EVALUATION OF POLYMER-SAND BRICKS AS A SUSTAINABLE BUILDING ALTERNATIVE

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Introduction

The increasing accumulation of plastic waste in landfills has created a need for innovative recycling solutions. This research explores the use of polyethylene terephthalate (PET), high-density polyethylene (HDPE), and polypropylene (PP) waste to produce plastic-sand composite bricks, inspired by the work of Gjenge Makers. In addition to evaluating the strength and durability of these bricks, the study analyzes the amount of recycled plastic incorporated into each and its potential to be remelted and reused, continuing its lifecycle. The plastic-sand composite bricks promote sustainable building practices while removing immense amounts of plastic from local landfills.

Manufacturing


Collection


Shredding


Heating


Pressing


Brick Formation

Evolution of Process:


Open Flame

→


Oven


Manufactured Pellets

→


Shredded Plastic


Shredder

Matrix:

Plastic Material	Ratio [Plastic : Sand]
High Density Polyethylene [HDPE]	40 : 60
	50 : 50
	100 : 0
Polypropylene [PP]	40 : 60
	50 : 50
	100 : 0
Polyethylene Terephthalate [PET]	40 : 60
	50 : 50
	100 : 0
High Density Polyethylene [HDPE] + Polypropylene [PP]	20 : 20 : 60
	25 : 25 : 50
	50 : 50 : 100

Environmental Impact

Globally, over 430 million tons of plastic are produced each year, yet only about 9% is recycled, leaving the majority in landfills or polluting natural environments. Converting plastic waste into bricks provides a practical solution, turning a pollutant into a durable construction material. This approach not only reduces landfill volume but also supports circular economy principles and aligns with United Nations sustainability goals.

Plastic Brick Weight = 1 kg

1 kg → 1 metric ton of plastic → 1,000 bricks

- 430 million metric tons of plastic → 430 billion bricks
- A 1,500 sq. foot house requires ~12,000 bricks

→ **~35.8 Million Houses**

Analysis

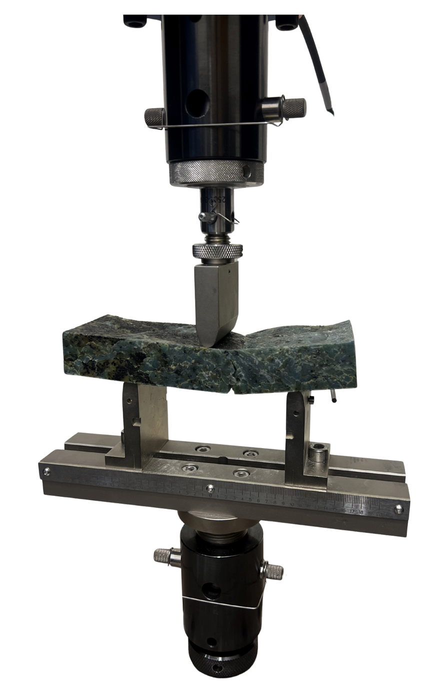
Mechanical Performance and Structural Viability

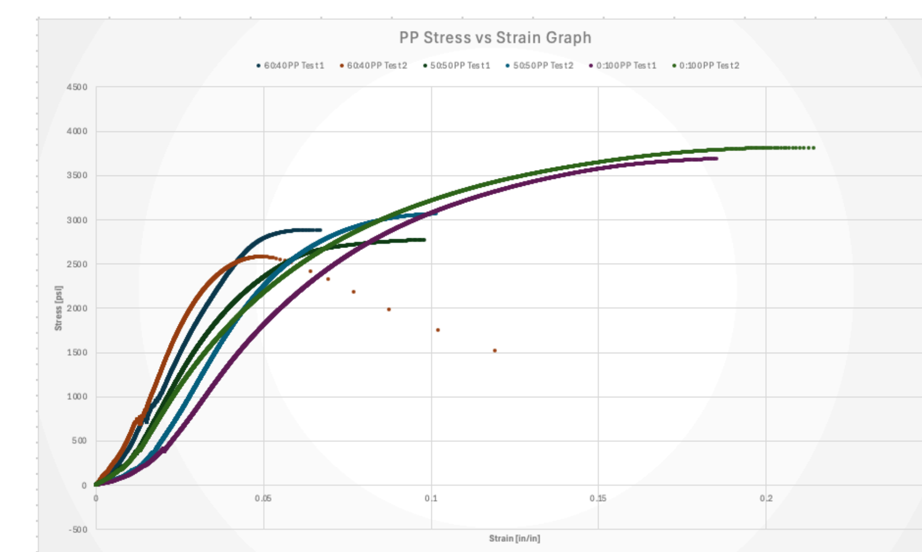
- **Optimized Stiffness and Durability:** The PET Plastic (40:60) composite exhibited the highest compressive modulus, demonstrating superior material stiffness and the least amount of deformation under load.
- **Superior Load-Bearing Capacity:** Multiple composite formulations successfully surpassed the ASTM C-62 standard for building bricks (minimum 2,500 psi), including:
  - High-Density Polyethylene (HDPE) at 50:50 and 100:0 ratios.
  - Polypropylene (PP) at 50:50 and 100:0 ratios.
  - Polyethylene Terephthalate (PET) at a 40:60 ratio.
- **Functional Interchangeability:** The PET (40:60) composite achieved a compressive modulus of 72.2 ksi, exceeding that of a C-62 SW (Severe Weathering) masonry brick at 71.8 ksi. Since it meets the mechanical thresholds of the SW grade, the industry's most stringent classification for durability, the data suggests that the composite is a viable replacement in any architectural application where C-62 SW bricks are currently specified.
- **Flexural Resilience:** Performance testing revealed that HDPE and PET composites yielded nearly identical flexural moduli, suggesting both materials are equally effective at resisting bending forces in structural applications.
- **Strain Resistance:** The PET 40:60 formulation was identified as the most structurally stable, pairing one of the highest recorded compressive strengths with the lowest recorded strain values.

Methodology

Tests Run:

- **3-Pt. Bend Test:** Resistance to cracking under bending
- **Compressive Test:** Ability to support structural loads
- **Ductility:** Deformation of material at the maximum load


Flexural Test Performed on an Instron



Stress vs Strain Graph of Polypropylene Bricks at Varying Plastic Ratios

Conclusion

The findings of this study confirm that recycled plastic composites, formulated with HDPE, PP, and PET, serve as technically viable alternatives to traditional masonry by meeting or exceeding the ASTM C-62 compressive strength standard of 2,500 psi. Analysis of material ratios reveals a distinct performance trade-off: an increased sand-to-plastic ratio enhances the compressive modulus, resulting in a more rigid structure, while a higher plastic concentration improves flexural strength at the expense of material stiffness. A pivotal finding of this study is the performance of the PET (40:60) formulation, which reached a compressive modulus of 72.2 ksi. This figure not only represents the highest stability among the tested groups but also surpasses the 71.8 ksi of C-62 SW (Severe Weathering) bricks. Such parity suggests these composites can be safely integrated into any architectural context currently requiring top-tier masonry durability. By validating these recycled composites against rigorous industry benchmarks, this research supports a circular economy model that diverts plastic waste from landfills and repurposes it into durable, long-term infrastructure solutions.

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