Experimental Investigation on Characteristics of Polythene Waste Incorporated Concrete

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Abstract

The Disposal of large quantity of plastic cover may cause pollution of land, water bodies and air. The proposed concrete which is made up by adding plastic in concrete may help to reuse the plastic cover as one of the constituent's material of concrete, to improve the certain properties of concrete. The properties of concrete as varying percentages of plastic will test for compressive strength and Split tensile strength and flexural strength shows that an appreciable improvement in tensile strength of concrete can be achieved by introducing cut pieces of plastic cover. This paper presents the experimental investigation of feasibility of polythene cover post consumer waste used for food packaging. The numbers of samples is prepared in M25 concrete mix with required water/ cement ratio. Plastic waste was converted in to fiber size form and added waste for three aspect ratios, is casted into desire shape and size as per requirement of the tests. Each specimen was cured for 7 days, 14 days, and 28 days. The workability of compression, tension and flexural tests were carried out. The results are compared with normal concrete was observed.

Keywords: *Compressive strength split tensile strength, plastic cover, and environmental problems.*

1. Introduction

One of the fastest growing industries is a plastic industry. Around the world almost one trillion plastic bags are covers per year are being used and it is just one example of a Product of Plastic. The plastic is one of the recent engineering materials. Which have appeared in the market all over the world there has been a step rise in the production of plastics from a more than year; it has touched 1000 million kn at present. Plastics are normally stable and not biodegradable. So, their disposal is a problem. Research works are going on in making use of plastics wastes effectively as additives in plain and reinforced concrete mixes for variety of purposes. Different forms and types of wastes are utilized to check the feasibility of them in concrete. This study attempts to give a contribution to the effective use of waste plastics in concrete in order to prevent the ecological and environmental strains caused by them, also to limit the high amount of environmental degradation.

2. Environmental Effects

In India, domestic waste plastics are causing considerable damage to the environment and hence an attempt has been made to understand whether they can be successfully used in concrete to improve some of the mechanical properties as in the case of the steel fibers. The primary objective of this investigation is to study experimentally the properties of fiber reinforced concrete containing polythene fibers. The properties of concrete, namely, compressive strength and flexural strength were studied. Plastic bags are popular with consumers and retailers as they are a functional, lightweight, strong, cheap, and hygienic way to transport food and other products. After they used plastic bags, most of these are become to waste and some are recycled. Each year, plastic bags are consumed approximately 500 billion to 1 trillion in worldwide. That is over one million bags are consumed per one minute. Particularly in China, the total number of plastic bags used is 3 billion per day. According to the number of plastic bags used, it can be affected to the environment. Plastic bags create visual pollution problems and can have harmful effects on aquatic and physical animals. Also plastic bags are especially components of the litter stream due to their size and it takes a long time to completely degradation.

3. Plastic Fibers

The ordinary polythene plastic film having thickness of 53 microns is collected and investigation for the plastic waste classification, category and Density will check before the use. The film should make as a four folding and give Required temperature of heat should melted & hand cut as length 3cm, 4cm, 5cm breadth an using into the properties of concrete.

Fig 1: Waste domestic plastic are made into fibers

Table 1: Properties of polythene used

Properties	Results
Thickness	53 microns
Density	1.4 gm/cc
Type	Polythene film (single metallised)
Category	Metallised food packing grade

3.1 Plastic waste consumption (P/C/YEAR)

The comparison of per capita plastic consumption in India with rest of the world is presented in table 2.

Table 2: Plastic Waste Consumption (P/C/YEAR)

Country Continent	Per Year Consumption (kg)
India	6.0
East Europe	10.0
South East Asia	10.0
China	24.0
West Europe	65.0
North America	90.0
World Average	25.0

3.2 Generation of plastic waste consumption

India has among the lowest per capita consumption of plastics and consequently the plastic waste generation is very low as seen from the table 3

Table 3: Generation of plastic waste

Description	World	India
Per capita per year	24 – 28	12 – 16
Recycling (%)	25	60
Plastic in solid waste (%)	7	9

4. Objective of Study

- The study of polythene waste in a concrete as a plastic fiber to improve the properties of concrete.
- This project will present a comparative study of compressive, tensile and flexural strength of concrete by mixing of polythene waste as concrete constituent.

5. Methodology

The methodology adopted includes practical work made to explore the polythene waste in a concrete as a plastic fiber to improve the properties of concrete in different percentage of polythene varying as per ratio dry weight of the sample is mixed with concrete. The strength produced with each mix will find out required strength is selected for the further testing of the projects.

Literature indicates that addition of Polythene waste in concrete not only solves the problem of their safe disposal but also improves the basic properties of concrete like tensile resistance, permeability to water, flexural strength, compressive strength with higher strength to weight ratio of material, workability, reduction in self weight etc. Materials were collected for the preliminary tests of concrete. Tests will be conducted for cement, fine aggregate and coarse aggregate. The design mixes will be prepared and different specimens will be casted and later on tested after that the results will be drawn and concluded.

Table 4: Mix Proportion

Water	Cement	Fine Aggregate	Coarse Aggregate
188.79	377.58	495	1171
0.5	1	1.31	3.10

From above table the mix ratio is 1:1.46:2

6. Experimental Investigations

The experiment was done with the basic and conventional concrete making materials like Ordinary Portland Cement (OPC) 53 grade, fine and coarse aggregate of maximum size as 20mm and tap water. The metalized polythene waste covers were made to the four folding of film & melting with required temperature form. The covers were not given any treatment except the normal water wash cleaning and day light drying.

7. Materials

The materials used in the present investigation are;

- Cement – OPC 53 grade conforming to IS 12269 – 1987
- Fine aggregate – natural sand – IS383 – 1970
- Coarse aggregate – crushed 20mm maximum size – IS383 – 1970
- Melted plastic piece
- Portable water

8. Tests on Materials

The various types of tests were conducted on cement, fine aggregate and coarse aggregate and the results are tabulated in table 5, table 6 and table 7 respectively. the table 5 below shows the different types of tests carried out on cement.

Table 5: Test on Cement

Test	Results
Specific Gravity	2.54
Fineness	97.33%
Consistency	31%
Initial Setting Time	34 min

The table 6 below shows the different types of tests carried out on fine aggregate.

Table 6: Test on Fine aggregates

Test	Results
Specific Gravity	2.73
Free Surface Moisture	2%
Gradation	Zone II

The table 7 below shows the different types of tests carried out on coarse aggregate.

Table 7: Test on Coarse Aggregates

Test	Results
Specific Gravity	2.78
Aggregate Impact Value	32.73%
Aggregate Crushing Values	18.90%

We have a total of 10 mixes of concrete with different percentage of polythene varying between (0%, 0.2%, 0.6% and 1%) and different sizes of (5cm, 4cm, 3cm), which the experimental investigation is carried out.

Table 8: Its shows mix proportions

Mix	Properties
1	OPC + FA + CA
2	OPC + FA + CA + 5cm - 0.2 % of Fiber
3	OPC + FA + CA + 5cm - 0.6 % of Fiber
4	OPC + FA + CA + 5cm - 1 % of Fiber
5	OPC + FA + CA + 4cm - 0.2 % of Fiber
6	OPC + FA + CA + 4cm - 0.6 % of Fiber
7	OPC + FA + CA + 4cm - 1 % of Fiber
8	OPC + FA + CA + 3cm - 0.2 % of Fiber
Table 8 continued…	
9	OPC + FA + CA + 3cm - 0.6 % of Fiber
10	OPC + FA + CA + 3cm - 1 % of Fiber

Where;

OPC: Ordinary Portland cement

FA: Fine aggregate

CA: Coarse aggregate

9. Tests on Fresh Concrete

The tests conducted on fresh concrete are shown below in table 9.

Table 9: Test on fresh concrete

Test	Results
Slump	23 mm
Compacting Factor	0.9

10. Testing Details

The two types of tests were performed on all concrete batches namely

- Compressive Strength
- Tensile Strength
- Flexural Strength

10.1 Compressive Strength

Compressive strength test were carried out on 150mm x 150mm x 150mm specimen for that three cube were prepared for each mix. Strength of each cube was evaluated after 7, 14, 28 days respectively. Test was carried out as per IS: 14858 – 2000.

10.2 Tensile Strength

Tensile strength is one of the basic and important properties of concrete. Split tensile strength test were carried out on a cylindrical specimen 150mm diameter and 300mm long. Specimen shall be tested after 7, 14, 28 days respectively.

10.3 Flexural Strength

Flexural tensile strength test were carried out on abeam specimen 100mm x 100mm x 500mm. Specimen shall be tested after 28 days respectively.

11. Test Results

11.1 Compressive Strength

The compressive strength of plain concrete and percentage of fiber used concrete as conducted for three different aspect ratio i.e. 5cm, 4cm, and 3cm as shown in table 10.

The compression test on hardened concrete was conducted as shown in figure 2

Figure 2: Compression test on Concrete cube

The test conducted on Compression test on concrete cubes with plastic piece was evaluated after 7, 14, and 28 days are shown below in table 10.

Table 10: Compressive Strength of cubes for all mixes.

Mix	Compressive Strength, N/mm^2 (7 days)	Compressive Strength, N/mm^2 (14 days)	Compressive Strength, N/mm^2 (28 days)
1	21.30	27.30	30.10
2	22.50	28.95	32.88
3	21.40	27.44	30.30
4	20.11	26.55	27.30
5	23.00	27.89	32.40
6	22.20	28.10	31.20
7	21.20	27.47	30.00
8	22.67	28.77	31.96
9	22.05	28.09	31.02
10	21.44	27.63	30.55

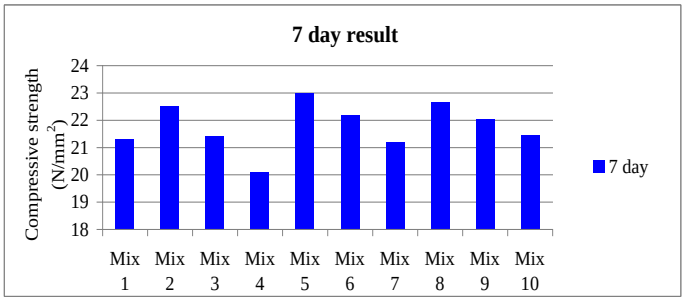

Figure 3: Shows the compressive strength of concrete cubes for 7 days

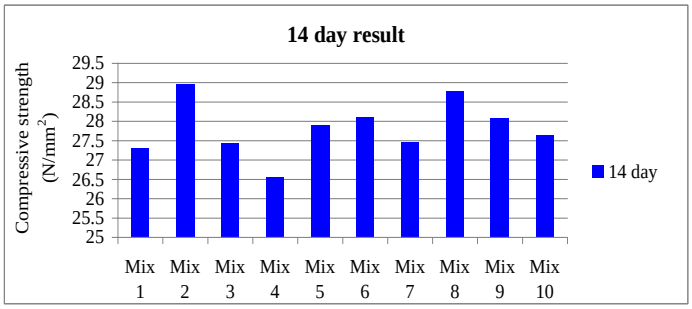

Figure 4: Shows the compressive strength of concrete cubes for 14 days

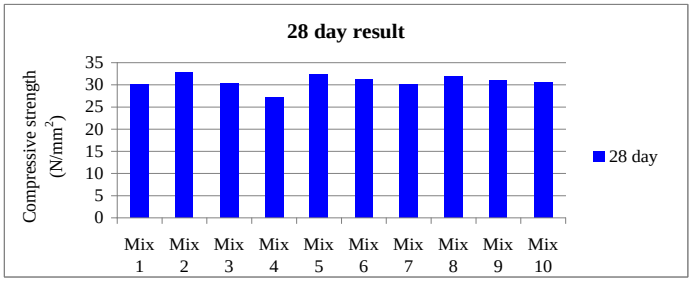

Figure 5: Shows the compressive strength of concrete cubes for 28 days

11.2 Tensile Strength

The 7, 14 and 28 days split tensile strength of plain concrete and plastic pieces in conducted for three different aspect ratio i.e. 5cm, 4cm, and 3cm as shown in table 11.

The Tensile Strength on hardened concrete was conducted as shown in figure 6

Figure 6: Tensile Strength on Concrete Cylinder

The test conducted on tensile strength on concrete cylinder with 5cm, 4cm, 3cm of plastic piece was evaluated after 7, 14, and 28 days are shown below in table 11.

Table 11: Tensile Strength on Concrete Cylinder with all mixes.

Mix	Tensile Strength, N/mm^2 (7 days)	Tensile Strength, N/mm^2 (14 days)	Tensile Strength, N/mm^2 (28 days)
1	2.40	2.88	3.44
2	2.44	2.92	3.42
3	2.38	2.90	3.48
4	2.02	2.46	3.16
5	2.48	2.78	3.38
6	2.42	2.84	3.42
7	2.22	2.66	3.18
8	2.46	2.92	3.48
9	2.38	2.84	3.38
10	2.22	2.68	3.22

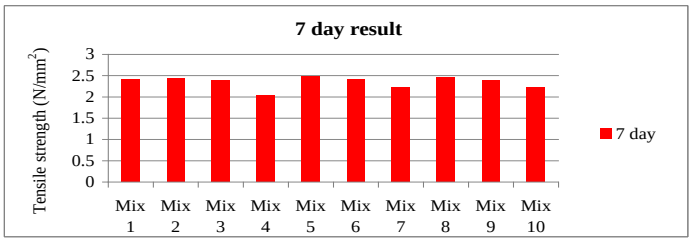

Figure 7: Shows the tensile strength of concrete cylinder for 7 days

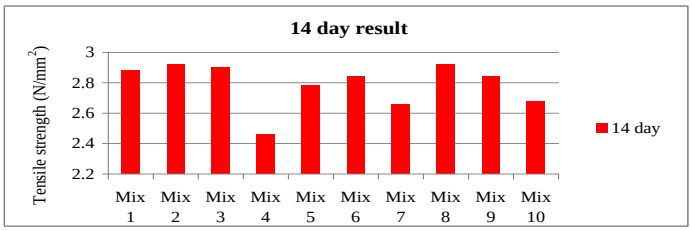

Figure 8: Shows the tensile strength of concrete cylinder for 14 days

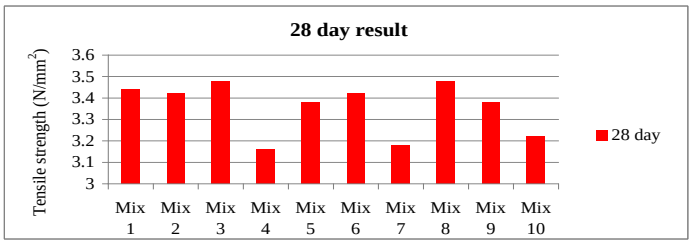

Figure 9: Shows the tensile strength of concrete cylinder for 28 days

11.3 Flexural Strength

The 28 days flexural strength of plain concrete and plastic pieces in conducted for three different aspect ratio and sizes as shown the results are tabulated in table 12.

The Flexural Strength on hardened concrete was conducted as shown in figure 10

Figure 10 Flexural strength on concrete beam

Table 12: Flexural Strength on Concrete beam with all mixes.

Mix	Flexural Strength, N/mm^2 (28 days)
1	4.0
2	5.5
3	5.0
4	5.5
5	6.0
6	5.5
7	6.0
8	4.5
9	6.0
10	5.0

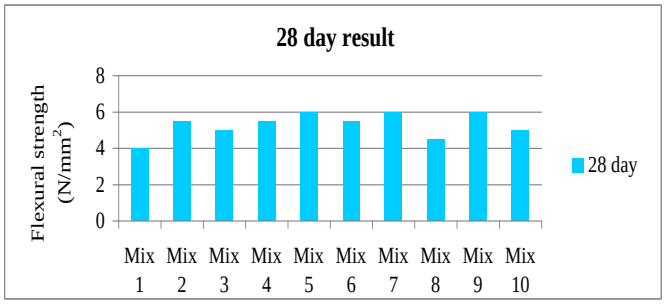

Figure 11: Shows the Flexural strength of concrete beam for 28 days

12. Conclusion

Based on the experimental data received after a wide range of samples with different proportions of polythene fibers following conclusions are made,

The Compression test observation its shows that the improvement of compressive strength of concrete. Up to 1% of plastic and the size is 4cm & 3cm its shows an increase in strength after 28 days. 1% of plastic and the size is 5cm its shows reduction in strength after 28 days.

The splitting tensile strength is affected by addition of plastic pieces and it goes on decreasing as the percentage an addition of 1% of plastic and the size is 5cm & 4cm in strength after 28 days, 1% of plastic and the size is 3cm its shows an increase in strength after 28 days.

The flexural strength its shows by the addition of plastic pieces and it goes on increased as the percentage addition 1% of plastic and the size is 5cm, 4cm, 3cm in strength after 28 days.

Thus it is conclude that the use plastic can be possible to increase the compressive & flexural strength of concrete.

From the above discussion it is identified that the use of plastic can be possible to improve the properties of concrete which can act as a one of the plastic disposal method.

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