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Comparative Analysis of Municipal Dry Waste Used as Partial Replacement of Coarse Aggregate in Concrete.

Rahul Patil[1], Akshay Salunkhe[2], Vishal Jadhav[3], Swapnil Shedule[4], Saurabh Jadhav[5], Suraj Jadhav[6]

[1]Assistant Professor, Department of Civil Engineering, Annasaheb Dange College of Engineering and Technology, Ashta, Maharashtra, India
[2-6]UG Student, Department of Civil Engineering, Annasaheb Dange College of Engineering and Technology, Ashta, Maharashtra, India

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Abstract - *In this paper high density polyethylene (HDPE) and polyethylene teraphthalate (PET) used as replacement for coarse aggregate for producing concrete cubes has been investigated and reported. HDPE and PET based concrete cubes were casted manually and also the strength of the test concrete in terms of compression was experimentally evaluated. It is found that the strength of PET plastic replaced concrete in terms of compression test may be comparable to the standard concrete. The present study is aimed toward concrete mix with partial replacement of coarse aggregate by Shredded HDPE and PET (Shredded bottle caps), (0%, 10%, 20%) which will provide a plus in reducing the dead weight of structure. This mix within the style of cubes and cylinders were subjected to compression to establish the strength parameter. Hence the employment of hard plastic in concrete making isn't only beneficial but also helpful in disposal of plastic wastes.*

Key Words: Partial Replacement, Coarse Aggregate, HDPE , PET, Compressive strength.

1. INTRODUCTION

As the world population grows, wastes of assorted types are being generated. One solution to the present crisis is recycling wastes into useful products With the rise in development, there's a rise in cost of construction and therefore the maintenance of heavy infrastructure. So, the Engineers and Designers are searching for new concept of using waste plastics in cement concrete. Concrete consumption within the world is estimated at two and a half tons per capita each year. 2.62 billion heaps of cement, 13.12 billion plenty of aggregate, 1.75 billion loads of water is important to organize this volume [1]. The generation of aggregates in itself may be a lengthy and tedious process because it involves the cutting of mountains or breaking river gravels or boulders, or breaking clay bricks. Of these processes demand the large inputs like labor, machinery and transportation etc. The working of machinery and transportation of the processed material (aggregates) also ends up in the environmental pollution and at the identical time we are utilizing the natural resources.

1.1 Types of plastics used for replacement

Polyethylene terephthalate(PET)
High density polyethylene(HDPE)

1.2 Sources of generation of plastics

Household: Carry Bags, Bottles, containers and trash bags.

Hotel and Catering: Mineral water bottles, Glasses, Packaging items, Plastic plates, Hand gloves

Health and Medicare: Disposable syringes, surgical gloves, glucose bottles, blood, Intravenous tubes, catheters

2. MATERIALS AND ITS PROPERTIES

2.1 Coarse and fine Aggregate

Table -1: Properties of Aggregate

Types 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 angles abrasion test	23.60%	----

Various properties of aggregates can influence the performance of concrete; therefore various considerations have to be kept in mind while selecting the material. Aggregate is important material for preparation of concrete. Fine aggregate is added as filler and Coarse aggregate is added for Strength, especially to increase compressive strength.

2.2 CEMENT

Table -2 : Properties of Cement

Specific gravity	3.15
Initial setting time	30 minutes
Final setting time	600 minutes
Soundness	6 mm

Ordinary Portland cement of 53 Grade was used as it satisfied the requirements of IS: 12269-1987.

2.3 PLASTIC

Table -3 : Properties of Plastic

Physical Properties	HDPE	PET
Tensile Stregth at Break (Mpa)	30	70
Elongation at Break (%)	150	165
Flexural Modulas (Mpa)	0.92	2.0
Tensile Modulas (Gpa)	0.86	2.9
Melting Point (C)	130	260
Water absorption (%)	0.01	0

HDPE :

It is the foremost widely used resin for plastic bottles. This material is economical, impact resistant, and provides a decent moisture barrier. HDPE is compatible with a large range of products including acids and caustics but isn't compatible with solvents.

PET :

PET is extremely flexible, colourless and semi-crystalline resin in its state of nature. Depending upon how it's processed, it's semi-rigid to rigid. It shows good dimensional stability, resistance to impact, moisture, alcohols and solvents.

3. METHODOLOGY

Steps

- To conduct mix design of M40 as per IS 10262 :1982
- To cast Both Normal as well as plastic mixed concrete cubes of size 150 x 150 x 150
- To find Compressive Strength in 0%, 10%, 20% of waste plastic added samples as a replacement of coarse aggregate.

Mix Design Details

Trial Mix 1 (150x150x150 with 0% of waste plastic added)

Cement = 400 kg/m^3
Water = 160 kg/m^3
Fine aggregate = 660 kg/m^3
Coarse aggregate 20 mm = 701 kg/m^3
Coarse aggregate 10 mm = 467 kg/m^3
Admixture(BS 17 3P) = 0.6 % by weight of cement = 2.4 kg/m^3 Cement: F.A.: C.A. = 1: 1.65: 2.92

Trial Mix 2 (for 3 Cubes of 150x150x150 with addition 10 % waste plastic)

Cement = 4.04 Kg
Sand = 6.666 kg
Aggregate = 11.79 kg
Adding 10% waste plastic = 1.17 Kg
Coarse Aggregate = 10.62 kg
Water = 1.616 kg
Admixture = 0.02424 kg

Trial Mix 3 (for 3 Cubes of 150x150x150 with addition 20 % waste plastic)

Cement = 4.04 Kg
Sand = 6.666 kg
Aggregate = 11.79 kg
Adding 20% waste plastic - 2.34 Kg
Coarse Aggregate = 9.45 kg
Water = 1.616 kg
Admixture = 0.02424 kg

Casting of Cubes

Mould and base plate should be cleansed and employed with oil so the concrete can't fix to the side of the cube. Base plate is affixed to the mould with bolt and nut. The cube should be stuffed with concrete in three layers. Each layer should be consolidated for 25 times. This process should be accomplished systematically and compaction should be finished equally to any or all the surfaces of the concrete.

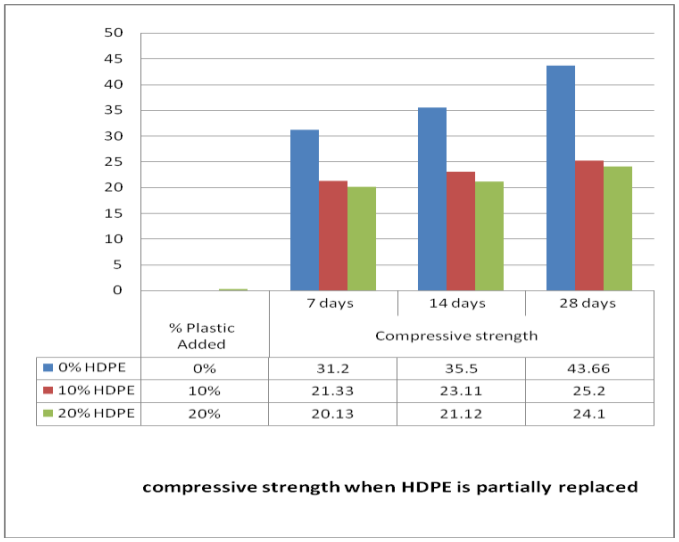
Compaction is additionally through with machine. The surface of concrete should be leveled to retain the equivalent level with the top side of the mould. Cubes which are produced at construction site should be wrapped with plastic protect a period of 24 hours before remove the moulds. After remolded, the concrete cubes should be drowned in water for curing. Compression strength test should be conducted for concrete at age 7,14and 28 days through compression test machine. To integrate waste plastic within the concrete cube we've got to check the properties of plastic first.

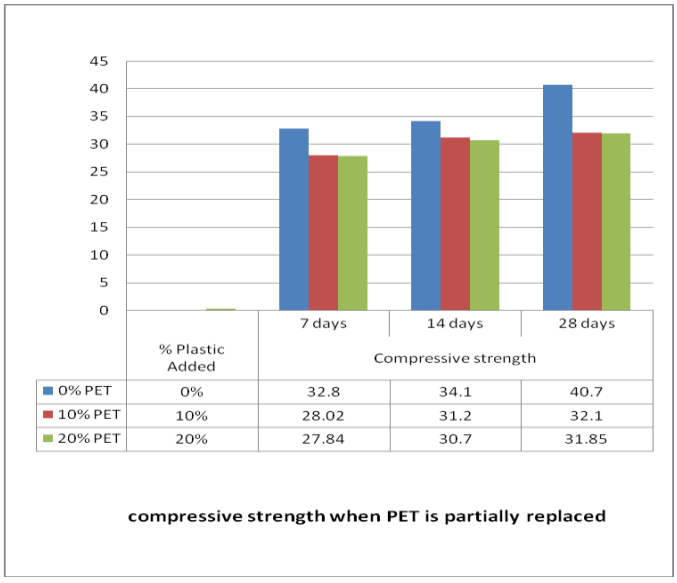
Type of plastic	% of plastic added	No. of cubes
PET	0%	3
	10%	3
	20%	3
HDPE	0%	3
	10%	3
	20%	3

Type of Plastic	% Plastic Added	Compressive strength		
		7 days	14 days	28 days
HDPE	0%	31.20	35.50	43.66
	10%	21.33	23.11	25.20
	20%	20.13	21.12	24.10
PET	0%	32.80	34.10	40.70
	10%	28.02	31.20	32.10
	20%	27.84	30.70	31.85

4. RESULTS AND DISCUSSION

Compressive strength values of all waste plastic concrete mixture tend to decrease below the values for the references concrete mixtures with increasing the waste plastic ratio in the least curing ages. From the test results it had been observed that the compressive strength value of concrete mix is decreased with the addition of waste plastics especially with in the case of HDPE. But workability of the concrete mixture is increasing due to the less absorption of water. Thanks to this advantage, we are able to add waste plastic in concrete.
It is determined that compressive strength of the concrete at 28 days is incredibly slightly decreased once we add 20% of PET bottle caps. So we can add PET plastic in concrete blocks so this will helps to reuse of plastics in concrete blocks.





5. CONCLUSIONS

The compressive strength values of all waste plastic concrete mixtures tend to decrease below the values for the reference concrete mixtures with increasing the waste plastic ratio in any respect curing ages. This may be attributed to the decrease within the adhesive strength between the surface of the waste plastic and cement paste. Additionally waste plastic is hydrophobic material which can restrict the hydration of cement. Workability of fresh concrete decreased with increase within the percentage of waste

plastic content. The compressive strength of all the concrete samples increased with increasing curing days. However the compressive strength for the traditional concrete was above the compressive strength of concrete samples containing HDPE plastic and decreased with increasing plastic content in concrete. But within the case of PET it's different, because as we increase the share of PET there's very slight decrease within the compressive strength and it's equivalent to the compressive strength of normal concrete cubes. The result shows that HDPE has not shown comparable results but on the opposite side PET has shown satisfactory results and PET has some future scope as a partial replacement in coarse aggregate.

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