MANTECH Publications

Journal of Ceramics and Concrete Technology
Volume 5 Issue 3
ISSN: 2457-0826 (Online)

Utilization of Waste Plastic as a Partial Substitute for Aggregate

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Abstract

Plastics and coarse aggregate are replaced with waste known as green innovation. Rapid industrialisation and urbanisation have considerably improved infrastructure in the nation. This procedure produces a slew of issues, including a scarcity of building resources and increasing waste and other product output. The repurposing of discarded plastics as a partial substitute for coarse aggregate in M20 concrete is the subject of this research. The most common type of concrete used in building is M20. To replace the same quantity of garbage, waste plastics were increased to 0 percent, 10 percent, 20 percent, 30 percent, 40 percent, and 50 percent. To establish the physical qualities of coarse aggregates, granular aggregates, cement, and waste plastics, tests were conducted. The strength of 150 mm X 150 mm X 150 mm size blocks was evaluated for 3, 7, and 28 days. The results demonstrate that M20 concrete with waste plastic has a higher compressive strength.

Keywords*: - Waste plastic, M20 concrete, partial replacement, compressive strength*

INTRODUCTION

Waste disposal management has become a serious environmental challenge in the globe as a result of the rise in daily inventories. Because of its adaptability, plastic is increasingly being used. In 2014, the total amount of plastic manufactured in the globe was predicted to be 313 million tonnes; in 2015, it grew to 322 million tonnes, a rise of about 3% in just two years. By 2015, India's plastic usage would have increased by 15 million tonnes, making it the world's third-largest consumer of plastics.

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Concrete is the most frequently used building material on the earth, coming in second only to water as the most frequently utilised substance. The present problem is the need for aggregates for concrete and the disposal of waste from numerous commodities. In today's building sector, sustainability is a key focus. Recycled plastics were utilised to make coarse aggregates in this study, which give a long-term solution for dealing with plastic trash.

To improve, the plastic gathered from the dumping area was sorted. These were crushed into little pieces and then cleaned to eliminate any extraneous material. The material was then heated to a specific temperature in order to achieve the desired brittleness. After extrusion, the molten plastic was cooled and gathered into a rock around 100 mm in size. These plastic boulders were smashed down to aggregate size.

METHODOLOGY

The primary goal of this initiative is to produce concrete using recycled resources. Because it is difficult to dispose of plastic garbage, it has negative environmental consequences. In the concrete business, the reuse of plastic waste is seen to be the most practical option. It decreases environmental pollutants as well as material costs.

MATERIAL AND PROCEDURE

Coarse Aggregate and Fine Aggregate

The porosity of concrete can be affected by aggregate qualities. As a result, different considerations should be made while choosing the material. The specific gravity and other parameters of the aggregates utilised in this study were examined, and the findings were summarised.

Table 1: Physical Properties of Coarse and Fine Aggregate

Type of Aggregate	Coarse	Fine
Specific Gravity	2.6	2.7
Water Absorption	0.50 %	1.0 %
Free (surface) Moisture	Nil	2.0 %
Aggregate Impact Value	18.57 %	----
Aggregate Crushing Value	17.88 %	----
Los-Angeles Abrasion Value	23.60 %	----

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Cement

The findings were calculated using ordinary Portland cement of grade 43, which met the standards of IS: 269 – 1969.

Table 2: Physical Properties of Cement

Specific Gravity	3.15
Initial Setting Time	36 Minutes
Final Setting Time	10Hours
Soundness (by Autoclave method)	0.6

Plastics

Plastics that can't be broken down any longer are ground into fine powder. The majority of these polymers are made of HDPE (High-Density Polyethylene) (HDPE).

Table 3: Physical Properties of Plastics

Specific Gravity	1.04
Density (g/cc)	0.945 - 0.962
Melting Point (^{0}C)	75 – 100
Softening Point (^{0}C)	110
Elongation at Break (%)	>500
Fineness	<2.36 mm

Casting and Curing

M20 concrete is often utilised for most building projects, hence M20 concrete was utilised in this project instead of waste plastic. Aggregates with percentages of 0%, 10%, 20%, 30%, 40%, and 50% were used to replace the same quantity of aggregates. To establish the physical

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qualities of coarse aggregates, granular aggregates, cement, and waste plastics, tests were conducted. Concrete blocks of 150 mm X 150 mm X 150 mm were cast and tested for strength over seven, fourteen, and twenty-eight days.

Testing for Compressive Strength

Casted specimens are examined for compressive strength for 3, 7, and 28 days using hydraulic compressive testing equipment. The test results are tabulated when the compression strength testing is completed.

RESULT AND DISCUSSION

After 3 days, 7 days, and 28 days, the following observations were made for the M20 grade mix percentage replacement with plastic 0 percent, 10%, 20%, 30%, 40 percent, and 50 percent.

Table 4

Waste Plastic in %	**Strength after 3 days in N/mm^2**	**Strength after 7 days in N/mm^2**	**Strength after 28 days in N/mm^2**
Normal concrete	12 N/mm^2	19 N/mm^2	25 N/mm^2
10% plastic replacement	11.2 N/mm^2	18.4 N/mm^2	24.6 N/mm^2
20 % plastic replacement	10.5 N/mm^2	16.6 N/mm^2	23.5 N/mm^2
30 % plastic replacement	9.4 N/mm^2	14.8 N/mm^2	22.7 N/mm^2
40 % plastic replacement	8.6 N/mm^2	13.4 N/mm^2	20.8 N/mm^2
50 % plastic replacement	6.4 N/mm^2	10.2 N/mm^2	18.6 N/mm^2

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As a result of this research, it was discovered that the compressive strength of concrete decreased somewhat when plastic material was replaced.

CONCLUSION

As a consequence of the observations, experiments, and findings, the following conclusions may be drawn:

1. Waste plastic can be utilised in concrete mixes.
2. A maximum of 30% to 40% waste plastic replacement may be made, with the desired and expected effects.
3. The results are pleasing, but not very healthy; as the amount of plastic trash grows, concrete strength drops.
4. It will aid in cost-cutting in the building industry.
5. Assists in avoiding traditional waste plastic disposal methods.
6. As the amount of waste plastic in concrete increases, the unit weight of the concrete lowers.

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