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Re-Use of Polyethylene Plastic Waste in Concrete with Plasticizer and Test for Compressive and Tensile Strength

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Abstract - *From plastic containers, bottles, bags to plastic toys; everywhere we look, we see most of the plastic items made of polyethylene. Polyethylene Plastic are not so easy to degrade, they takes100s & even 1000s of years in environment for its complete breakdown so the environmental damage is long lasting. The proposed concrete which is made up by introducing Polyethylene tetraphthalate in varying percentages and admixture called plasticizer in concrete, & it may help to improve the certain properties of concrete & can be a helping hand towards environment. The properties of concrete of grade M25 containing varying percentages of plastic were tested for compressive strength and Split tensile strength and the comparision is made between conventional concrete & proposed concrete.*

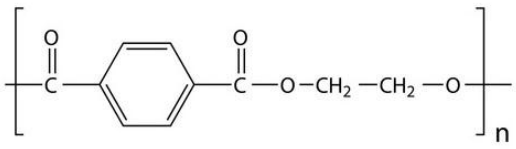
Key Words: Compressive strength, Environmental damage, Polyethylene tetraphthalate, Split Tensile Strength, Admixture, Plasticizer.

1. INTRODUCTION

Due to rapid industrialization and urbanization in the country lots of infrastructure developments are taking place. Most of the construction work uses concrete as a main constituent material, Concrete is the one of the most widely used construction material made by man and second most utilized stuff on earth after water. In parallel with the advancements in technology, Generation of plastic waste is one of the fastest growing areas. CPCB (Central pollution control board) data on plastic waste generation from a 2015 study showed that, in 2010-12, India generated 25,940 tonnes plastic per day. Polyethylene Plastic Waste in known percentages is introduced in concrete mix with plasticizer and properties are tested, the optimum percentage at which higher strength is obtained is calculated. Considerable researches were carried out in some countries like USA, UK on this topic however there have been very limited studies on plastics in India.

1.1 Polyethylene plastic as a Concrete Component

Polyethylene terephthalate (PET or PETE) is a general-purpose thermoplastic polymer which belongs to the polyester family of polymers. Polyester resins are known for their excellent combination of properties such as mechanical, thermal, chemical resistance as well as dimensional stability.



Molecular Structure of Polyethylene Terephthalate PET Chemical Formula: (C10H8O4)n

1.2 Plasticizer

Plasticizer is used for:

1. To Produce Pumpable concrete
2. To produce high strength, high grade concrete by substantial reduction in water resulting in low permeability & high early strength.
3. To produce high workability concrete requiring little or no vibration during placing.

2. OBJECTIVE

The objectives of the research proposal are to study the feasibility and influence of various percentage of Polyethylene tetraphthalate as a constituent material of concrete on mechanical properties of concrete to establish the optimum percentage of Polyethylene tetraphthalate.

Evaluating and studying the effect of varying percentages of Polyethylene Plastic and comparing the results with normal concrete. It will also be a great gesture towards environment.

Detailed Scope of study:

1. Investigation on the concrete mixes containing 0%, 2%, 4%, 6%, of Polyethylene Terephthalate, & 1% of plasticizer by weight of cementinious material to evaluate the mechanical properties of concrete such as compressive strength, tensile splitting strength,

2. Performing the slump test and analyzing the difference of slump for different % of Polyethylene Terephthalate to obtain the workability of the concrete.

3. Give a Helping hands towards mother nature by reusing Polyethyelene plastic waste.

3. PROPERTIES OF MATERIALS

Table 3.1

TEST	RESULT	RANGE
Cement		
Specific Gravity	2.62	2-3
Fineness	8	<10%
Consistency	31% (6mm)	5-7%
Initial Setting Time	170 min	>30 min
Final Setting Time	295 min	<600 min
Sand		
Specific Gravity	2.62	2.5-3
Fineness Modulus	2.75	2-3.5
Coarse Aggregate		
Specific Gravity	2.87	2.5-3
Fineness Modulus	7.55	6-8
Bulk Density	1.77	-
Water Absorption	0.9%	<2%
Impact Value Test	5.65%	-
Crushing Value Test	17.29%	<30%
Plasticizer		
Specific Gravity	1.250-1.270 at 270c	-
pH at 270c	Minimum 6	-
Chloride content	Nil to IS 456	-
Polyethylene plastic		
Tensile strength	80Mpa for biax film	190-260
Density (g.cm-3)	1.3-1.4	-
Poisson's ratio	0.37-0.44	-

4. MIX PROPORTION

Table 4.1

Materials	Quantity(Kg/m3)	Proportion
Cement	438	1
Natural Sand	648.53	1.48
Coarse aggregate	1263.86	2.88
Water	162	0.37

Plasticizer: 1% by weight of cement.

5. COMPRESSIVE STRENGTH TEST

The 7 days , 14days, 28 days compressive strength results were presented in Table 5.1 compressive strength of concrete goes on reducing with increase in percentage of plastic but the rate of educing compressive strength is very Low.

Days	Average Compressive strength 7,14 & 28 days		
Mix proportions	7 Days (N/mm2)	14 Days (N/mm2)	28 Days (N/mm2)
PET 0	26.67	36.93	41.03
PET 2	26.69	35.57	40.43
PET 4	24.86	37.63	40.09
PET 6	24.34	34.39	38.64

Table 5.1

6. SPLIT TENSILE STRENGTH TEST

The 7 days, 14days, 28 days compressive strength results were presented in Table 6.1., split tensile strength of concrete goes on increasing with increase in percentage of plastic.

Days	Average tensile strength 7,14 & 28 days		
Mix proportions	7 Days (N/mm2)	14 Days (N/mm2)	28 Days (N/mm2)
PET 0	1.65	2.82	4.31
PET 2	2.20	2.89	4.42
PET 4	2.86	3.12	5.10
PET 6	3.19	3.35	5.51

Table 6.1

7. FLEXURAL TENSILE STRENGTH TEST

The 7 days, 14days, 28 days compressive strength results were presented in Table 7.1 flexural tensile strength of concrete goes on increasing with increase in percentage of plastic

Table 7.1

Days	Average flexural tensile strength 7,14 & 28 days		
Mix proportions	7 Days (N/mm2)	14 Days (N/mm2)	28 Days (N/mm2)
PET 0	2.62	3.72	4.67
PET 2	2.25	3.93	4.75
PET 4	3.11	4.22	5.39
PET 6	3.45	4.79	6.18

8. RESULTS

After performing the tests following results were obtained:

- Highest compressive strength value is obtained at 2% addition of polyethyelene plastic at 28days, &the lowest one is observed at 7th day with the addition of 6 % of polyethyelene plastic.
- Highest split tensile strength also flexural strength value is obtained at 6% addition of polyethyelene plastic at 28days, &the lowest one is observed at 7th day with the addition of 2 % of polyethyelene plastic.

9. CONCLUSIONS

From the experimental results following conclusions can be drawn with regards with the addition of Polyethyelene plastic in concrete with plasticizer:

- Polyethylene Terephthalate can be effectively reused without affecting the mechanical properties of concrete upto 6%
- Compressive strength of concrete is affected by addition of plastic & it goes on reducing as the percentage of plastic increases
- The split tensile strength shows the improvement of tensile strength, rise in split tensile strength is observed upto 6% of Polyethylene Terephthalate.
- Flexural tensile strength is observed to be more than split tensile strength.
- From the above discussion it is observed that, we can successfully utilized waste plastic in concrete for less important work where there is not much load on the structure.

Future Scope of the work:

- Studies can be further extended by increasing the percentage of Plasticizer to see upto which extent Plastic can be utilized in concrete.
- It can be test for the durability to study its behavior in long run
- We can look for the technological advancements to increase the tensile strength of concrete.

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