Recycled Plastic Wastes as Partial Replacement for Sand

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Abstract: *This paper investigates the effect of using waste plastic materials on the concrete. Waste plastic were collected from homes. Most plastics are not biodegradable. They will stay in landfills until they are cleaned up. An important problem we are facing is dumping of plastic materials it causes lot of problems. In order to decrease the plastic waste, it can be used in construction field, plastic is inorganic in nature so it does not alter the chemical properties of concrete and also it does not affect the quality and consistency of concrete. The plastic can be as filler material in concrete as well as it can be used to improve the mechanical properties of concrete. Concrete is a composite material consists of Cement, Water, Fine Aggregate and Coarse Aggregate. High strength concrete was prepared of W/C 0.35 and the percentage of waste plastic replaced by 10% of cement, Fine aggregate and Coarse aggregate used in concrete. The sizes of cubes 150x150x150mm.*

Keywords: Sustainability, pavement, recycled concrete, aggregate.

I. INTRODUCTION

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 shredded plastics were used to prepare the coarse aggregates thereby providing a sustainable option to deal with the plastic waste. So these plastics will end up as earth fill. In this circumstance instead of recycling it rep+eatedly, if it is utilized to prepare aggregates for concrete, it will be a boon to the construction industry. Most of the failures in concrete structures occur due to the failure of concrete by crushing of aggregates. PCAs which have low crushing values will not be crushed as easily as the stone aggregates. Due to rapid industrialization and urbanization in the country lots of infrastructure developments are taking place.

II. LITERATURE REVIEW

1. *"STUDY ON PARTIAL REPLACEMENT OF PLASTIC WASTE AS FINE AGGREGATE IN CONCRETE": Elango A1, Ashok Kumar A2 (2018)*

   Disposal of used Plastics is a major problem in the present era, as the usage of plastics is growing day by day and it takes hundreds of years for plastic material to degrade. So effective ways to recycle & reuse of plastics are being formulated. According to their composition, plastics have been classified into seven types each having their own recycle rate. The used plastics were collected, ground into smaller components, pulverized in order to get granules of plastic lower than 4.75mm size. The density of the Pulverized plastic was found to be 460 kg/m3 & its specific gravity was 1.1. Sieve analyses were carried out & about 75% of the plastics were found to be in the range of 1 -1.7mm. 24 nos. of 10cm x10cm x10 cm cement concrete Cubes of 1:1.7:3.1 (M 20) mix were cast for 0%, 10%, 20%, 30%, sand being replaced with Pulverized plastic material. Volumetric proportioning was adopted instead of design mix since the density of plastic material was too low. Workability test, weight and compressive strength of the cubes were determined. The test results revealed that the compressive strength of concrete at seventh day decreased by about 3 to 3.2 N/mm2 for 20% replacement & 4 to 6.5 N/mm2 for higher replacements of Plastic when compared to conventional concrete. The water Cement ratio was also found to increase with the proportion of Plastics for a slump of 10 mm & weight of the cube decreased with an increase in replacement of Sand by Plastic Material. Thus it is inferred that Replacement of sand by plastic up to 20% can be adopted so that disposal of used plastic can be done as well the deficiency of Natural aggregates can be managed effectively.

2. "Replacement of Sand with Shredded Plastic in Cement Concrete": Vikas Khandelwal (2019)

   The concrete is the second largest material using on earth after water. In India, approximately 400 million metric cube concrete is being used every year and is increasing day by day. This increase in demand will create disturbance in proportion between availability and need of material. Hence an alternative material is required to vanishing this disturbance. In this paper studies conducted on utility of waste shredded plastic material used in the concrete. Moreover this paper will focus toward the change

in various properties of concrete when partially replacing with shredded plastic. Concrete with 0.5%, 1.0%, 2%, 4% and 6 % shredded plastic is prepared. Specific gravity, fineness, setting time, sieve analysis, fineness modulus tests on cement, coarse and fine aggregates are performed in this study. As per IS 10262-2009 mix design code, Mix design is done. Cubes and beams are cast for M20 grade concrete with and without shredded plastics and tests on concrete are conducted. The standard mechanical properties of concrete like compressive strength, flexural and strength are tested and compared with the results of standard specimen. Higher compressive and flexural strength were observed on 4 % replacement of fine aggregate with shredded plastic.

3. *"Polyethylene Terephthalate (PET) Bottles Waste as Fine Aggregate in Concrete":Altamashuddinkhan Nadimalla, Siti Aliyyah Binti Masjuki, Asmahani Binti Saad, Kamsiah Binti Mohd Ismail, Maisarah Bt Ali (2019)*

Concrete construction industry is one of the major sector utilizing natural resources to produce concrete for building constructions. The rapid increase in building constructions and the demand for natural aggregates has resulted in depletion natural resources at an alarming rate. Uncontrolled mining activity worsens the situation. Thus serious awareness has been taken into consideration, has to be identified as a potential river sand substitution for fine aggregates replacement in concrete. For this review, utilizing recycled material are described as a fine aggregate replacement to river sand, particularly recycled Polyethylene Terephthalate (PET) bottles. Recycled PET Bottles are categorized as non-biodegradable waste materials which are injurious to health. Recycled PET bottles in concrete are economical and help in reducing disposal problems.

III. METHODOLOGY

Factor affecting the choice of mix proportions:

1. Compressive strength:

It is one of the most important properties of concrete and influences many other describable properties of the hardened concrete. The mean compressive strength required at a specific age, usually 28 days, determines the nominal water-cement ratio of the mix. The other factor affecting the strength of concrete at a given age and cured at a prescribed temperature is the degree of compaction. According to Abraham's law the strength of fully compacted concrete is inversely proportional to the water-cement ratio.

2. Workability:

The degree of workability required depends on three factors. These are the size of the section to be concreted, the amount of reinforcement, and the method of compaction to be used. For the narrow and complicated section with numerous corners or inaccessible parts, the concrete must have a high workability so that full compaction can be achieved with a reasonable amount of effort. This also applies to the embedded steel sections. The desired workability depends on the compacting equipment available at the site.

Fig. No. 1 Workability Slump cone test

TABLE-I: Concrete Mix Design Proportions for 100% Replacement with Plastic Crush

1. Conventional Block:

Material	Quantity (1 block)	No's of Block	Total Quantity
Cement	1. 3942 kg	6	8.16 kg
Sand	2. 5665 kg	6	15.399 kg
Aggregate	4. 3942 kg	6	26.36 kg
Water	0.93 lit.	6	5.58 lit.

TABLE-II: Concrete Mix Design Proportions for 10% Replacement with Plastic Crush

2. Using 10% Plastic Crush:

Material	Quantity (1 block)	No's of Block	Total Quantity
Cement	1. 3942 kg	6	8.16 kg
Sand	2.3098 kg	6	13.85 kg
Aggregate	4. 3942 kg	6	26.36 kg
Plastic crush	0.25665 kg	6	1.53 kg
Water	0.93 lit.	6	5.58 lit.

TABLE-III: Concrete Mix Design Proportions for 20% Replacement with Plastic Crush

3. Using 20% Plastic Crush:

Material	Quantity (1 block)	No's of Block	Total Quantity
Cement	1. 3942 kg	6	8.16 kg
Sand	1.7512 kg	6	10.50 kg
Aggregate	4. 3942 kg	6	26.36 kg
Plastic crush	0.5153 kg	6	3.06 kg
Water	0.93 lit.	6	5.58 lit.

TABLE-IV: Concrete Mix Design Proportions for 30% Replacement with Plastic Crush

4. Using 30% Plastic Crush:

Material	Quantity (1 block)	No's of Block	Total Quantity
Cement	1.3942 kg	6	8.16 kg
Sand	1.7966 kg	6	10.77 kg
Aggregate	4. 3942 kg	6	26.36 kg
Plastic crush	0.7699 kg	6	4.61 kg

Water	0.93 lit.	6	5.58 lit.

IV. RESULT

Standard metallic cube molds (150*150*150 mm) were casted for compressive strength. Compaction of the hand filled concrete cubes was done. The specimens were demolded after 24 hours and subsequently immersed in water. We have casted total nine cubes (three cubes for each type of RCA proportion) and tested them periodically after 7 days and 28 days. The test was performed on Compressive Testing Machine (CTM).

Compressive Strength

Sr. No.	Case	Compressive strength 7 days (MPa) Average	Compressive strength 28 days (MPa) Average
1.	Block No 1 – Conventional PPC + Fine Aggregate + Coarse Aggregate + Water	28.41	39.36
2.	Block No 2 - 10 % Plastic crush PPC + Fine Aggregate + Coarse Aggregate +10 % Plastic crush + Water	26.57	37.84
3.	Block No 3 - 20 % Plastic crush PPC + Fine Aggregate + Coarse Aggregate+20 % Plastic crush + Water	25.88	36.81
4.	Block No 4 - 30 % Plastic crush PPC + Fine Aggregate + Coarse Aggregate +30 % Plastic crush + Water	25.19	35.80

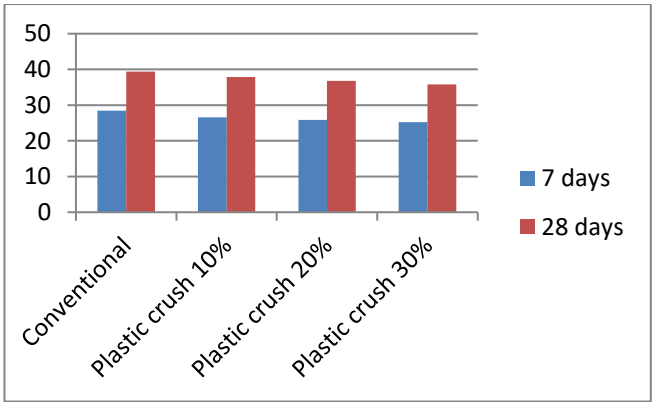

Fig No.2 Testing on C.T.M.

Workability result :

Workability Result			
No.	Block	Slump value	Workability Result
1	Conventional block	120mm.	High
2	10% Plastic used in concrete	115mm.	Medium
3	20% Plastic used in concrete	90mm.	Medium
4	30% Plastic used in concrete	80mm.	Medium

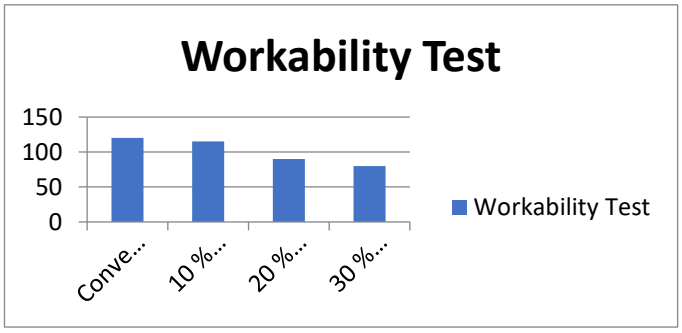

Fig. No. 3 Workability Slump cone test

V. CONCLUSION

1) Compressive strength 10% changed concrete cube achieves early equal power when in contrast to conventional concrete at the end of 28 days, but at the equal time 20% replaced concrete dice energy is much less at the quilt of 28 days.
2) The behavior of sparkling concrete is checked by way of workability take a look at by way of the usage of a slump cone and it is determined that the workability is identical in all cases i.e. conventional concrete 10% ,20%,30% fine aggregate changed concrete.
3) When we compare the weight, the weight is decreased when we increase the percentage of Plastic crush in concrete via combination alternative.
4) As per IS 456:2000 minimum compressive strength of a concrete above 15Mpa

Future Scope :

1) When deploying water and gas meters the utilities face challenges to provide power to the wireless sensors, so an efficient battery base low power sensor design is required.
2) This analysis has been carried out with consumption at domestic level. The analysis can be extended to generation plants.
3) Modernization of current electric network architecture Standardization of communication protocol.

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