Figure 17: Curing of Brick

Table 1: Absorption of Water (Sample -SP37)

SL No	Sample Code	Dry (Gram)	Wet (Gram)	Water (Gram)	Percentage
1	SP371	3130.00	3231.00	101.00	3.23%
	SP372	2830.00	2945.00	115.00	4.06%
	SP373	2925.00	3016.00	91.00	3.11%
	SP374	2960.00	3045.00	85.00	2.87%

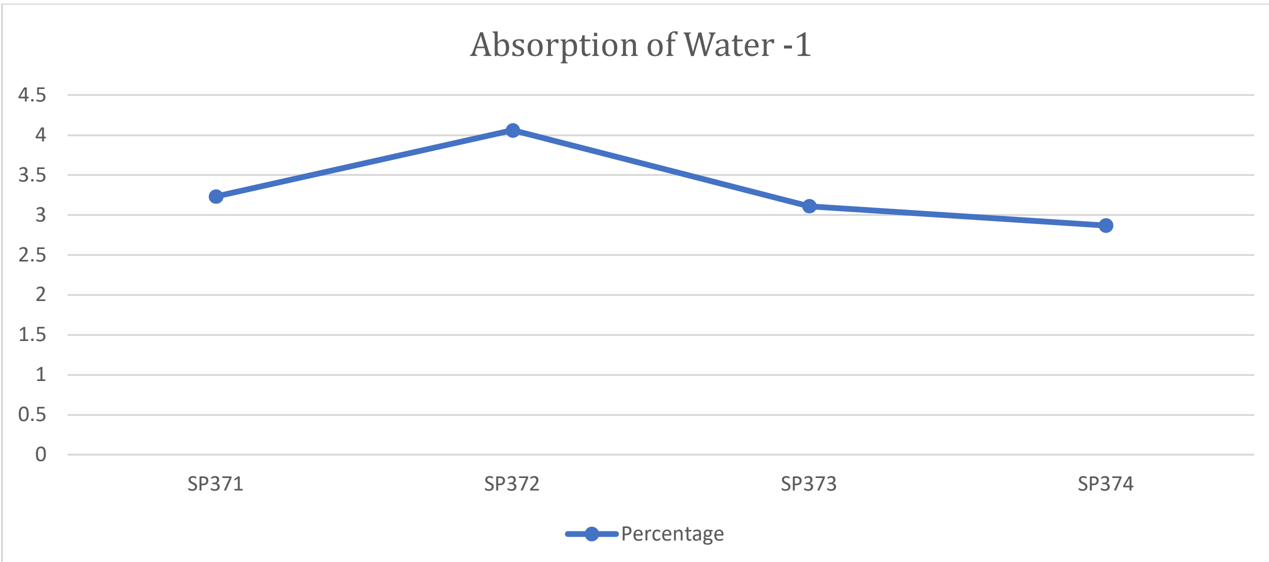

Chart 1:Water Absorption-1

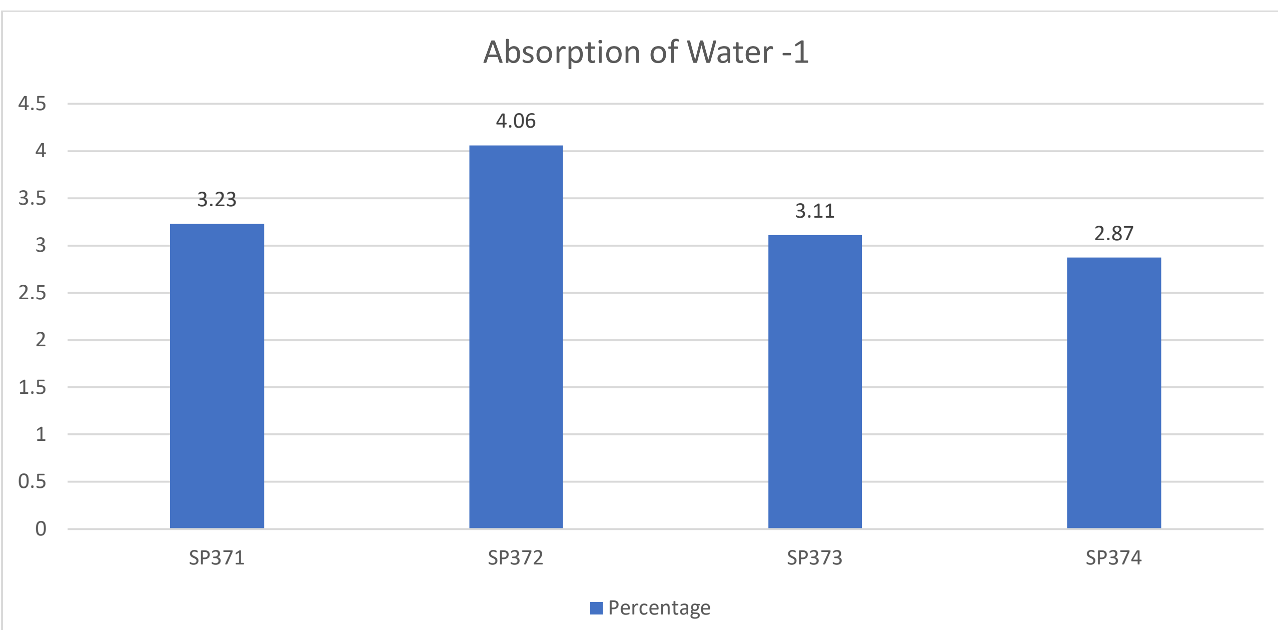

Chart 2: Water Absorption-1

Table 2: Absorption of Water (Sample -SP46)

SL	Sample Code	Dry (Gram)	Wet (Gram)	Water (Gram)	Percentage
2	SP461	2998.00	3026.00	28.00	0.93%
	SP462	2685.00	2708.00	23.00	0.86%
	SP463	2785.00	2811.00	26.00	0.93%
	SP464	2740.00	2756.00	16.00	0.58%

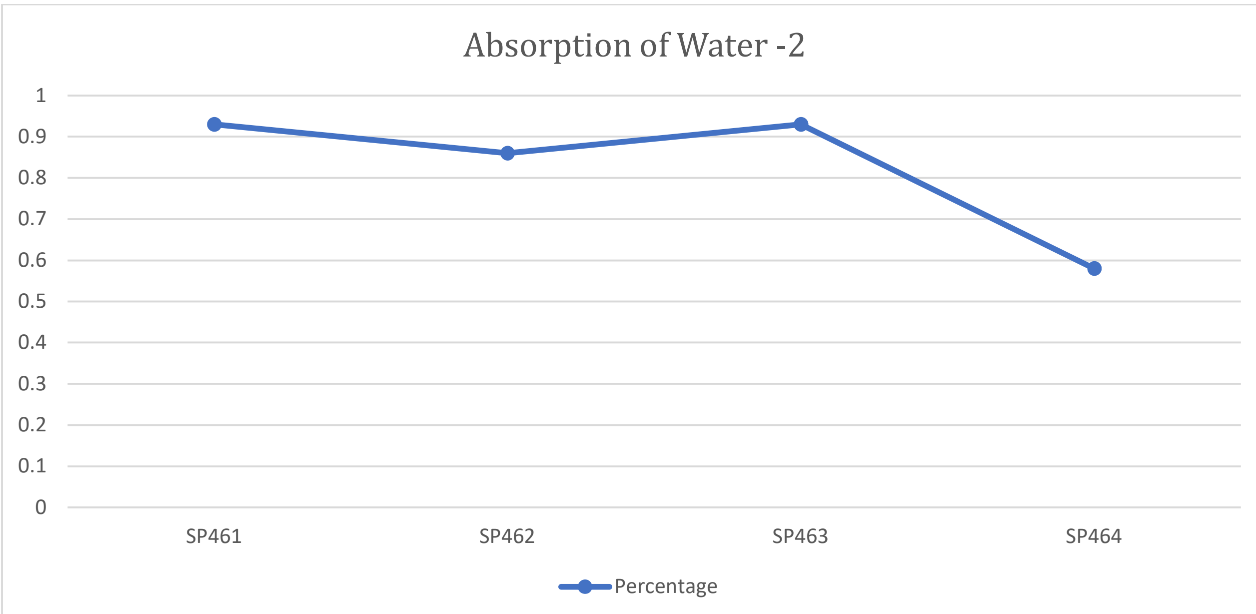

Chart 3: Water Absorption-2

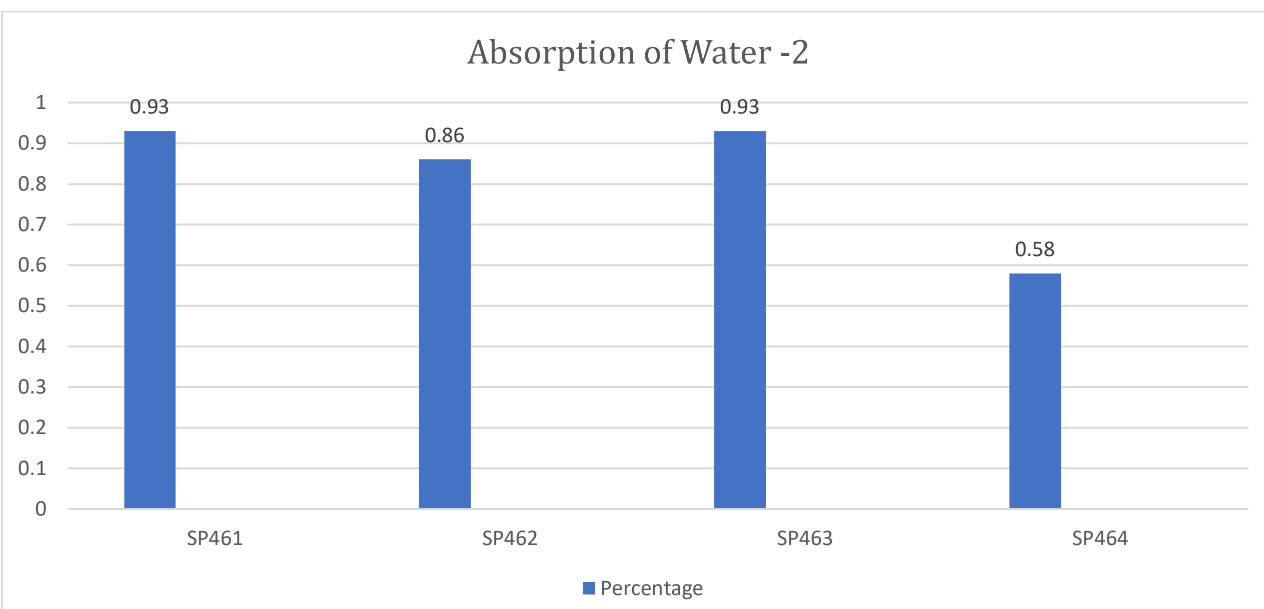

Chart 4:Water Absorption-2

Table 3: Absorption of Water (Sample -SP55)

SL	Sample Code	Dry (Gram)	Wet (Gram)	Water (Gram)	Percentage
3	SP551	2670.00	2743.00	73.00	2.73%
	SP552	2630.00	2705.00	75.00	2.85%
	SP553	2721.00	2802.00	81.00	2.98%
	SP554	2695.00	2774.00	79.00	2.93%

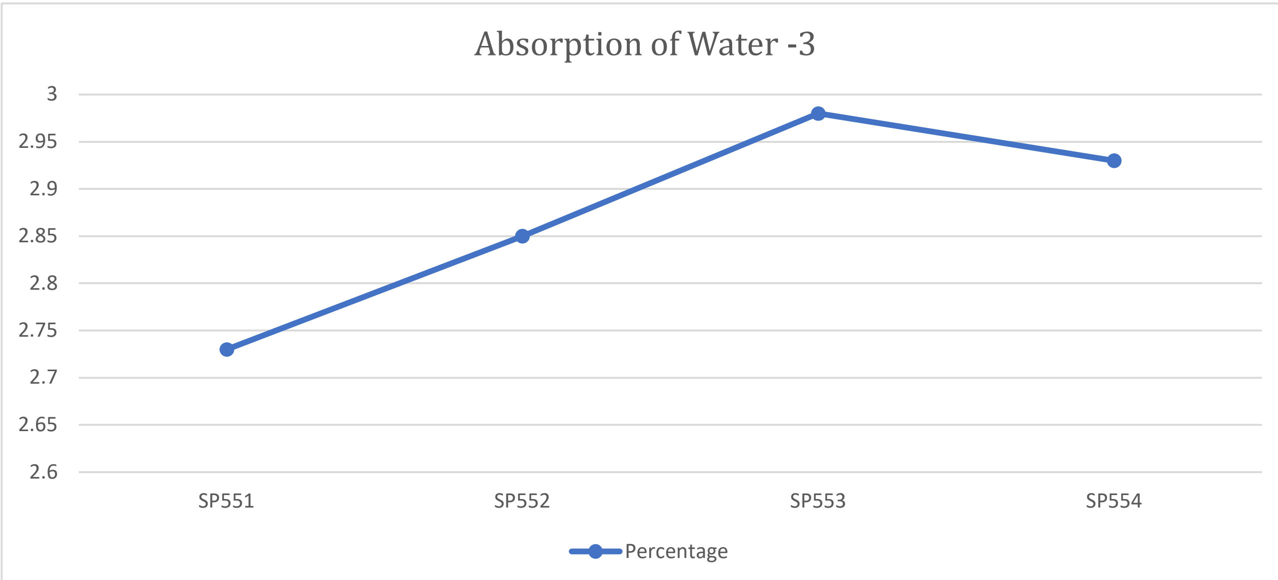

Chart 5: Water Absorption-3

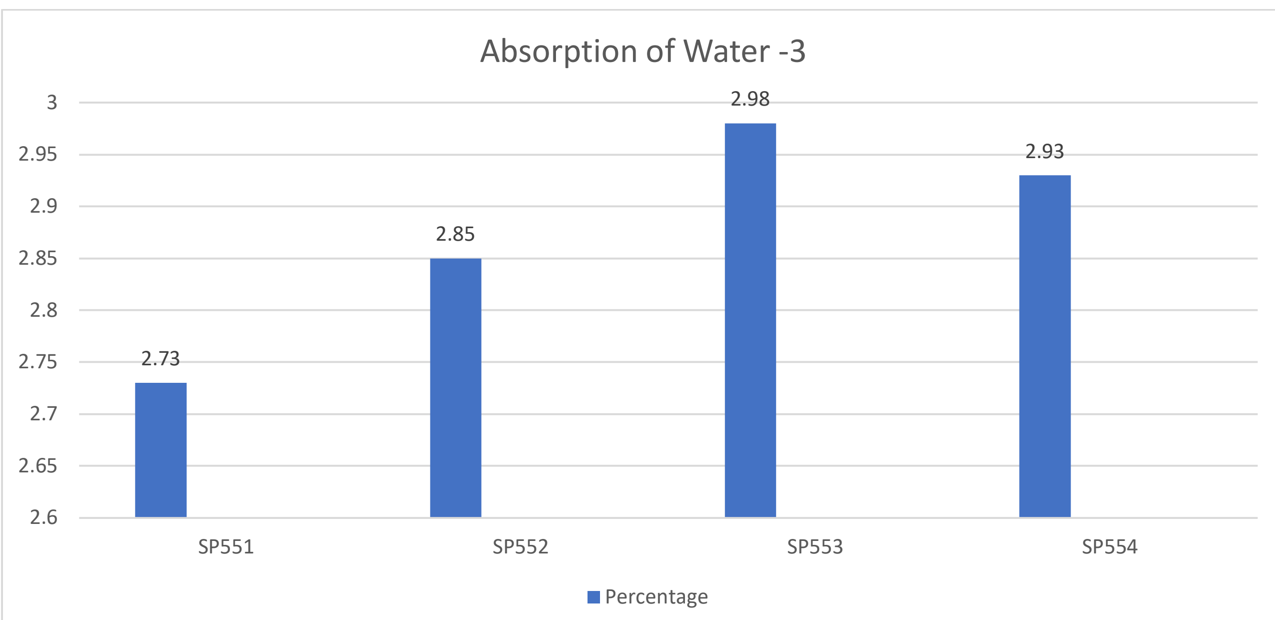

Chart 6: Water Absorption-3

Table 4: Absorption of Water (Sample -SP64)

SL No	Sample Code	Dry (Gram)	Wet (Gram)	Water (Gram)	Percentage
4	SP641	2900.00	3014.00	114.00	3.93%
	SP642	3020.00	3156.00	136.00	4.50%
	SP643	2980.00	3082.00	102.00	3.42%
	SP644	2890.00	2990.00	100.00	3.46%

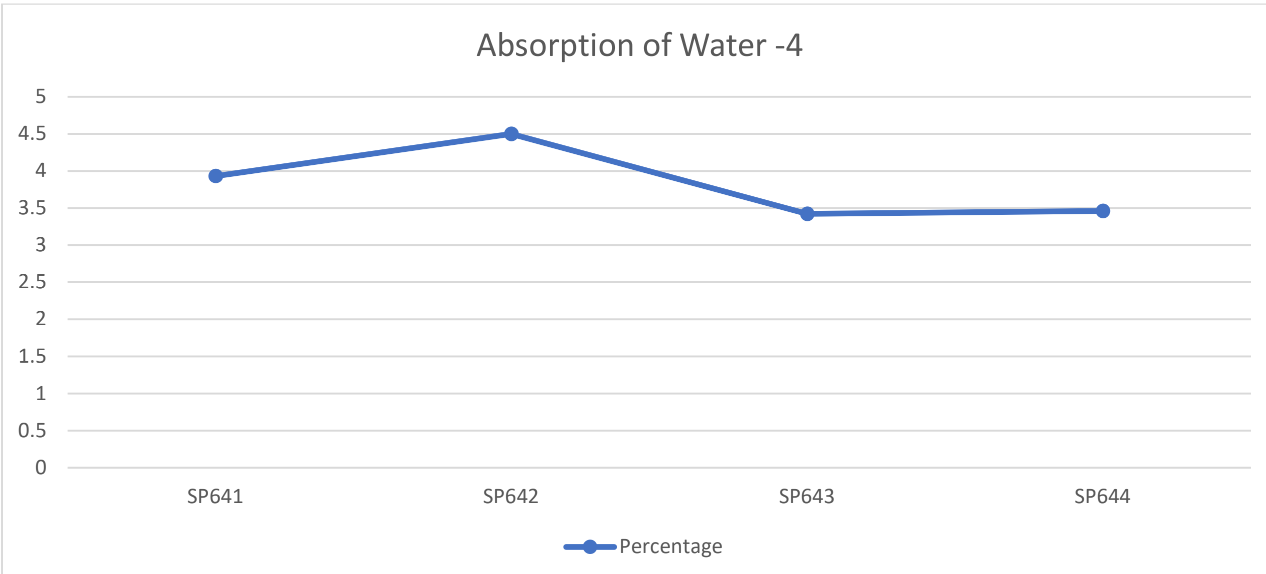

Chart 7: Water Absorption-4

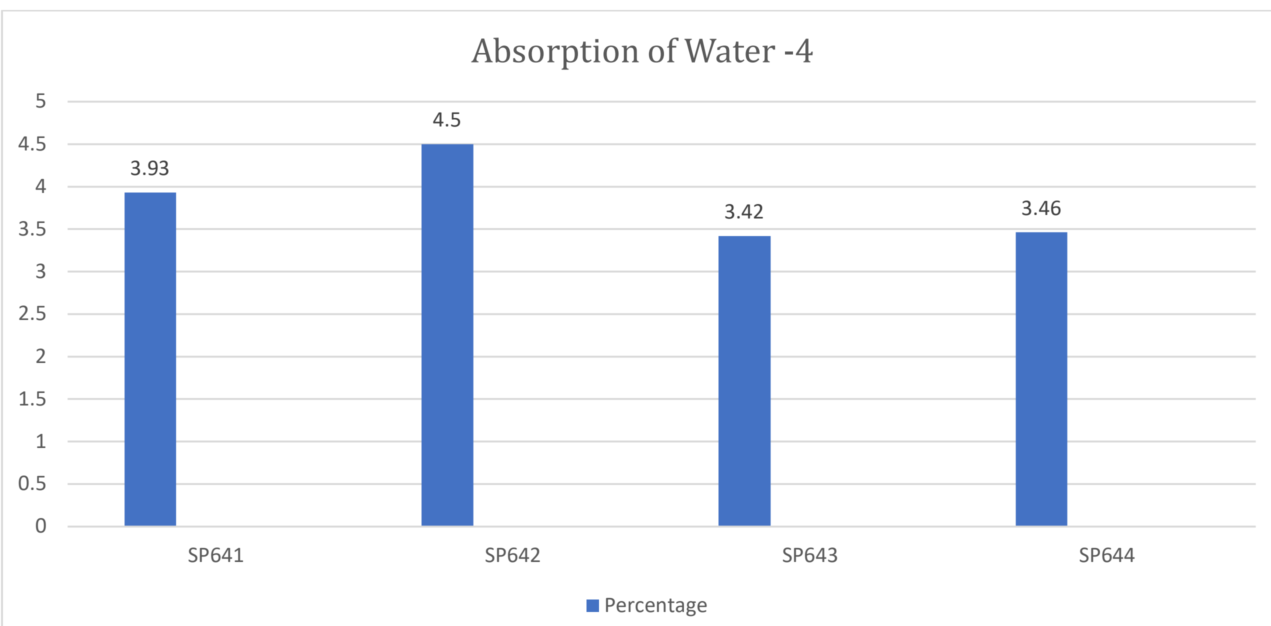

Chart 8: Water Absorption-4

4.4 Compressive Strength Test

To determine the compressive strength, the specimen was first positioned properly in the custom-built CTM (Compression Testing Machine). After alignment, the CTM was activated to apply compressive load. The hydraulic system increased the pressure gradually, and the load at which the first hairline crack appeared was recorded. The load was then increased further to identify the maximum load-bearing capacity of the sand plastic bricks and to observe whether the specimens failed or could sustain additional load.

Using this procedure, bricks made with different mix ratios were tested. The corresponding test values are presented below, allowing us to compare which mix ratio exhibited higher load-bearing capacity and which performed lower.

Figure 18: CTM (Compression Testing Machine)

Table 5: Compressive Strength Test (Sample -SP37)

SL No	Sample Code	Load KN	Load MPa
1	SP371	237.30	10.22
	SP372	320.00	13.78
	SP373	352.30	15.17
	SP374	295.36	12.72

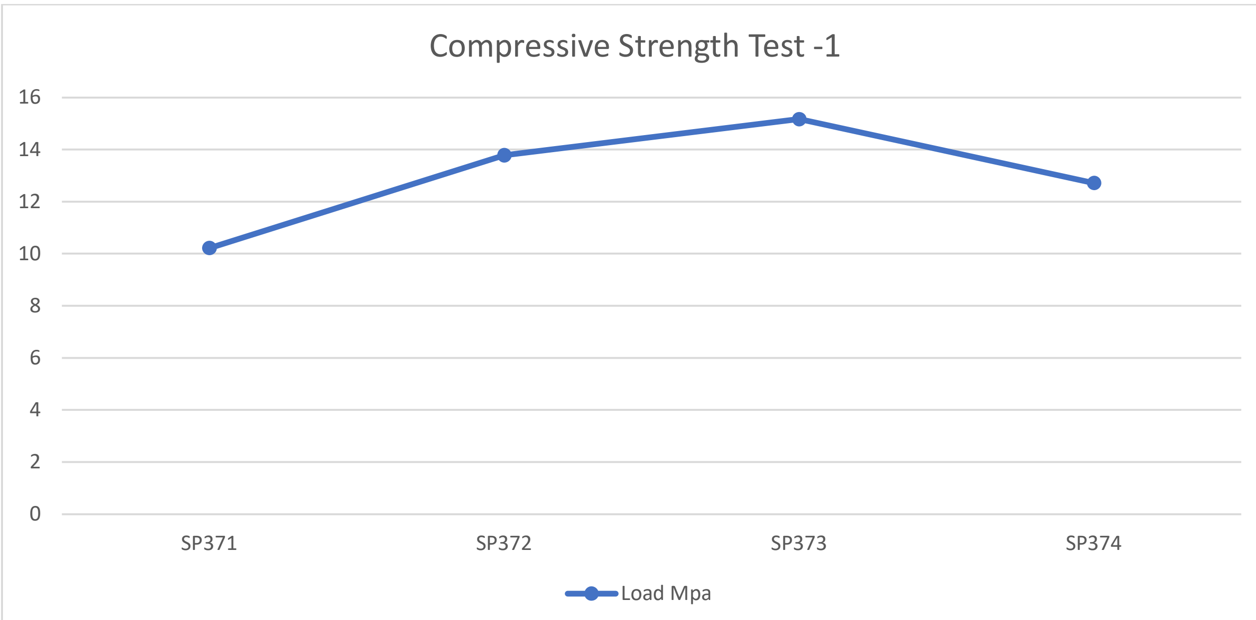

Chart 9: Compressive Strength-1

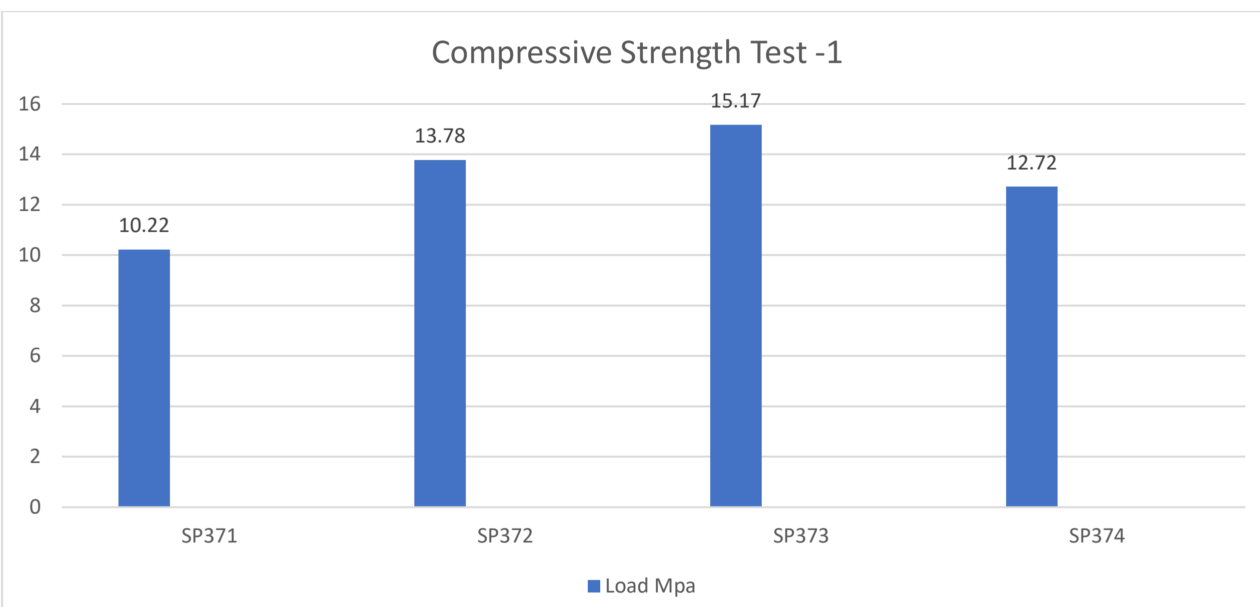

Chart 10: Compressive Strength-1

Table 6: Compressive Strength Test (Sample -SP46)

SL No	Sample Code	Load KN	Load MPa
2	SP461	180.32	7.76
	SP462	220.96	9.51
	SP463	190.00	8.18
	SP464	165.04	7.11

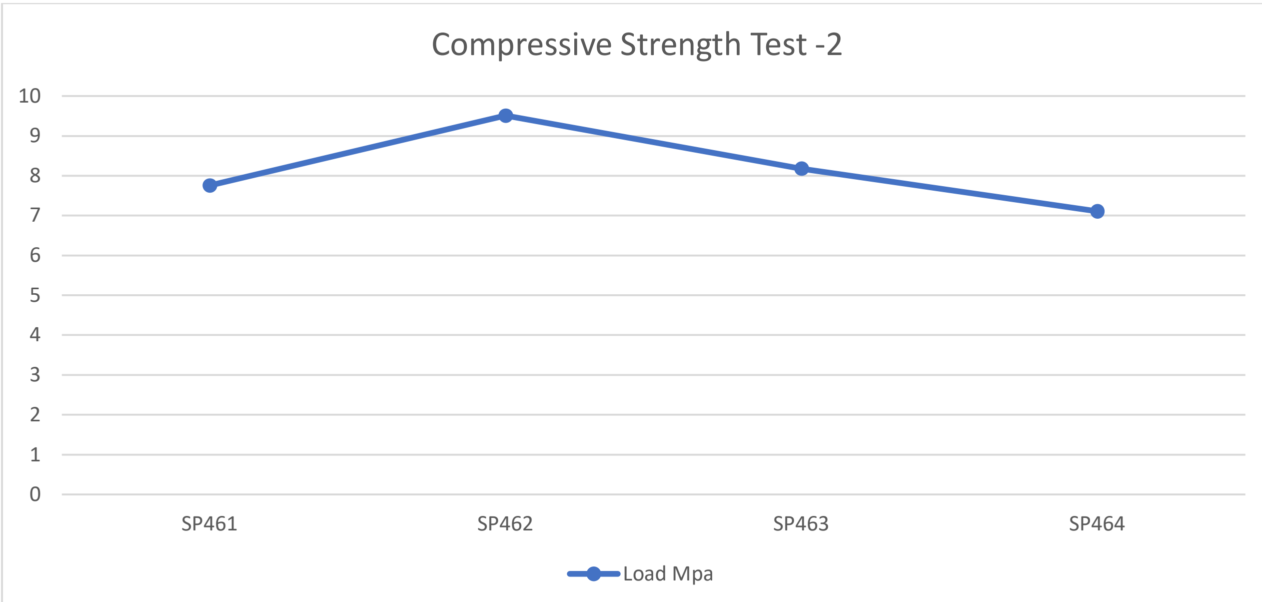

Chart 11: Compressive Strength-2

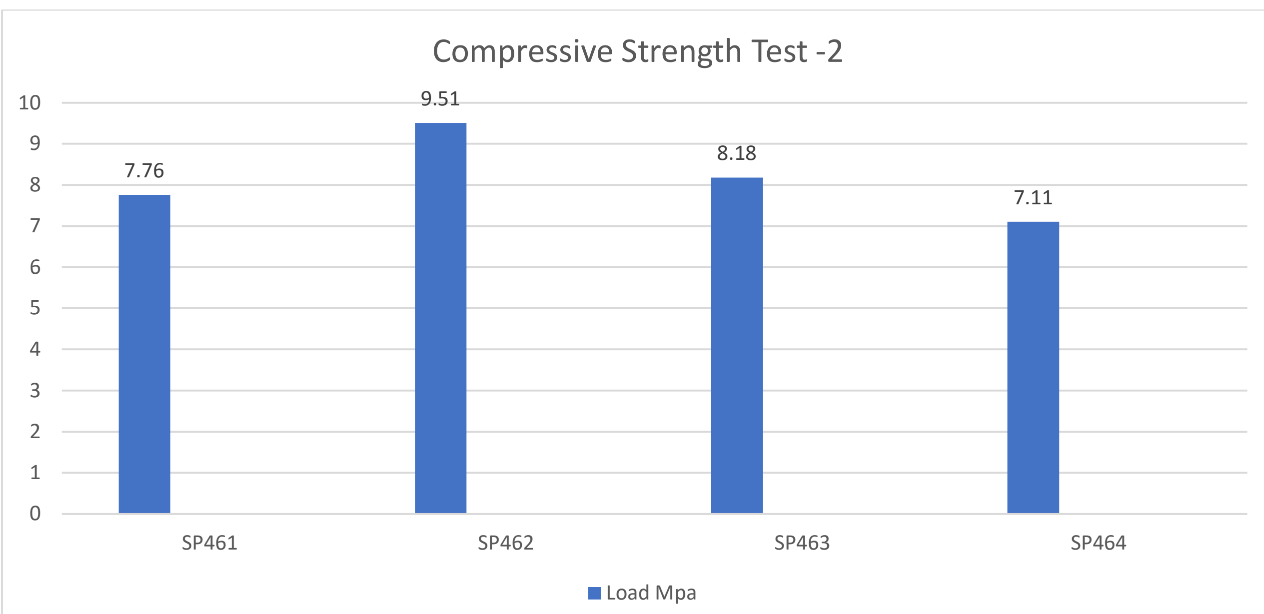

Chart 12: Compressive Strength-2

Table 7: Compressive Strength Test (Sample -SP55)

SL No	Sample Code	Load KN	Load MPa
3	SP551	235.5	10.14
	SP552	285.82	12.31
	SP553	310.00	13.35
	SP554	290.00	12.49

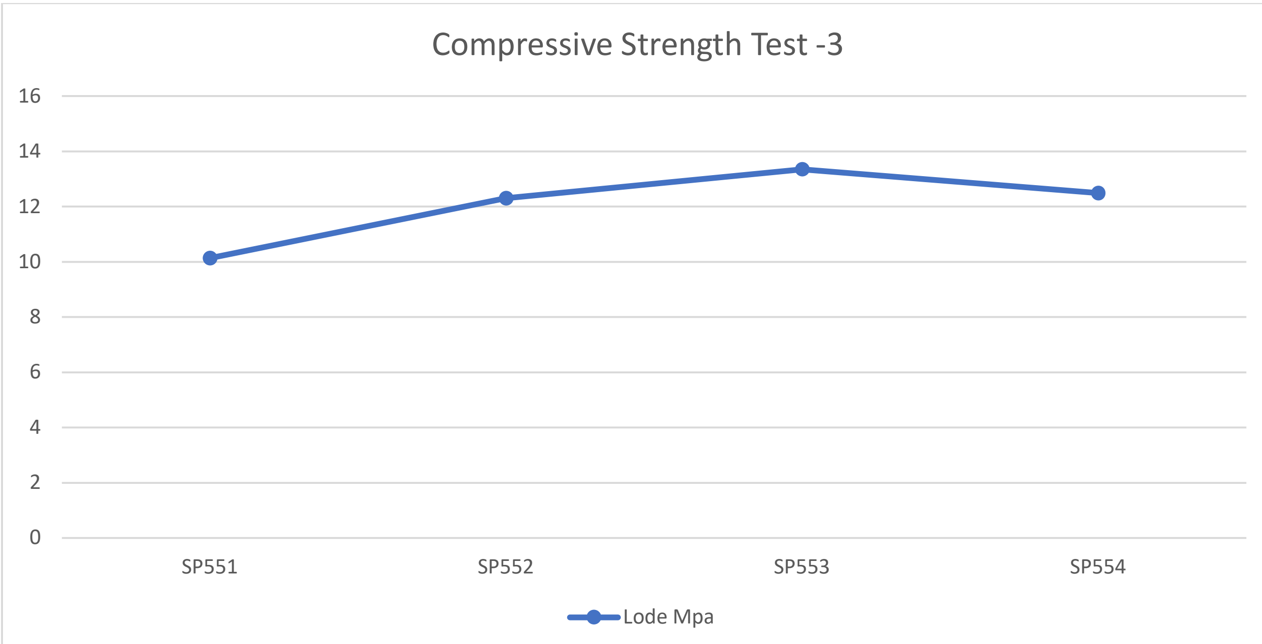

Chart 13: Compressive Strength-3

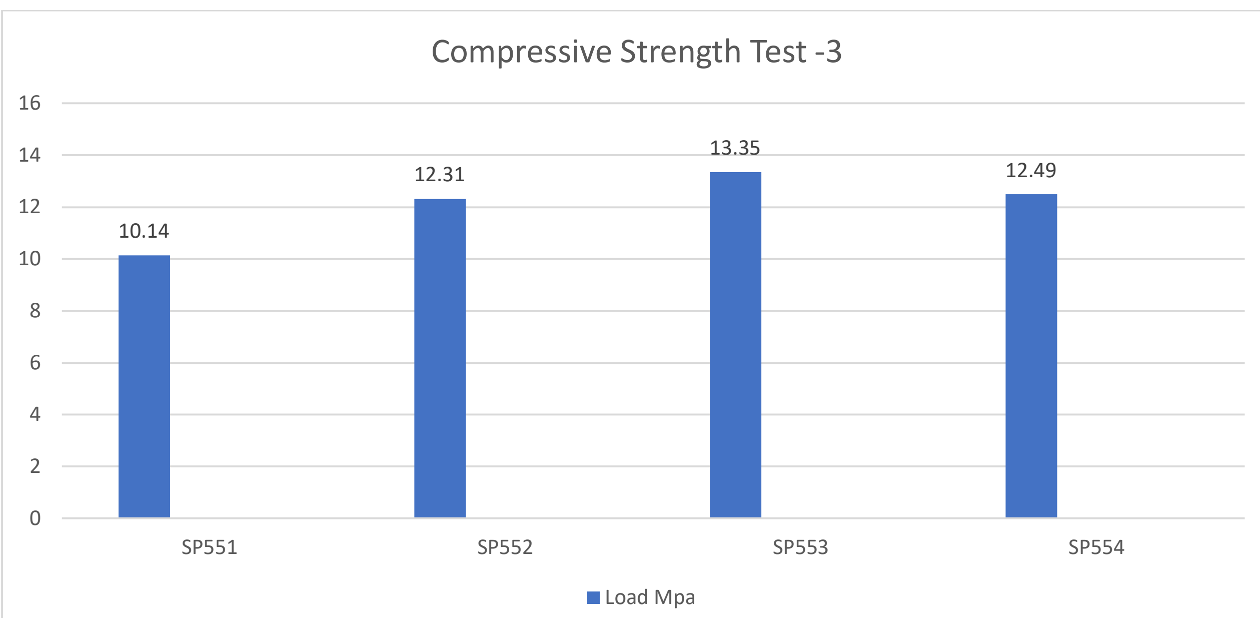

Chart 14: Compressive Strength-3

Table 8: Compressive Strength Test (Sample -SP64)

SL No	Sample Code	Load KN	Load MPa
4	SP641	99.43	4.28
	SP642	140.00	6.03
	SP643	180.20	7.76
	SP644	152.56	6.57

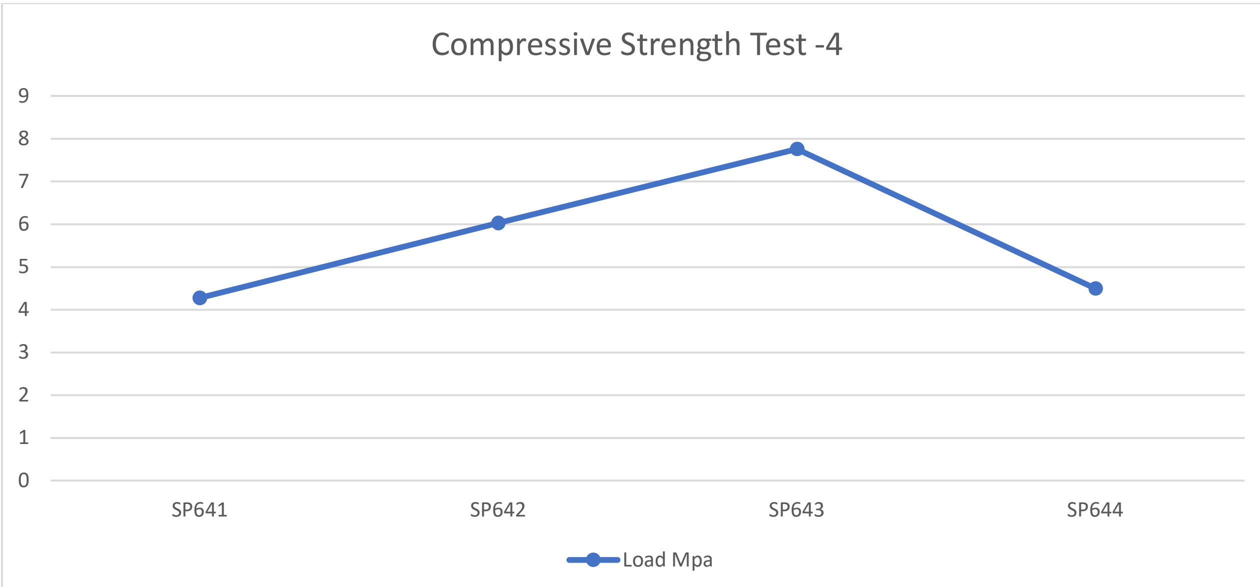

Chart 15: Compressive Strength-4

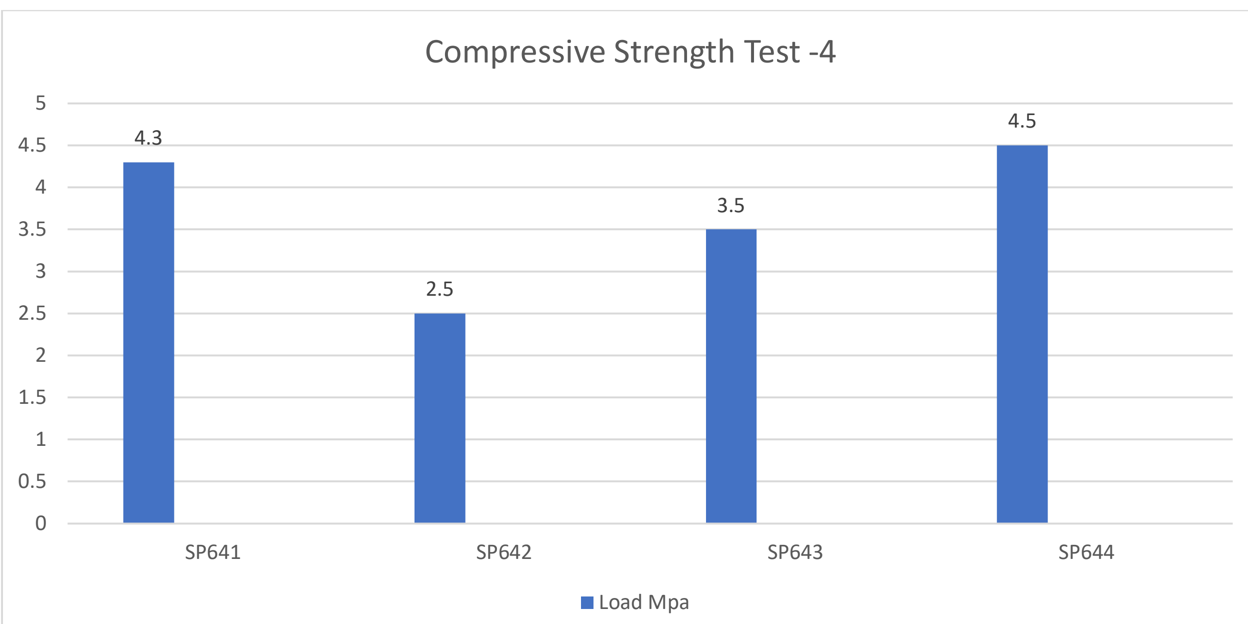

Chart 16: Compressive Strength-4

4.5 Abrasion Test

Abrasion testing is performed to evaluate the wear resistance of materials. This test is commonly conducted using the Los Angeles (LA) Abrasion Machine. Among several available standards, we selected the **AASHTO T96** method.

Figure 19: Los Angeles (LA) Abrasion Machine.

According to this method, two sieves are required: 20 mm and 12.5 mm. A total sample quantity of 5000 g is prepared, consisting of 2,500 g retained on the 20 mm sieve and 2,500 g retained on the 12.5 mm sieve.

Figure 20: The khoa is being sieved for the Abrasion testing.

Figure 21: Weighing the Khoa for the Abrasion test.

The prepared sample is then placed inside the LA Abrasion Machine along with 11 steel spheres, each weighing 400–450 g. The machine is operated for 500 revolutions.

Figure 22: Steel balls and materials inside the Los Angeles machine.

After completing 500 revolutions, the material is removed and sieved using the 1.68 mm sieve. The percentage of wear (abrasion value) is then calculated using the standard formula.

If the abrasion value is less than 30%, the material is considered to have good abrasion resistance and therefore higher durability.

Table 9: Abrasion Test Report

Grading	Sieve Size	Weight Indicated Size g	Weight Before Testing [A], g	Number of Sphere	Number of Revolutions	Weight of Sample on Sieve NO. 1.68 [B], g	Percentage Loss by abrasion (A-B) X100/A	Spec
B	20mm	2500.0	2500.0	11.0	500.0			<30%
	12.5mm	2500.0	2500.0					
	Total Weight	5000.0	5000.0			3948.0	**21.04**	

The abrasion test conducted using the Los Angeles machine yielded a result of **21.04%**, which is considered good since it is below the standard threshold of 30%. This indicates that our plastic-and-sand bricks successfully passed the abrasion test.

4.6 Cost Analysis

We used different ratios to prepare the various sample proportions. Based on these ratios, we analyzed the weight and cost of each sample.

Table10: Per Pcs Brick Making Cost.

SL	Sample Code	Sand	Plastic	Average (g)	Sand (g)	Plastic (g)	Sand Price	Plastic Price	Total Amount
1	SP37	30%	70%	2961.25	888.38	2072.88	0.74	62.19	**62.92**
2	SP46	40%	60%	2802.00	1120.80	1681.20	0.93	50.44	**51.37**
3	SP55	50%	50%	2679.00	1339.50	1339.50	1.11	40.19	**41.30**
4	SP64	60%	40%	2947.50	1768.50	1179.00	1.47	35.37	**36.84**

We made the bricks in different ratios, using varying amounts of plastic. The cost of the plastic used in these bricks ranged from 36.83 taka to 62.92 taka and Normal brick 16-25 Taka.

Table 11: Average Brick Weight.

SL	Sample Code	Sand	Plastic	Dry (W)	Average
1	SP371	30%	70%	3130.00	2961.25
	SP372	30%	70%	2830.00	
	SP373	30%	70%	2925.00	
	SP374	30%	70%	2960.00	
2	SP461	40%	60%	2998.00	2802.00
	SP462	40%	60%	2685.00	
	SP463	40%	60%	2785.00	
	SP464	40%	60%	2740.00	
3	SP551	50%	50%	2670.00	2679.00
	SP552	50%	50%	2630.00	
	SP553	50%	50%	2721.00	
	SP554	50%	50%	2695.00	
4	SP641	60%	40%	2900.00	2947.50
	SP642	60%	40%	3020.00	
	SP643	60%	40%	2980.00	
	SP644	60%	40%	2890.00	

4.7 Environmental Impact

Our brick-making process has a positive impact on the environment because we collect plastic waste and turn it into bricks. Plastics are found in many places—roads, drains, houses, factories, rivers, and more and they cause serious environmental problems. When drains are bricked by plastic, water cannot flow properly. As a result, even light rain can cause waterlogging in the city, making movement difficult and creating health hazards. Stagnant water can lead to the spread of diseases and even epidemics. If the drains were clear of plastic, rainwater would drain quickly, preventing waterlogging and reducing public suffering and health risks.

By collecting this plastic and converting it into bricks, we are helping the environment in multiple ways. Instead of using traditional clay, we use plastic in our eco-friendly bricks. This not only removes plastic waste from the environment but also conserves the soil that would otherwise be used for conventional brick-making.

4.8 Summary of Findings

The Study of eco-friendly bricks using microplastics and sand. collected these microplastics from homes, offices, courts, municipal dumping sites, and other locations. After collecting them, the microplastics are thoroughly cleaned, heated to liquefy, mixed with sand in a certain proportion, and made into bricks using a mold. After making the bricks, Various tests have been done, such as water absorption capacity, compressive strength test, and brick corrosion resistance test.

In the water absorption test, the brick has absorbed a maximum of **4.06%** water according to the **ASTM-67** method. Which we see as positive because a standard brick absorbs **15&** to **20**% percent of such water after soaking for 24 hours. There, the brick mixed with plastic and sand has 4.06%, which is much better than the standard.

In the compressive strength test of this brick, the obtained a maximum load of **15.17 MPa** was obtained according to the **ASTM-67** method. The minimum compressive strength of a standard first-class brick is **10.5 MPa**. Moreover, the compressive strength of normal bricks is within the range of **5** to **15** MPa. In that case, the compressive strength of bricks made from microplastics is more than 15. In this case, can say that it is much better or equivalent to normal bricks.

Abrasion resistance was evaluated using the **AASHTO T-96** Category B test with a Los Angeles abrasion machine. The obtained value was **21.04%,** which is well below the maximum allowable limit of **30%**. This result indicates that the brick has good strength and excellent resistance to wear and abrasion.

4.8.1 Optimum Composition:

The most suitable mix ratio was determined to be 70% plastic and 30% sand, offering the best balance between strength, weight, and surface finish.

4.8.2 Mechanical Performance:

The eco-bricks exhibited high compressive strength, durability, and dimensional stability, making them suitable for paving bricks, boundary walls, and other non-load-bearing applications.

4.8.3 Environmental Impact:

These bricks reuse non-biodegradable plastic waste, thereby reducing land and water pollution. They eliminate the need for firing or curing, which helps lower carbon emissions and preserve natural clay and topsoil typically used in traditional brick production.

4.8.4 Limitations:

Not all types of plastics melt evenly; mixing heterogeneous plastic waste may affect uniformity. Air voids can form during cooling if the material is not properly compacted.

CHAPTER -5

CONCLUSION

Conclusions

This research on making bricks from plastic and sand makes an important contribution to the field of eco-friendly construction technology, microplastic management, and full utilization. The use of bricks made from these microplastics has been initially prepared for some specific places. For example, sidewalks, parking lots, and basements of houses. Which facilitates people's daily movement, the environment is beautiful and pollution-free, which helps to keep our world beautiful.

This research was conducted to investigate the potential of using waste plastic materials as a partial replacement for conventional brick-making ingredients. The aim was to develop eco-friendly, cost-effective, and sustainable bricks that reduce environmental pollution and promote green construction practices.

The study addresses two pressing global challenges:

1. The ever-growing problem of plastic waste management, and

2. The environmental damage caused by traditional brick production, which consumes large amounts of natural clay and fuel.

By recycling plastic waste into construction materials, the project provides an innovative solution that supports both environmental protection and sustainable development. This study concludes that eco-bricks made from waste plastic and sand offer a sustainable, innovative, and practical solution to two pressing global challenges: plastic waste management and the demand for affordable, eco-friendly construction materials. Through experimentation and analysis, it was demonstrated that waste plastic can be effectively used as a binding material when mixed with sand, producing strong, durable, and lightweight bricks suitable for various construction applications.

The findings revealed that plastic eco-bricks possess desirable physical and mechanical properties, including good compressive strength, low water absorption, high durability, and thermal resistance. These qualities make them an excellent substitute for conventional clay or cement bricks, particularly in non-load-bearing structures such as pavements, partition walls, footpaths, and garden structures. The minimal water requirement and the absence of cement in the production process further enhance their environmental credentials, reducing both carbon emissions and natural resource depletion.

Moreover, the study highlights the significant environmental benefits of using plastic waste as a raw material. Recycling plastic into construction materials helps reduce landfill waste, prevent environmental pollution, and support circular economy practices. This approach transforms plastic waste into a valuable resource, contributing directly to global sustainability goals.

Economically, plastic eco-bricks provide a low-cost and energy-efficient alternative to traditional building materials. With raw materials plastic waste and sand being inexpensive and readily available, large-scale production is feasible even in developing regions. This opens opportunities for local entrepreneurship, job creation, and community-based waste management initiatives.

In summary, plastic eco-bricks represent a forward-thinking innovation in green construction technology. They offer an effective means to reuse plastic waste, minimize environmental impact, and promote sustainable development in the construction industry. While further research is recommended to enhance their load-bearing capacity and long-term performance, this study demonstrates that plastic eco-bricks have strong potential to become a vital component of future eco-friendly and cost-efficient building solutions

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APPENDICES

Methodology

1. Collection and Preparation of Materials

Waste plastics—mainly polyethylene (PE) and polypropylene (PP)—were collected, cleaned, and shredded into small pieces. Fine river sand was also collected, washed, dried, and sieved to ensure uniform grain size and cleanliness.

2. Melting and Mixing Process

The shredded plastic was heated until molten, after which sand was gradually added in measured proportions of **30:70, 40:60, 50:50, and 60:40 (plastic-to-sand ratios)**. The mixture was thoroughly stirred to achieve a uniform and workable plastic–sand composite.

3. Molding and Cooling

The hot mixture was poured into **steel molds** of standard brick dimensions (**9.5” × 4.5” × 2.75”**). The mixture was compacted to remove any air bubbles and then allowed to cool and harden at room temperature.

4. Testing and Evaluation

Laboratory tests were conducted to evaluate compressive strength, water absorption, and abrasion resistance, following standard procedures such as **AASHTO T96** and **IS 3495**.

Results and Discussion

1. Compressive Strength

The compressive strength varied with the plastic-to-sand ratio. The **30:70 (plastic: sand)** composition yielded the **highest compressive strength**, exceeding the minimum required value for **non-load-bearing walls**. Higher plastic content tended to reduce strength due to weaker inter-particle bonding, while a greater proportion of sand enhanced compactness and strength.

2. Water Absorption

Plastic–sand bricks exhibited **very low water absorption (<20%)**, significantly lower than that of conventional clay bricks, which typically absorb 25–30%. This indicates excellent water resistance and durability, making these bricks suitable for damp or wet environments.

3. Abrasion Resistance

The **abrasion loss** was recorded at **21%**, which is within the acceptable limit of **<30%**. This result demonstrates **good surface hardness** and **resistance to wear and erosion**, making the bricks suitable for applications exposed to friction or impact.

Objectives of the Study

The main objectives of this study were:

1. To design and manufacture eco-friendly bricks using waste plastic and sand in varying proportions.
2. To determine the optimum mix ratio of plastic and sand that provides the best mechanical and physical properties.
3. To evaluate the compressive strength, water absorption, and abrasion resistance of the produced bricks.
4. To compare the performance of plastic–sand eco-bricks with conventional clay bricks.
5. To assess the environmental, economic, and social impacts of using plastic–sand eco-bricks in construction.

Experimental Results and Conclusion

The study concludes that eco-bricks made from waste plastic and sand are a sustainable, durable, and economical alternative to conventional building materials. The research demonstrates that plastic waste can be successfully transformed into high-value construction products, reducing environmental pollution while promoting circular economy principles.

This innovation represents a significant step toward green construction technology, aligning with global goals for environmental sustainability, resource efficiency, and waste management. With further research, standardization, and government support, plastic–sand eco-bricks have the potential to play a vital role in the future of sustainable housing and infrastructure development.