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Utilization of Plastic Waste as Construction Material

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Abstract

Plastic is one of the most commonly used materials in modern life, but it significantly contributes to environmental pollution. Rapid urbanization has led to increased demand for construction materials, exacerbating sustainability challenges. Utilizing plastic waste in construction can address this issue by conserving natural resources, minimizing environmental damage, and reducing construction costs. This study explores the use of plastic waste in concrete mixtures and block manufacturing. Experiments demonstrate that molten waste plastics such as polypropylene can produce durable, heat-resistant, and water-resistant blocks with sufficient compressive strength.

Keywords: Plastic Waste, Sustainable Construction, Concrete Mix Design, Compressive Strength, Environmental Impact, Reuse and Recycling, Material Properties

1. INTRODUCTION

Plastics are economical and highly useful, yet their overproduction—over 380 million tonnes annually—poses severe environmental risks. Much of this plastic ends up in oceans and landfills, contributing to microplastic pollution and harming ecosystems. Most plastic is non-biodegradable and non-recyclable, making sustainable disposal a major concern. Addressing this challenge requires innovative reuse methods, including their incorporation into construction materials.

2. Literature Review

Sridhar Sawant et al. (2017) investigated the use of polypropylene fibers to reduce shrinkage-induced cracking in green concrete, enhancing its structural integrity.

Ankur C. Bhogayata et al. (2017) analyzed the use of shredded plastic waste as fibers in concrete, finding improved toughness and workability.

Archit Hardikar et al. (2019) showed that plastic aggregates, though having lower specific gravity, can be effectively used with appropriate admixtures to improve bonding and performance.

3. Methodology

A. Concrete Block with Granular Plastic as Admixture

- 1. Plastic waste was collected, cleaned, shredded, and air-dried.
- 2. Granular plastic was mixed into M20-grade concrete at proportions of 1%, 3%, 5%, 6.11%, and 7%.
- **3.** Blocks (150×150×150 mm) were cast, compacted, cured for 28 days, and tested for compressive strength.



B. Plastic Blocks Made from Molten Waste

- 1. Mixed plastic waste was melted at 150–170°C and poured into oiled molds (150×150×75 mm).
- 2. After cooling, the blocks were demolded and tested.
- 3. Polypropylene was primarily used due to its favorable thermal and mechanical properties.

4. Results and Discussion

A. Concrete Blocks

Concrete blocks with up to 5% plastic waste showed compressive strengths comparable to standard blocks, indicating feasibility for structural applications.

B. Polypropylene Plastic Blocks

These blocks exhibited good compressive strength and can be used in pedestrian pathways and decorative landscaping.

5. Conclusion

- 1. India generates ~34.7 lakh TPA of plastic waste; about 50% is unrecycled.
- 2. This waste can serve as a raw material for blocks, reducing environmental exposure.
- 3. Incorporating up to 5% plastic does not significantly reduce concrete block strength.
- **4.** Polypropylene blocks have suitable compressive strength and are cost-effective, lightweight alternatives for pedestrian and decorative applications.
- 5. Plastic waste reuse in construction supports a circular economy and helps mitigate plastic pollution.

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