

Sustainable Bricks Made of Plastic

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Abstract-The conventional brick manufacturing process has long posed challenges related to environmental sustainability and resource consumption. To address these concerns, this research presents a pioneering approach in brick production through the creation of composite bricks that incorporate a blend of plastic waste, foundry sand, rock dust, and clay. This innovative approach offers a promising solution for the construction industry to adopt eco-friendly alternatives to traditional bricks. This study investigates the composition of these composite bricks, with a focus on their structural properties, durability, and environmental impact. By recycling plastic waste and repurposing materials such as foundry sand and rock dust, the research aims to reduce the pressure on natural resources and minimize the carbon footprint associated with brick production. Laboratory testing, including assessments of compressive strength and thermal resistance, demonstrates the suitability of these composite bricks for various construction applications. Additionally, a comprehensive life cycle analysis reveals a substantial reduction in energy consumption .

In conclusion, the integration of plastic waste, foundry sand, rock dust, and clay into composite bricks presents an innovative avenue for sustainable construction materials. These composite bricks not only mitigate the environmental impact of the construction sector but also contribute to responsible waste management and resource conservation. The findings from this research advocate for the widespread adoption of these composite bricks as a viable and eco-conscious alternative to traditional construction materials, paving the way for a more sustainable future.

The conventional brick manufacturing process has long posed challenges related to environmental sustainability and resource consumption. To address these concerns, this research presents a pioneering approach in brick production through the creation of composite bricks that incorporate a blend of plastic waste, foundry sand, rock dust, and clay. This innovative approach offers a promising solution for the construction industry to adopt eco-friendly alternatives to traditional bricks. This study investigates the composition of these composite bricks, with a focus on their structural properties, durability, and environmental impact. By recycling plastic waste and repurposing materials such as foundry sand and rock dust, the research aims to reduce the pressure on natural resources and minimize the carbon footprint associated with brick production. Laboratory testing, including assessments of compressive strength and thermal resistance, demonstrates the suitability of these composite bricks for various construction applications. Additionally, a comprehensive life cycle analysis reveals a substantial reduction in energy consumption .

Keywords- raw materials, materials required , procedure , observation , precautions , testing types , applications , advantages and disadvantages , conclusion , references .

1. Introduction

In the ever-evolving landscape of construction and sustainable architecture, the introduction of plastic bricks represents a remarkable advancement in building materials. These innovative bricks, composed of recycled plastics, offer a multitude of advantages that extend beyond traditional construction methods. The following introduction explores the key aspects of plastic bricks, their composition, properties, and the potential impact they can have on the construction industry.

1. Composition:

Plastic bricks are primarily crafted from recycled plastics, including materials such as PET bottles, polyethylene, and polypropylene. These plastics undergo a meticulous

process of shredding, cleaning, and compression, and further heating and subjecting to solid state to molten state and by adding suitable ingredients in order to form sturdy and durable building blocks.

2. Key Properties:

Plastic bricks boast a set of unique properties that contribute to their appeal:

Sustainability: The use of recycled plastics reduces the environmental impact by repurposing waste materials.

Durability: Plastic bricks exhibit remarkable resistance to weathering, erosion, and corrosion, ensuring the longevity of structures.

Insulation: The inherent insulating properties of plastic bricks enhance energy efficiency, offering potential cost savings in heating and cooling.

Customizability: Their versatility in design allows for a wide range of architectural applications.

Environmental Impact: One of the most compelling aspects of plastic bricks is their contribution to sustainability. By diverting plastics from landfills and oceans, these bricks play a crucial role in mitigating plastic pollution and reducing the carbon footprint of the construction industry.

2. Raw Materials

Sand: Sand is a granular material composed of finely divided mineral particles. Sand has various compositions but is defined by its grain size. Sand grains are smaller than gravel and coarser than silt. Sand can also refer to a textural class of soil or soil type; i.e., a soil containing more than 85 percent sand-sized particles by mass

Rock dust: Rock dust is a pulverized rock, usually limestone, sprayed on walls inside underground coal mines to prevent coal dust explosions. The dust acts as a heat sink, keeps coal dust levels down, and also prevents the incidence of black lung disease. Rock dust has been used since the early 1900s

Foundry: Foundry sand consists primarily of clean, uniformly sized, high-quality silica sand or lake sand that is bonded to form molds for ferrous (iron and steel) and nonferrous (copper, aluminum, brass) metal castings. Although these sands are clean prior to use, after casting they may contain Ferrous (iron and steel) industries account for approximately 95 percent of foundry sand used for castings. The automotive industry and its parts suppliers are the major generators of foundry sand.

Plastic: Plastics are a wide range of synthetic or semi-synthetic materials that use polymers as a main ingredient. Their plasticity makes it possible for plastics to be moulded, extruded or pressed into solid objects of various shapes. This adaptability, plus a wide range of other properties, such as being lightweight, durable, flexible, and inexpensive to produce, has led to its widespread use. Plastics typically are made through human industrial systems. Most modern plastics are derived from fossil fuel-based chemicals like natural gas or petroleum; however, recent industrial methods use variants made from renewable materials, such as corn or cotton derivatives.

Recyclable plastic are as follows

1. PET (Polyethylene Terephthalate)

- Common Uses: PET is widely used in the production of plastic bottles for beverages, food containers, and various packaging materials. It is also used in the textile industry for making synthetic fibers such as polyester.

- Properties: PET is a clear, strong, and lightweight plastic that is resistant to moisture, chemicals, and UV radiation. It is known for its excellent gas barrier properties, making it suitable for carbonated beverage bottles.
- Recycling: PET is highly recyclable and is identified with the resin code "1" for recycling. Recycled PET, known as rPET, is used in various applications, including clothing, carpet, and new plastic products.
- **Formula:** $\text{HO-CH}_2\text{-CH}_2\text{-OH} + \text{HOOC-C}_6\text{H}_4\text{-COOH} \rightarrow [-\text{O-CH}_2\text{-CH}_2\text{-OOC-C}_6\text{H}_4\text{-COO-}]_n + 2\text{H}_2\text{O}$

2.HDPE (High-Density Polyethylene):

- Common Uses: HDPE is used for a wide range of applications, including plastic bottles for milk and juice, plastic bags, toys, pipes, and containers for various chemicals. It is also used in the construction industry for geomembranes and drainage pipes.
- Properties: HDPE is a versatile plastic known for its high strength, resistance to chemicals, impact resistance, and low moisture absorption. It is a durable material and has excellent environmental stress-cracking resistance.
- Recycling: HDPE is one of the most commonly recycled plastics, identified with the resin code "2" for recycling. Recycled HDPE is used in the manufacturing of new bottles, pipes, and various other products.
- **Formula:** $(-\text{CH}_2=\text{CH}_2)_n \rightarrow [-\text{CH}_2\text{-CH}_2\text{-}]_n$

3.PP (Polypropylene):

- Common Uses: Polypropylene is used in a wide range of applications, including food containers, plastic furniture, automotive parts, packaging materials, and textiles. It is also used in medical devices and laboratory equipment.
- Properties: PP is a tough and lightweight plastic with excellent resistance to moisture, chemicals, and heat. It has a high melting point, making it suitable for applications that involve high-temperature environments.
- Recycling: PP is recyclable and is identified with the resin code "5" for recycling. Recycled PP can be used in the manufacturing of automotive parts, plastic bins, and fibers for textiles.
- **Formula:** $(\text{CH}_3)\text{-CH}=\text{CH}_2 \rightarrow [-\text{CH}_2\text{-CH}(\text{CH}_3)\text{-}]_n$

3. Proposed Methodology

Creating Plastic Bricks By Combining Plastic with Various Materials Like Sand, Foundry Sand, and Rock Dust Is A Sustainable Approach To Reuse Waste Plastics and Reduce The Environmental Impact of Traditional Construction Materials. Here Are the General Procedures For Making Plastic Bricks using these Combinations:

1. Plastic and Sand Bricks:

Materials Needed:

Plastic Waste (E.G., Pet Bottles Or Other Recyclable Plastic Clean and Dry Sand Molds Or Brick-Forming Equipment Heat Source (For Melting Plastic) Mixing and Compaction Tools

Procedure:

Collect and Prepare Plastic: Start By Collecting Plastic Waste and Cleaning it Thoroughly. Remove Labels, Caps, and any Contaminants. Dry the Plastic to Eliminate Moisture.

Melt The Plastic: In A Controlled Environment With Adequate Ventilation, Melt The Plastic Waste Using A Heat Source Such As An Electric Hotplate Or A Makeshift Oven. Ensure The Plastic Doesn't Burn But Only Melts. Be Cautious As Overheating Can Produce Harmful Fumes.

Mixing: Combine The Melted Plastic With Clean and Dry Sand In The Desired Proportions. The Exact Ratio Will Depend On The Type Of Plastic And The Desired Properties Of The Bricks. Mix Thoroughly To Achieve A Uniform Consistency.

Molding: Pour The Plastic-Sand Mixture Into Molds Or Brick-Forming Equipment. Compact The Mixture To Remove Air Bubbles And Achieve The Desired Shape And Density For The Bricks.

Cooling And Curing: Allow The Bricks To Cool And Cure For A Specified Time. This Can Range From A Few Hours To A Few Days, Depending On The Mixture And Environmental Conditions.

Demolding: Once The Bricks Have Cured And Solidified, Carefully Demold Them. Handle With Care To Avoid Breakage.

2. Plastic and Foundry Sand Bricks:

Procedure:

The Procedure For Making Plastic Bricks Using Foundry Sand Is Similar To The Plastic And Sand Bricks Mentioned Above, With The Key Difference Being The Use Of Foundry Sand As A Replacement For Regular Sand. Foundry Sand, Which Is A Byproduct Of Metal Casting Processes, Can Be Used As A Sustainable Alternative To Natural Sand In The Mixture.

3. Plastic And Rock Dust Bricks:

Procedure:

Creating Plastic Bricks With The Combination Of Plastic And Rock Dust Follows The Same Basic Steps As Plastic And Sand Bricks, With Rock Dust As A Substitute For Natural Sand. Rock Dust, Often Obtained From Quarry Operations Or Crushed Rocks, Is Used In The Mixture To Improve

The Strength And Durability Of The Bricks. The Ratio Of Plastic To Rock Dust Will Vary Depending On Specific Requirements.

The Critical Aspect In Each Of These Procedures is the Careful Selection And Mixing Of Materials, As Well As The Curing Process, Which Ensures The Formation Of Durable And Stable Plastic Bricks. Additionally, Safety Precautions, Particularly When Working With Heated Plastics, Are Crucial To Protect Against Potential Health Hazards. The Exact Ratios And Curing Times May Vary Based On The Specific Type Of Plastic And Materials Used, As Well As The Intended Application Of The Bricks.

4. Observation Table

SLNO	BRICK TYPE	COMPOSITION
1	PLASTIC+SAND	PET BOTTLES, SAND
2	PLASTIC+ROCKDUST	PET BOTTLES, ROCKDUST
3	PLASTIC+FOUNDRY	PET BOTTLES, FOUNDRY

4. Precautions

1. Care should be taken while the melting of the plastic is done.
2. Must and wear the mask, shoes and full-length clothing to avoid the burns.
3. Observe weather the solids present in the liquidized plastic.
4. Gloves are must and should.
5. Do not touch the mould after pouring the liquidized plastic mixture with bear hands.

5. Testing Types

1. Compressive Strength Test:This test determines the ability of a brick to withstand axial loads or compression. A sample brick is placed in a testing machine, and the maximum load it can withstand before failing is recorded. Compressive strength is a crucial property for bricks in load-bearing structures.

2. Water Absorption Test:Water absorption testing measures the ability of a brick to absorb water. A dry brick is weighed, then immersed in water for a specified duration. Afterward, the brick is weighed again to determine the amount of water absorbed. Lower water absorption is generally preferred as it indicates better resistance to weathering and durability.

3. Efflorescence Test:Efflorescence is the formation of white, powdery deposits on the surface of bricks due to the leaching of soluble salts. Bricks are visually inspected for efflorescence, and the severity of efflorescence can be classified as slight, moderate, or severe.

4. Dimensional Tolerance Test:This test assesses the dimensional accuracy and uniformity of bricks. The length, width, and height of multiple bricks are measured, and variations are compared to standard dimensions. Bricks with consistent dimensions are crucial for masonry work.

5. Hardness Test:The hardness of a brick is determined by scratching it with a knife or a similar instrument. Bricks with a higher degree of hardness are more resistant to wear and abrasion.

6. Soundness Test:This test evaluates the resistance of bricks to sudden changes in temperature. Bricks are subjected to freezing and thawing cycles, and any visible signs of deterioration are noted. Sound bricks should not disintegrate or crack under such conditions.

7. Density and Specific Gravity Test:This test measures the density and specific gravity of bricks. It helps in assessing the weight and compactness of the material, which can affect their structural and thermal properties.

8. Flexural Strength Test:This test determines the ability of a brick to withstand bending forces. A brick specimen is subjected to a bending load, and its resistance to

bending is measured. This property is important for special applications where bricks may experience lateral loads.

9. Thermal Conductivity Test: Bricks are tested for their ability to conduct heat, which is crucial for evaluating their insulation properties. Lower thermal conductivity is desirable for bricks used in insulation.

These tests are essential for quality control and ensuring that bricks meet the necessary standards for construction. The specific tests conducted may vary depending on the intended use of the bricks and local building codes and regulations.

Advantages

- **Environmental Sustainability:** Utilizes recycled plastics, reducing the demand for new raw materials.
- Helps manage and reduce plastic waste, contributing to environmental sustainability.
- **Durability and Resistance:** Resistant to weathering, erosion, and corrosion, leading to increased durability. Depending on composition, can be resistant to chemicals, ensuring stability.
- **Reduction in Construction Costs:** Cost-effective production, especially when using recycled plastics.
- **Community Engagement:** Supports community recycling initiatives by encouraging plastic waste collection.
- **Innovation and Research Opportunities:** Ongoing research may lead to technological advancements in strength and durability.
- **Potential for Large-Scale Projects:** Can contribute to large-scale infrastructure projects with a focus on sustainability

Applications

Plastic bricks find use in a variety of construction Projects, from residential buildings to infrastructure development. Their lightweight nature, ease of assembly, and insulating properties make them particularly suitable for regions with diverse climate conditions.

Regulations and Standards: As with any construction material, the production and use of plastic bricks are subject to stringent regulations and quality standards to ensure safety, structural integrity, and adherence to environmentally responsible practices.

Disadvantages

- **Limited Heat Resistance:** Depending on the composition of the plastic used, plastic bricks may have limited heat resistance compared to traditional building materials. This can be a concern in high-temperature environments.
- **Cost Considerations:** While plastic bricks can offer cost savings in some areas, factors such as the availability of recycled plastics, production technology, and local market conditions can affect overall costs.
- **Dependency on Plastic Waste Streams:** The availability and quality of recycled plastics, a key component of plastic bricks, depend on effective waste management systems. In regions without proper waste infrastructure, the raw material source may be limited.

6. Conclusion



The introduction of plastic bricks into the construction industry signifies a transformative shift towards sustainability and eco-friendly building materials. These innovative bricks not only address environmental concerns but also offer durable and cost-effective solutions for modern construction projects. Their adoption represents a pointed step towards a greener, more sustainable future in the field of architecture and infrastructure.

Appendix

The sustainable plastic bricks are also called as the eco bricks which can withstand the heat temperature up to the 300 degrees centigrade and it has high compressive strengths.

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