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# Utilization of Plastic Waste in Fly-Ash Bricks: A Sustainable Approach

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## Abstract:

Plastic waste accumulation poses serious environmental concerns due to its non-biodegradable nature. This study explores the utilization of plastic waste (HDPE) as a partial replacement for stone dust in fly-ash brick manufacturing. The experimental program involved preparation of fly-ash bricks with varying percentages of plastic waste and testing their compressive strength, water absorption, dimensional stability, and other characteristics. Results indicated enhanced mechanical performance and durability for specific mix proportions, demonstrating potential for sustainable construction materials.

*Keywords* **— Plastic Waste, Fly-Ash Brick, Stone Dust Replacement, HDPE, Sustainable Construction, Compressive Strength.**

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## I. INTRODUCTION

Plastic waste, predominantly polyethylene variants, presents ecological challenges due to its non-decomposable characteristics. This work aims to mitigate plastic pollution by incorporating HDPE plastic waste into fly-ash bricks as a partial replacement for stone dust, simultaneously addressing waste disposal and material sustainability in civil engineering.

## II. LITERATURE REVIEW

Previous studies demonstrate the feasibility of using plastic waste in bricks. Bhusahaiah et al. (2019) achieved 20MPa compressive strength using molten LDPE. Kumar and Gomathi (2017) reported 4.5MPa with 5% crushed plastic inclusion. Lanjewar et al. (2019) achieved 4.12MPa at 7% PET plastic usage. Amir and Yusof (2018) used glycolyzed PET in binder and aggregate forms reaching 28.8MPa. Asim et al. (2022) used shredded plastic bottles and found optimal mix with 10MPa strength. Prasanth et al. (2018) and Dubey et al. (2019) also confirmed strength and water absorption benefits from plastic incorporation.

## III. MATERIALS AND METHOD

### A. Materials used

**Fly-Ash:** Class-C fly-ash sourced locally.
**Plastic Waste:** HDPE in granule form.
**Stone Dust, Cement:** Commercially available OPC-53 cement and stone dust.

### B. Mix proportions

Eight mix designs were prepared with plastic waste replacing stone dust at 0%, 5%, 10%, up to 15%. Standard size moulds (19cm x 9cm x 9cm) were used. Table 1 shows sample proportions.

| Sample | Fly-Ash (%) | Stone Dust (%) | Plastic Waste (%) |
|---|---|---|---|
| 1 | 50 | 50 | 0 |
| 2 | 50 | 45 | 5 |
| 3 | 50 | 40 | 10 |
| 4 | 50 | 35 | 15 |

**Table 1:** Mix Proportion of Bricks

### C. Manufacturing and testing

Bricks were cured, dried, and tested for compressive strength (ASTM C67), water absorption, dimension, efflorescence, and soundness.

## IV. Results And Discussion

### A. *Compressive strength*

Bricks with 10–12% plastic waste replacement showed maximum strength (approx. 12MPa). Strength decreased beyond 13% replacement.

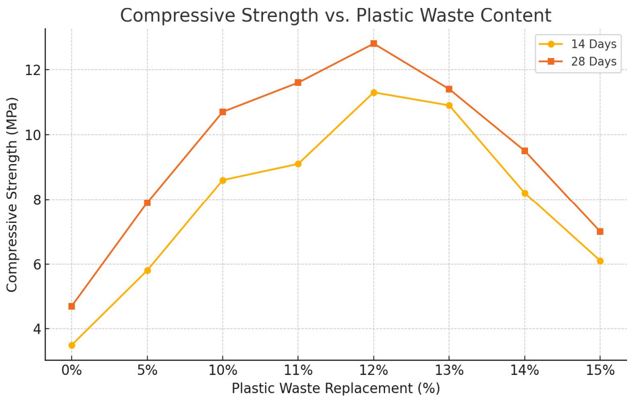


**Figure 1:** Compressive Strength at 14 and 28 Days for Various Mixes.

### B. *Water absorption*

Water absorption was lowest for bricks with 10–13% plastic, indicating reduced porosity.

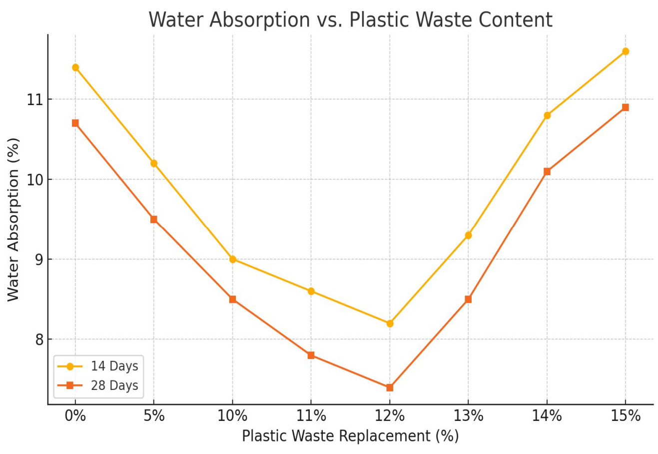


**Figure 2:** Water Absorption at 14 and 28 Days.

### C. *Dimensional and durability tests*

All sample's passed standard IS code specifications for efflorescence and dimension. Impact and soundness tests confirmed structural integrity.

**Table 2:** Dimensional Tolerance of Bricks

| Parameter | Measured Value | IS Standard |
|---|---|---|
| Length (cm) | 19.1 | 19 ± 0.2 |
| Width (cm) | 9.0 | 9 ± 0.15 |
| Height (cm) | 9.1 | 9 ± 0.15 |

## V. CONCLUSIONS

HDPE plastic waste can be effectively used up to 12–13% as a partial replacement for stone dust in fly-ash bricks. This not only enhances the brick's strength and durability but also supports sustainable waste management practices.

## ACKNOWLEDGEMENTS

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