International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 04 | April-2016 www.irjet.net p-ISSN: 2395-0072

Effect of Use Plastic Aggregates as Partial Replacement of Natural Aggregates in Concrete with Plastic Fibres

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Abstract: - *The use of alternative aggregates like Plastic Coarse Aggregate (PCA) is a natural step in solving part of depletion of natural aggregates. The investigation on alternative material for concrete making started before half a century. Concrete made from plastic waste as coarse aggregates will be studied for workability, compressive strength, Split tensile strength and Flexural strength. Further, study of its durability will ensure greater dependability in its usage. So here in this project, Plastic Coarse Aggregates and Plastic fibers has been used as replacement of Natural Coarse aggregate by different percentage for making concrete of M-20, with w/c ratio 0.50. The percentage replacement will be 0%, 06%, 12%, 18%, 24%, and 30%, with natural Coarse aggregates and plastic fiber is 01%. For making concrete OPC-53 grade cement is used. Cubes and beams will be casted and tested compressive strength, Split tensile strength. Optimum replacement of PCA can be used in structural concrete.*

Key words:- Plastic Aggregates, Light weight concrete, plastic Waste minimization, Compressive strength, Tensile strength.

1. 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 recycled plastics were used to prepare the coarse aggregates thereby providing a sustainable option to deal with the plastic waste.

There are many recycling plants across the world, but as plastics are recycled they lose their strength with the number of recycling. So these plastics will end up as earth fill. In this circumstance instead of recycling it repeatedly, 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.

PCA which have low crushing values will not be crushed as easily as the stone aggregates. These aggregates are also lighter in weight compared to stone aggregates. Since a complete substitution for NCA was not found feasible, a partial substitution with various percentage of PCA was done. Both volumetric and grade substitution was employed in this investigation Generation of plastic waste is one of the fastest growing areas. Also now days many types of fibers used in concrete work for increasing strength of concrete. Here also use plastic strips waste as a fiber in concrete with plastic aggregates.

1.1 Definition of Plastic

A material which contains one or more number of polymers having large molecular weight" Solid in its finished state or same state manufacturing or processing into finished articles is known as Plastic. Looking to the global issue of environmental pollution by post-consumer plastic waste, research efforts have been focused on consuming this waste on massive scale in efficient and environmental friendly manner. Researchers planned to use plastic waste in form of concrete ingredient as the concrete is second most sought material by human beings after water. The use of postconsumer plastic waste in concrete will not only be its safe disposal method but may also improve the concrete properties like tensile strength, chemical resistance, drying shrinkage and creep on short and long term basis.

1.2 Why The Plastics:- Polymers have a number of vital properties, which exploited alone or together, make a significant and expanding contribution to constructional needs.

- Durable and corrosion resistant.
- Good Insulation for cold, heat and sound saving energy.
- It is economical and has a longer life.
- Maintenance free (such as painting is minimized)
- Hygienic and clean
- Ease of processing / installation
- Light weight

2. PROPOSED METHODOLOGY

Recycled Plastic Aggregate (RPA) in concrete is acceptable there are for the making of concrete used coarse aggregate having size 10mm & 20mm, natural river sand used for making a concrete and plastic aggregate and plastic fibers used in concrete. Test carried out on aggregate specific gravity, sieve analysis, water absorption, Impact value test, all these test conduct on Recycled plastic aggregate sample. Conventional aggregate and compressive strength and

tensile strength of concrete at 06%, 12%, 18%, 24%, 30% replacement of plastic aggregate and 01% addition of plastic fibers in concrete.

3. MATERIALS

a) Cement
b) Water.
c) Fine aggregate (sand),
d) coarse aggregate
e) Plastic Fibers.
f) Recycled Plastic aggregate.

a) Cement

Ordinary Portland cement of 53-grade was used as it satisfied the requirements of IS: 269- 1969 and results have been tabulated in table 1.

Initial setting time		25min.
Final setting time		240min.
Compressive strength	3days	32.3N/mm^2
	7days	41.9N/mm^2
	28days	59.5N/mm^2
Fineness (90umsieve)		1.7%
Standard consistency		31.5%

Table 1 Properties of cement

b) Water

Portable tab water is used for preparation of specimens and curing of specimens.

c) Fine aggregate

As per IS 383-1970, table4 sand used for experimental program was locally produced and was conforming zone II. The specific gravity of fine aggregate was found to be 2.638.

Gradation	Fall in Zone II
Fine modulus	2.56
Silt content	0.78%
Specific Gravity	2.638
Moisture content	1.4%

Table 2 Properties of Fine Aggregate

d) Coarse aggregate

Locally available coarse aggregate passing from 20mm sieve and conforming IS 383-1970 were used in present work. The specific gravity of coarse aggregate was found to be 2.836.

Aggregate Impact value	12.4
Aggregate Abrasion Value	16.3
Specific Gravity	2.836
Water Absorption	1.06%
Combined Flakiness Index, Elongation Index	22.9%

Table 3 Properties of Coarse aggregate

e) Plastic fibres

Low density polyethylene is used as fibres. Generally these made by cutting the Packaging strips in to laminar shaped fibres are used and thicknesses of fibres are varying from 0.150 to 01mm. By trail mix results 01% (by the weight of cement) is added in the concrete of present experimental work.

f) Plastic Aggregates

Plastic aggregates are made from locally available plastic collect and burn at temperature of 140ºC to 180ºC, After burning cooled at natural temperature for 4hrs to 5hrs. After cooling crush them in aggregates size 4.75mm to 20mm.

Aggregate Impact value	9.06
Specific Gravity	0.93
Water Absorption (%)	0.02
Density (g/cc)	0.84

Table 4 Properties of Plastic aggregate

3.1 Mix design

The mix was designed as per IS 10262:2009 for M20 grade concrete with 0.5 water cement ratio. Concrete mixes are prepared by partial replacement of natural Aggregates by plastic aggregates with different percentages (0%, 06%, 12%, 18%, 24%, 30%) respectively and adding fixed percentage of plastic fibres (01% of weight of cement) for every mix. The materials of each mix are given in table 6.

	Water	Cement	F.A.	C.A.
By Weight (Kg)	186	372	535	1342
By Volume	0.5	1	1.44	3.61

Table 5 Mix Design M20

Mix	Cement	F.A.	N.C.A.	P.C.A	P.F.
Mix-1	100%	100%	100%	00%	00%
Mix-2	100%	100%	100%	00%	00%
Mix-3	100%	100%	96%	06%	1.0%
Mix-4	100%	100%	88%	12%	1.0%
Mix-5	100%	100%	82%	18%	1.0%
Mix-6	100%	100%	76%	24%	1.0%
Mix-7	100%	100%	70%	30%	1.0%

Table 6 Mix Type

3.2 Test Specimens and Test Procedure

Cement, sand and aggregate were taken in mix proportion as per mix design M20 grade of concrete respectively. The 150mm x 150mm x 150mm size concrete cubes were used as test specimens to determine the compressive strength, split tensile respectively.

Cast the cubes with different mix proportion and put in water curing tank for 28days. After complete curing done the compressive and tensile strength.

4. RESULTS AND DISCUSSION

4.1 Slump Test

Slump test is done before casting of each mix, Slump of concrete is increase respectively increase of PCA in concrete. Reason of slump increase was less water absorption of plastic aggregates and plastic fibres. The slump test results are shown in figure 1.

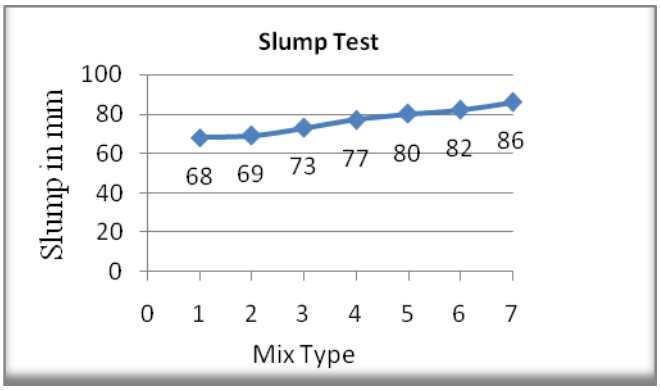

Figure 1 Slump test Results

4.2 Compressive Strength

The compressive strength results of different mixes are given by table 7 and fig 2.In the present investigation compressive strength of concrete produced by replacing natural Aggregates by plastic aggregates with addition of plastic fibre is goes on increasing up to 30% replacement of PCA.

In compressive strength results mix2 increase compressive strength because of using plastic fibers, after mix2 strength increse in mix 3 and after decreasing because of increases PCA content in concrete. The percentage in the compressive strength at this 0% to 30% replacement of PCA found to be seen in table 7 and fig2.

Sr. No.	Mix	Compressive Strength(N/mm2)		
		7 Days	14 Days	28 Days
01	Mix 01	14.65	17.36	26.50
02	Mix 02	17.25	19.54	280.2
03	Mix 03	17.48	20.00	28.05
04	Mix 04	17.19	19.66	26.91
05	Mix 05	16.74	18.52	26.52
06	Mix 06	16.22	18.18	25.94
07	Mix 07	15.55	17.05	24.02

Table 7 Compressive Strength Results

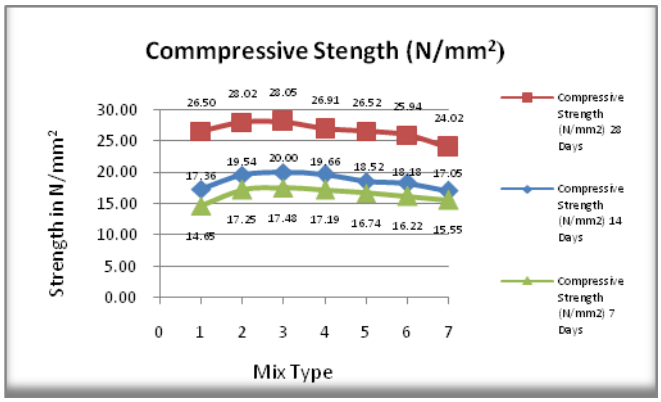

Figure 2 Compressive Strength Results

4.3 Tensile Strength

Similarly for split tensile strength up to 30% replacement of PCA, in tensile strength tensile strength increase in mix2 because of using plastic fibers. After mix2 all mixes decrease

tensile strength of Concrete because of increase in PCA content in concrete.

The percentage of split tensile strength for 0% to 30% replacement of PCA found to be is shown in table 8 and fig3.

Sr. No.	Mix Type	Tensile Strength (N/mm^2)
		28 Days
01	Mix 01	3.82
02	Mix 02	4.48
03	Mix 03	4.29
04	Mix 04	3.96
05	Mix 05	3.68
06	Mix 06	3.21
07	Mix 07	2.84

Table 8 Tensile Strength Results

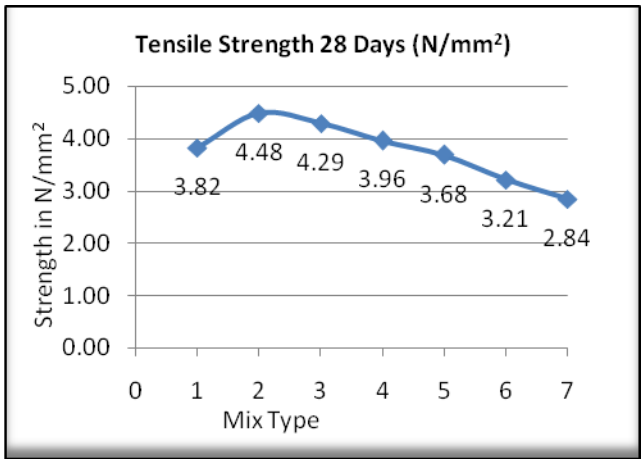

Figure 3 Tensile Strength Results

5. CONCLUSION

- It is identified that plastic waste can be disposed by using them as construction materials in concrete.
- The workability property of concrete was affected in PCA, may be due resistance offered by the fibers to the movement of aggregates. The dry density was also reduced and made concrete light weight.
- Increase the Compressive Strength 5.74% Compare to normal concrete due to 01% addition of fibres.
- Increase the Tensile Strength 17.28% Compare to normal concrete due to 01% addition of fibres.
- However Strength noticeably decreased when the plastic content was more than 30% as aggregates in concrete.
- Density of concrete is reducing after 20% replacement of coarse aggregates in a concrete.
- From this experimental investigation, the composites would appear to be low cost materials which would help to resolve some solid waste problems and preventing environment pollution.
- Optimum replacement of PCA and optimum strength getting in mix 5 or 18% replacement of aggregates.

ACKNOWLEDGEMENT

The writers express their sincere thanks to Mr. Priyank Bhimani (Asst. Prof. At Civil Dept. HJD Institute), Dr. Kalpana Maheshwari (HOD Civil Dept. HJD Institute), Dr. Rajesh Patel (Principal HJD Institute), Mr. Bipin Pindoriya, Mr. Nitesh Kerai, Mr. Dhaval Ganatra, under graduate students, HJD Institute–Kera (Kutch), Gujarat, India, for their laborious effort in this investigation.

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