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Study on Strength Parameters of Concrete Made with Waste Plastic from Plastic Recycling Industry

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Abstract: ***This research work focus on the experimental study related to strength parameters testing of concrete made with plastic waste collected from plastic recycling industry. The tests conducted by replacing waste plastic aggregates with natural granite coarse aggregates in concrete by partial replacement percentages like 0%, 5% and 10%. Tests conducted by considering M-30 grade concrete. Experimental tests conducted to check its basic physical properties, concrete in fresh state and concrete in hardened state like compressive strength, split tensile strength, flexural strength, impact strength and shear strength. Results observed that replacement of waste plastic from plastic recycling industry have shown normal values up to 5% replacements.***

Keywords: Recycled Waste Plastic (RWP), Concrete, Strength

1. Introduction

Due to fast development of usage of plastic in the field of domestic, medicine, engineering, and non-engineering field, it has been observed that its adverse effect on the environment towards health oh human beings and animals. We face major problems in terms of recycling of plastic in proper way, it has also been seen that all waste plastic shall not be recycled because of difficulties in proper way of dispose, collection, separation and sending it to its proper recycling unit.

By considering the above said issues in recycling of waste plastic, if we use waste plastic from recycling industries, waste plastic shall be utilized in concrete towards construction field and such that in future if the structure is demolished, again we can utilise the waste concrete as recycled concrete aggregates.

Also, it has been recommended that to create awareness about limiting on use of plastic in future and reusing of plastic already generated as waste in concrete.

In this research work I considered waste plastic from recycling industries to replace in seme percentage with natural coarse aggregates and finding the results towards its utilisation in concrete.

2. Materials and Methodology

A) Cement

I considered Ultratech OPC cement for making concrete and the cement confirms to IS 8112-1989, 43Grade. The properties of cement are shown in table1.

B) Fine Aggregates (FA)

Natural river sand available at local site used and that confirms to zone II of IS: 383-1970 and its test results shown in table 2

C) Coarse Aggregates (CA)

Here locally available natural granite coarse aggregates were used and that confirms to IS: 383-1970 and its test results shown in table 3

D) Plastic waste & RWP

Plastic waste usually collected from residential house, hotels, industries, hospitals etc., are sent to recycling industries and there, the plastic waste sent to certain level of treatment before it recycling process. The treatment process consists of separation, washing, again separation based on colour and density, shredding to make it as small pieces, again separation based on size.

Later, plastic waste sent to melting chamber, specially designed for it. After plastic sent to melting chamber it has been delivered like wire or tubes. And such output plastic shall be resized to small pieces of aggregates to use in concrete. In this present research work, I used waste plastic which has been not utilised for recycled plastic products which is obtained during recycling process, that is waste plastic jammed in the output chamber, output nozzles, and after completing the melting process or during change of feeding shifts.

Figure 1: Waste plastic from garbage

Figure 2: Waste plastic pressing

Figure 3: Waste plastic pressing unit

Figure 4: Waste plastic shredding

Figure 5: Waste plastic feeding to melting chamber

Figure 6: Recycled waste plastic output nozzles

Figure 7: Recycled waste plastic cutting box

Figure 8: Recycled waste plastic aggregates

Table 1: Physical Properties of Cement.

Sl. No.	Materials Properties	Test values
1	Grade & Brand	43Grade, Ultra Tech
2	Specific Gravity	3.14
3	Standard consistency	32 %
4	Initial setting time	83 minutes
5	Final setting time	480 minutes
6	Bulk density	1440Kg/Cum

Table 2: Sieve Analysis and Physical Properties of River Sand

IS Sieve Size	Cumulative percentage passing of fine aggregates	Specifications for Zone II as per IS:383-1970
4.75 mm	100	90-100
2.36 mm	95	75-100
1.18 mm	87	55-90
600 microns	57	35-59
300 microns	14	8-30
150 microns	2	0-10
Pan	0	0
Specific Gravity = 2.65		
Bulk Density = 1750 Kg/m3		
Water absorption = 1%		

Table 3: Sieve Analysis And Physical Properties Of Coarse Aggregate

IS Sieve Size In mm	Percentage passing of coarse aggregates		Percentage passing of different fractions			Specifications as per IS:383-1970		
IS Sieve Size In mm	I 20 mm	II 12.5 mm	I 60%	II 40%	Combined 100%	Graded	Single sized I	Single sized II
20	200	100	60	40	100	95-100	85-100	--
12.5	0	98.5	0	0	0	--	--	85-100
10	0	35.20	0	29.5	29.5	25-55	0-20	0-45
4.7	0	8.4	0	4.1	4.1	0-10	0-5	0-10
Specific Gravity=2.60								
Bulk Density = 1740 Kg/m3								
Water absorption = 0.6%								

Table 4: Physical Properties of RWP

S. No.	Test	Results
1	specific gravity	0.8
2	bulk density	500 to 600 kg/cum
3	sieve analysis	20mm passing and 10mm retaining

Figure 9: Specimen casting process

Figure 10: Casted specimens

3. Methodology

The methodology adopted in the present work divided in to two parts, that is basic material testing (Physical properties of key ingredients of concrete and RWP) and testing of concrete on fresh state followed by hardened state.

In order to found out strength parameters, cube specimen, cylindrical specimen, flexure specimen, shear specimen, impact specimens were casted with M30 Grade concrete as per IS 10262-2009 and Testing specimens were casted to 0%, 5% and 10% replacement to natural coarse aggregates. The tests were conducted on,

a) Cube samples of size 150mm for compressive strength,
b) Cylinders of 150mm diameter and 300mm length to check split tensile strength.
c) L-shaped shear samples to check shear strength.
d) 400mm length beam samples to check flexural strength and 5. 150mm diameter and 60mm depth cylindrical samples for impact test.

4. Experimental results and observations

Table 5: Overall Compressive Strength Values

PA replacement to NGCA	Average compressive strength
0%	38.5
5%	37.5
10%	33.35

Table 6: Overall Split Tensile Strength Values

PA replacement to NGCA	Average tensile strength
0%	10.50
5%	12.00
10%	10.30

Table 7: Overall Flexural Strength Values

PA replacement to NGCA	Average flexural strength values
0%	4.50
5%	4.25
10%	3.00

Table 8: Overall Shear Strength Values

PA replacement to NGCA	Average shear strength values
0%	10.50
5%	12.00
10%	10.00

Table 9: Overall Impact Strength Values

Member Identification	Average First Crack (N-M)	Average Final Crack (N-M)
NC 0%	7050	7200
NC 5%	6900	7150
NC 10%	6720	6380

5. Conclusion

Recycled waste plastic shall be used in concrete as a replacement to natural granite coarse aggregates up to 10% in concrete. Based on further tests like temperature test, this recycled waste plastic may be recommended to use in road concrete works and other structural works.

It in concrete to avoid difficulties in reusing plastic, difficulties in proper collection and disposing of waste plastic, helps to avoid death of cattle's by eating plastic covers at garbage yards and finally keeps the environment safe by reusing plastic waste. Light weight concrete can be made as the lesser density of plastic aggregates.

As the slipping property within the concrete mass when subjected to loading, improper bonding within the concrete mass, sharp exposed edges on its surface, broken glasses were difficult to use in concrete precast products.

Because of excessive moisture absorption of DBBA, precast members were almost exposed to environment will absorb moisture easily and damage the concrete products.

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