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EXPERIMENTAL INVESTIGATION ON STRENGHT PROPERTIES OF WASTE PLASTIC IN CONCERTE

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Abstract: Concrete is the most widely used man made construction material. In the present study the recycled plastics were used to prepare concrete there by providing a sustainable option to deal with the plastic waste.

Experimental investigations were performed to study Fresh properties (slump and density) and mechanical properties (compressive strength, flexural strength, splitting tensile strength).

It is to conclude that Waste plastic can be effectively re-used without affecting the mechanical properties considerably (5-10%). With increase in the percentage of plastic there has been a sudden decrease in early strength but the strength developed to the value as that of the conventional M25 concrete when 28 day tests were performed.

As the Mix M4 for 6% of waste plastic, the strength has been developed at 39.38 N/mm^2 in compressive strength at 28 days.

It is observed that for more percentage addition of plastics i.e 6% in the present case, the 7 day strength has been increased when compared with conventional concrete. The Mix M4 for 6% of waste plastic, the strength has been developed at 4.38 N/mm^2 in flexural strength of concrete. For Mix M4 for 6% of waste plastic, the strength has been developed to about 3.54 N/mm^2 in split tensile strength in 28 days. For less percentage addition (2-4%) of plastic, there is no considerable variation in 7 day, and 28 day compression strength and split tensile strength.

Concrete with plastic waste can be used for less important works where concrete is not going to bear more loads.

Index Terms- Plastic waste, strength

INTRODUCTION

[1]1.1 GENERAL:

concrete is the most widely used man made construction material in the world and its second only to water as the most utilized substance in the planet. Seeking aggregates for concrete and to dispose of the waste from various commodities is the present concern. Today sustainability has got top priority in construction industry. In the present study the recycled plastics were used to prepare there by providing a sustainable option to deal with the plastic waste.

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II LITERATURE REVIEW

Raghatate Atul M et al., has done research on "Use Of Plastic In A Concrete To Improve Its Properties". The properties of concrete containing varying percentages of plastic were tested for compressive strength and Split tensile strength and shows that an appreciable improvement in tensile strength of concrete can be achieved by introducing cut pieces of plastic bags. He concluded Compressive strength of concrete is affected by addition of plastic pieces and it goes on decreasing as the percentage of plastic increases addition of 1 % of plastic in concrete causes about 20% reduction in strength after 28 days curing. The splitting tensile strength observation shows the improvement of tensile strength of concrete. Up to 0.8 % of plastic improvement of strength recorded after that addition of strength of concrete decreases with addition of plastic.

Malek Batayneh et al., has done research on "Use of selected waste materials in concrete mixes". The waste materials considered to be recycled in this study consist of glass, plastics, and demolished concrete. Such recycling not only helps conserve natural resources, but also helps solve a growing waste disposal crisis. Ground plastics and glass were used to replace up to 20% of fine aggregates in concrete mixes, while crushed concrete was used to replace up to 20% of coarse aggregates. To evaluate these replacements on the properties of the OPC mixes, a number of laboratory tests were carried out. These tests included workability, unit weight, compressive strength, flexural strength, and indirect tensile strength (splitting). The main findings of this investigation revealed that the three types of waste materials could be reused successfully as partial substitutes for sand or coarse aggregates in concrete mixtures. The researchers concluded that the tests carried out in this study were primarily designed to provide an indication of relative advantages and disadvantages of the use of a number of construction wastes, such as crushed concrete waste, plastics, and glass. This would provide an overview of the reuse of construction waste materials in the construction industry.

III EXPERIMENTAL INVESTIGATIONS

3.1 OBJECTIVE

Experimental program is performed to study the effect of internal curing on different types of concrete properties:

(i) Fresh properties (slump and density);

(ii) Mechanical properties i.e. Compressive strength (Cube 150mm x 150mm x 150mm)., Flexural strength (Prism 100mm x100mm x 500mm), Splitting tensile strength (Cylinders 150mm dia x 300mm height).

3.2 MATERIALS USED

In this project Plastic waste materials were utilized to produce Structural concrete. The following materials were used in this investigation

3.2.1 CEMENT

Cement is one of the binding materials in this project. Cement is the important building material in today's construction world. 53 grade Ordinary Portland Cement (OPC) conforming to IS: 8112-1989. Table 2.1 gives the properties of cement used.

3.2.2 PLASTIC

Pieces Polyethylene bag, which are commonly used for the packaging and carrying goods are used in concrete.

3.2.3 FINE AGGREGATE

Locally available river sand conforming to Grading zone I of IS: 383 –1970.Clean and dry river sand available locally will be used. Sand passing through IS 4.75mm Sieve will be used for casting all the specimens.

3.2.4 COARSE AGGREGATE

Crushed granite stones obtained from local quarries were used as a coarse aggregate. The maximum size of coarse aggregate used was 20 mm. The properties of aggregate were determined by conducting test as

Per IS: 2386 (Part – III).

3.2.5 WATER

Water is an important ingredient of paper Crete as it actively participates in the chemical reaction with cement. It should be free from organic matter and the pH value should be between 6 to 7.

3.3 PROPERTIES OF PLASTIC

According to the Indian standard specifications the property of aggregates such as specific gravity, aggregate crushing value and density were determined [6], [7]. From Table I comparing the properties of aggregate for both NCA and PCA

it is observed that the specific gravity and density for PCA is much lower than NCA which offers a light weight concrete. A lower crushing value indicates the complexity with which a PCA concrete could be crushed under compressive stresses.

TABLE 1.0: Physical Properties plastic aggregate

Property	NCA	PCA
Specific Gravity	2.74	0.9
Density	3.14	0.81

3.4. MIX DESIGN

IS : 456-2000, IS : 10262-1982. The mix design of plain concrete is carried out. Mix Proportion ratios are

Cement = 427 kg/m^3

Water = 192 litres

Fine aggregates = 772kg/m^3

Coarse aggregates = 1046 kg/m^3

Water cement ratio = 0.45

3.5 TEST ON FRESH CONCRETE

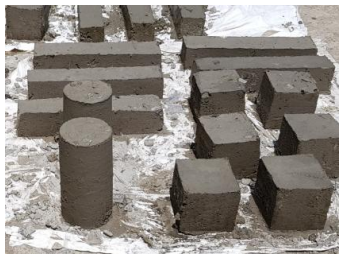
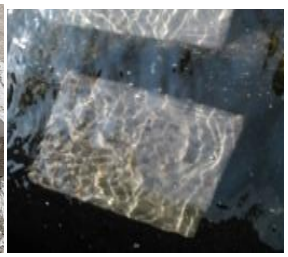
3.5.1 SLUMP TEST:

The slump test is prescribed by IS456 (2000), and BS 1881 Part 102: 1983.This test was performed to check the consistency of freshly made concrete. The slump test was done to make sure a concrete mix is workable.

Sl. No	**Mix**	**Slump Value**
1.	M1	65mm
2.	M2	68mm
3.	M3	72mm
4,	M4	75mm

3.6 Mixing, Casting & Curing

The Plastic Waste concrete is manufactured by as similar to the classical concrete. Initially the dry materials Cement, Aggregates & Sand are mixed. The liquid component of the mixture was then added to the dry materials and the mixing continued for further about 4 minutes to manufacture the fresh concrete. The fresh concrete was cast into the moulds immediately after mixing, in three layers for cube specimens. For compaction of the specimens, each layer was given 60 to 80 manual strokes using a rodding bar, and then vibrated for 12 to 15 seconds on a vibrating table. Before the fresh concrete was cast into the moulds, the slump value of the fresh concrete measured.

3.7 TESTING

The mechanical properties were carried out i.e. compressive strength, flexural strength, splitting tensile strength.

3.7.1 Compressive strength of concrete (IS: 516 – 1959)

Compressive Strength $(N/mm^2) = \frac{LOAD}{AREA} = \frac{P}{A}$

3.7.2 Split Tensile Strength (IS: 5816 – 1970)

Split Tensile Strength (N/mm2) $= \frac{2P}{\pi dl}$

3.7.3 Flexural Strength Test (IS: 516-1959)

Flexural Strength $(N/mm^2) = \frac{PL}{bd^2}$

IV RESULTS AND DISCUSSION

4.1 RESULTS

4.1.1 COMPRESSIVE STRENGTH (IS: 516 – 1959)

The 7 days and 28 days compressive strength result were presented. The compressive strength of concrete goes on reducing with increase in percentage of plastic pieces but the rate of reducing compressive strength is very low

Sl.No	Waste Plastic (%)	Load (Tones)	Average Compressive Strength (N/mm^2)
1.	0%	41.89	17.73
2.	2%	40.15	16.72
3.	4%	39.67	16.97
4.	6%	52.30	21.72

Table No 2 Compressive strength of concrete for 7 days.

Sl.No	Waste Plastic (%)	Load (tones)	Average Compressive Strength (N/mm^2)
1.	0%	36.8	36.24
2.	2%	34	33.27
3.	4%	36.62	35.75
4.	6%	40.98	39.38

Table No 3 Compressive strength of concrete for 28 days

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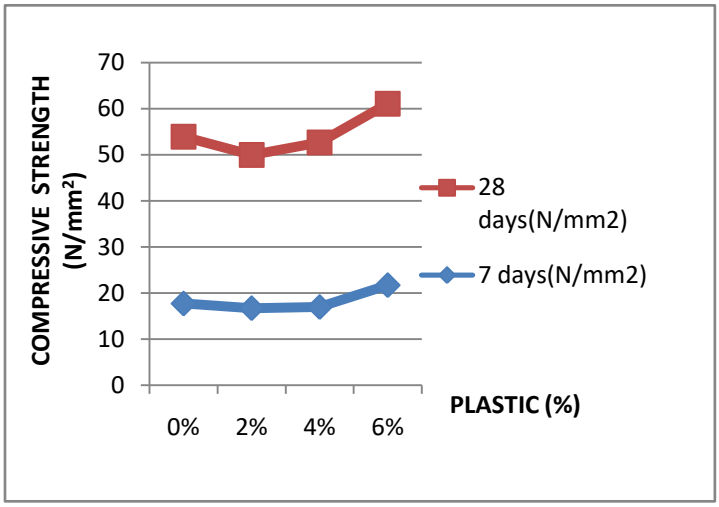


Graph 1 Compressive Strength of concrete for 7 days & 28 days

4.1.2 SPLIT TENSILE STRENGTH (IS: 5816 – 1970)

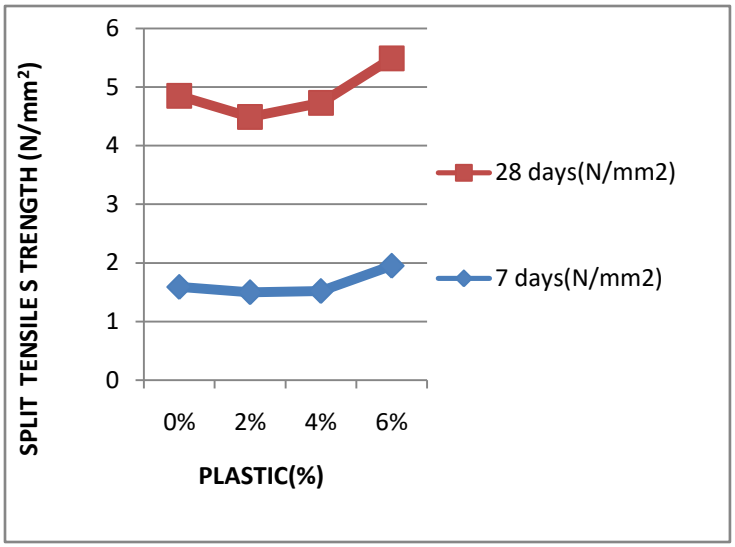
Table No 4 Tensile strength of concretefor 7 days.

Sl.No	Waste Plastic (%)	Load (tones)	Average Split Tensile Strength (N/mm^2)
1.	0%	1.14	1.59
2.	2%	1.08	1.5
3.	4%	1.09	1.52
4.	6%	1.4	1.95

Table No 5 Tensile strength of concrete for 28 days.

Sl.No	Waste Plastic (%)	Load (tones)	Average Split Tensile Strength (N/mm^2)
1.	0%	2.34	3.26
2.	2%	2.15	2.99
3.	4%	2.31	3.21
4.	6%	2.55	3.54

Graph 2 Split Tensile Strength for 7days & 28 days



4.1.3 FLEXURAL STRENGTH (IS: 516-1959)

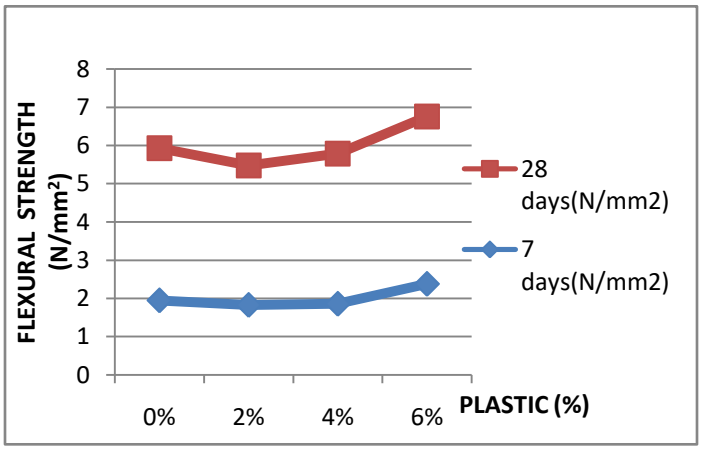
Table No 6 Flexural strength of concrete for 7 days.

Sl.No	Waste Plastic (%)	Load (tones)	Average Flexural Strength (N/mm^2)
1.	0%	3.97	1.95
2.	2%	3.73	1.83
3.	4%	3.79	1.86
4.	6%	4.8	2.38

Table No 7 Flexural strength of concrete for 28 days.

Sl No	Waste Plastic (%)	Load (tones)	Average Flexural Strength (N/mm^2)
1.	0%	8.1	3.98
2.	2%	7.44	3.65
3.	4%	8.01	3.93
4.	6%	8.9	4.38

Graph 3 Flexural Strength for 7 days & 28 days



V CONCLUSION

1. Waste plastic can be effectively re-used without affecting the mechanical properties considerably (5-10%).

2. With increase in the percentage of plastic there has been a sudden decrease in early strength but the strength developed to the value as that of the conventional M25 concrete when 28 day tests were performed.

As the Mix M4 for 6% of waste plastic, the strength has been developed at 39.38 N/mm^2 in compressive strength at 28 days.

3. It is observed that for more percentage addition of plastics i.e 6% in the present case, the 7 day strength has been increased when compared with conventional concrete.

4. The Mix M4 for 6% of waste plastic, the strength has been developed at 4.38 N/mm^2 in flexural strength of concrete.

5. For Mix M4 for 6% of waste plastic, the strength has been developed to about 3.54 N/mm^2 in split tensile strength in 28 days.

6. For less percentage addition (2-4%) of plastic, there is no considerable variation in 7 day, and 28 day compression strength and split tensile strength.

7. Concrete with plastic waste can be used for less important works where concrete is not going to bear more loads.

VI REFERENCES

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