Utilization of Waste Low Density Polyethylene for Cement Brick

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Abstract: - One of the most pressing challenges throughout the world is the correct disposal of plastic garbage. Using such garbage can help to alleviate both prior and current issues. The major goal of this study was to see if utilizing leftover low-density polyethylene as a partial replacement for sand in cement bricks was practical and feasible. We employed cement, fine aggregates, coarse aggregates, ground plastic, and water in this experiment. The proportions were 2: 1.7: 4 in the mix (cement, sand, stone). The ground plastic was employed at a rate of 0%, 20%, and 50% by volume sand. Furthermore, sand has a density of 1,650.0 kg m3 and crushed plastic has a density of 710. 4 kilograms per square meter. It was discovered that when the plastic concrete strength grew, the compressive strength dropped. At 5%, 10%, and 20% plastic content, the compressive strength ranged from 16.21 N/mm2 to 37.05 N/mm2, respectively. Although there was a considerable drop in density as the plastic component increased, the density was reduced by roughly 5% when plastic replaced 20% of the total fine aggregate.

Key Words: — ***Plastic concrete pavement blocks, Low-density polyethylene waste, Water cement ratio, Compressive strength.***

I. INTRODUCTION

Infrastructure development has resulted in an increase in the demand for building materials. It is critical to understand the materials and how they are used in building in this regard. Because of its safety and durability, many choose concrete to wood. One of the materials used in houses or constructions is cement brick. Cement, fine sand, and water are among the constituents.

Plastic garbage is difficult to dispose of due to its non-biodegradable nature. The majority of these plastics wound up in landfills, and when burnt, they had the worst effect. Many studies have demonstrated efforts to reduce the problem by using discarded plastics into concrete mixtures.

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The bottle made of polyethylene terephthalate (PET) has been utilized as a partial and substitute for sand in concrete composites, according to Marzouk et al. (2007). Choi et al. (2005) looked into the impact of discarded PET bottle aggregate on concrete characteristics. The flow characteristics of lightweight self-consolidating concrete (LWSCC) and normal weight self-consolidating concrete (NWSCC) were investigated using varying amounts of lightweight and normal weight, coarse and fine particles as a control, according to Toutanji (2015).

Suganthy et al. (2013) also indicated that when the plastic component in concrete grew, the weight of the concrete decreased. Local waste materials have been effectively used as a partial replacement for cement in concrete products in several regions of the world. In the literature, several researchers have used waste tires as fine and coarse aggregates (Eldin and Senouci, 1993; Topcu, 1995; Toutanji, 1996; Khabibulin and Bayley, 1999; Ling, 2011; Ohemeng and Yalley, 2013), demonstrating the use of massive volumes of waste tire in concrete products.

In addition, various studies on the strength of plastic concrete have been published. It has been discovered that when the amount of LDPE in plastic concrete decreases, the strength of the concrete decreases. Plastic bottles shredded into microscopic PET particles can be utilized as sand substitute aggregates in cementitious concrete composites, according to Yazoghli et al. (2007).

II. RESEARCH SIGNIFICANCE

Every day, people all across the globe rely on plastic to meet their requirements. Plastic garbage that is not properly disposed of can be detrimental to the environment. Plastic recycling will be utilized to make cement bricks in order to minimize plastic pollution.

The cement brick business is one of the largest users of natural resources. It might also be used to recycle garbage because to its composite composition, which includes cement, water, and other materials. Recycling garbage into natural aggregates is not only cost-effective, but it's also good for the environment. As a result, this method may be beneficial for landscaping ideas, as well as garden constructions like retaining walls, driveways, and pathway paving.

III. RESEARCH OBJECTIVES

- This study intends to develop a solution for manufacturing alternative construction materials, such as cement made from plastic bottles, which is a beter method to help the environment and save money.
- To serve as a background study for future scholars who want to look into this type of research.
- And, to determine the efficacy of LDPE in cement bricks.

IV. EXPERIMENTAL STUDIES

4.1 Materials

The materials used in this study consist of cement, fine aggregates (sand), coarse aggregates (stones), ground plastic, and water.

Fig.1. Samples of the Materials

4.2 Cement

The strength of Portland cement [(CEMEX) Apo Cement Type M] in relation to ASTM Specification C-270. Apo CementType M is a load-bearing building section with a below-grade exterior.

Table.1. Physical Properties of Apo Cement Type M

Fineness 45 -um (No. 325) sieve max .,35%	24
Autoclave expansion max., %	1.0
Air content, volume %	
Min. Max.	8 19
Water retention, min.	70

4.3 Sand, Coarse Aggregate (Stones), Ground Plastic and Water

For this experiment, natural sea sand was used. To eliminate the dampness, the sand was dried out in the open. The nominal size of the coarse aggregate employed in this investigation was 10 mm. The fineness of the ground plastic employed in this investigation is 3.51. In this investigation, non-potable water was used.

Table.2. Physical properties of sand, stones, ground plastic and water

Material	Bulk density (kg/m^3)	Fineness	Moisture content %
Sand	1650.00	2.50	2.0
Stones	1720.00	1.50	1.12
Ground plastic	710.40	4.00	-
Water	-	-	-

4.4 Preparation of Ground Plastic

Low-density polyethylene was collected and cleaned in the form of bottles, plastic bags, and packaging. They were first sliced into bits until they were extremely small. They were also placed in an open area to allow them to harden. And with the use of a pestle and mortar

Figure 2. *Preparation of Ground Plastic*

Fig.2. Preparation of Ground Plastic

V. METHODS

5.1 Mix Proportion

The proportions of cement, sand, and stone in the mix were 2: 1.7: 4. The percentage weight of ground plastic was 0%, 20%, and 50% by volume sand. For the experiment, several water-cement ratios were employed.

Sand has a density of 1,650.0 kg m3, whereas ground plastic has a density of 710. 4 kilograms per square meter As a result, the weight of the ground for an equivalent volume of sand is 2.32. The mixed percentage of aggregates for waste LDPE for cement brick is shown in Table 3.

Table.3. Mix proportion (weight in kilogram)

Cement	Water	Sand	Stone	Ground plastic
2.50	1.29	3.536	7.29	0.636
3.45	2.13	4.265	7.29	0.980
4.15	2.89	4.270	7.45	1.232
4.82	3.51	4.270	7.45	1.568
5.10	3.51	4.645	7.45	2.122

VI. RESULT AND DISCUSSION

6.1 Compressive Strength

A perpendicular line was drawn at the top of the brick to evaluate its strength. To ensure the solidity of the cement, plywood strips were placed in front and behind the brick. The compressive strength of the specimen was determined using the formula F=P/A, where F is the specimen's compressive strength in MegaPascal, P is the maximum applied load in Newton, and A is the estimated cross-sectional area in mm2.

The findings of the cement brick's compressive strength for varied ratios and plastic contents. It's easy to see how compressive strength rises as the ratio rises. At 5%, 10%, and 20% plastic content, the compressive strength rose from 16.21 N/mm2 to 20.60 N/mm2, 12.26 N/mm2 to 24.02 N/mm2, and 32.10 N/mm2 to 37.05 N/mm2, respectively. This means that the compressive strength has increased by around 22%.

The varied volumes of water utilized in the cement brick production might be one cause for the increase in strength. Concrete required a particular quantity of water to reach its full strength. Assume, however, that the cement was receiving the proper amount of water for the process, and that this had a beneficial impact on the strength.

Figure 4. *Trial products*

Fig.3. Trial Products

The compressive strength of the cement brick declined as the plastic content rose, from 20.13 N/mm2 to 16.17 N/mm2, 28.76 N/mm2 to 24.06 N/mm2, and 32.50 N/mm2 to 28.17 N/mm2, implying that the compressive strength was lowered by 10% to 15%. The reason for the reduction in strength could be attributed to the smooth surface of the plastic, which may have reduced the distance between the plastic and cement boundaries. The study is backed up by Batayneh et al (2007), who found that as the plastic content in plastic concrete increased, the compressive strength decreased.

The density falls as the plastic component increases. When 20 percent of the total fine aggregate was replaced by plastic, the density was reduced by around 5%. Plastic has a lower gravity than sand, which might explain the density. The sand is clearly heavier than the plastic. Furthermore, Choi et al. (2005), Suganthy et al. (2013), Marzouk et al. (2007), and Al-Manaseer and Dalal (1997) reported that as the density of plastic concrete grew, it reduced.

Figure 5. *Final Product*

Fig.4. Final product

VII. Conclusion

The incorrect disposal of plastic garbage is a major problem with which we are now dealing. To alleviate this stigma, we should look for ways to minimize, reuse, and recycle plastic garbage by using it as a key element. The researchers propose using LPDE waste as one of the cement bricks' ingredients. Furthermore, using plastic instead of sand changed the physical qualities of cement bricks. As the density and strength of the plastic grew, so did the rates of density and strength. Although the usage of LDPE can reduce the value of water while also reducing the value of sand on bricks, it can also reduce the value of sand on bricks. The use of LDPE instead of sand, on the other hand, can reduce the weight of the cement brick.

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