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BEHAVIOUR OF CONCRETE USING WASTE PLASTIC AND CRUMB RUBBER

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Abstract: Waste plastic and crumb rubber are industrial by-products that have a disposal problem. The building industry's demand for aggregate is steadily expanding in the modern period. As a result, these waste materials are becoming increasingly important in the search for suitable aggregate alternatives in future development. The natural coarse aggregate was partially replaced with crumb rubber and waste plastic as aggregate in this study at various proportions such as 0, 3, 6, 9, and 12 percent. Waste plastic is also used to replace natural coarse aggregate in various proportions of 5, 10, 15, 20, and 25%. On M40 grade concrete, an experiment was carried out to determine the compressive, split tensile, and ultrasonic pulse velocity of the specimen.

Keywords: Compressive strength,Crum brubber, High density polyethylene and Split tensile strength.

1. INTRODUCTION

The building sector in India is now among the world's top five. With the growing population, the demand for new construction is on the rise. As a result, India now faces an issue with nonrenewable aggregate supply. Given the current shortfall, the building industry's future is bleak. New materials have been used in the development industry in search of aggregates for concrete. New waste materials have been used in the development industry in order to focus on the environment and safeguard shared assets. The amount of strong garbage produced in India is rapidly increasing as the population grows. Plastics account for 8% of all strong squanders in terms of weight. These non-biodegradable plastic materials will eventually be used as fill in the ground. Reuse of plastic in cement is thought to be the most feasible application for settling the transfer of large amounts of plastic materials and meeting the growing need for totals. Plastic totals will not be squashed as effectively as regular totals because plastic is made up of long string particles that are reinforced with carbon molecules.

2. OBJECTIVE OF THE PRESENT STUDY

The purpose of this research is to investigate the strength of concrete when natural aggregate is partially replaced with plastic aggregate.

a. To optimize the percentage optimization of plastic waste and crumb rubber.
b. To estimate the compressive and split tensile strength of M40 grade of concrete.

3. MATERIALS

3.1 Cement

Ordinary Portland cement from locally available market was employed for the examination.

3.2 Fine Aggregate

The fine aggregate in the concrete mix used is made from locally accessible sand.

3.3 Coarse Aggregate

The locally available aggregate used.

3.4 Water

Water responds with the concrete to tie different segments together to shape a strong, stone-like material.

3.5 Plastic Aggregate

The melted polymers were allowed to fall on a rough surface (die) and 20mm thick plastic sheets were formed from them. On the exterior of the sheets, undulations were produced. These sheets were then chopped into 20mm aggregates (Fig. 1).

Fig.1 Plastic aggregate

3.6 Crumb Rubber

Crumb rubber is made into the desired size and used as coarse aggregate (Fig. 2).

Fig.2 Crumb aggregate

4. MIX PROPORTION

The mix design for M40 grade is based on the properties of materials tested in the laboratory confining to IS:10262-2009.

5. RESULTS AND DISCUSSION

5.1 Compression test

The compression tests were carried out at 28, 56 and 90 days and in table 1-3.

Table 1. Compressive strength of crumb rubber

Crumb rubber	Compressive strength, N/mm^2		
	28 days	56 days	90 days
0%	48.25	52.23	56.15
3%	49.67	53.87	58.03
6%	51.40	55.86	59.69
9%	45.94	49.92	53.62
12%	44.65	48.30	51.98

Table 2.Compressive strength of plastic aggregate

HDPE	Compressive strength, N/mm^2		
	28 days	56 days	90 days
0%	48.25	52.23	56.15
5%	51.83	56.17	60.34
10%	57.03	61.74	66.71
15%	64.10	69.45	74.86
20%	59.96	64.82	69.99
25%	54.09	58.73	62.90

Table 3.Compressive strength of combined replacement

Combined replacements	Compressive strength, N/mm^2		
	28 days	56 days	90 days
0%	48.25	52.23	56.15
%15hdpe+%6cr	65.67	71.16	76.23

5.2 Split tensile strength test

The cast cylinder specimen is tested in a compression testing machine and results are furnished in tables 4-6.

Table 4. Split tensile strength of crumb rubber

Crumb rubber	Split tensile strength, N/mm^2		
	28 days	56 days	90 days
0%	4.58	4.95	5.31
3%	4.72	5.12	5.48
6%	4.90	5.32	5.71
9%	4.34	4.71	5.06
12%	4.28	4.65	4.99

Table 5. Split tensile strength of plastic aggregate

HDPE	Split tensile strength, N/mm^2		
	28 days	56 days	90 days
0%	4.58	4.95	5.31
5%	4.91	5.32	5.71
10%	5.38	5.83	6.25
15%	6.02	6.52	6.98
20%	5.64	6.12	6.58
25%	5.10	5.54	5.93

Table 6. Split tensile strength of combined replacements

Combined replacements	Split tensile strength, N/mm^2		
	28 days	56 days	90 days
0%	4.58	4.95	5.31
%15HDPE+%6cr	6.36	6.87	7.38

5.3 UPV test

The UPV test was conducted on the cured specimen and presented in table 7 to 9.

Table 7. UPV test for HDPE

% of HDPE	Pulse velocity (m/s) @ 28 days
0%	4450
5%	4581
10%	4638
15%	4728
20%	4688
25%	4592

Table 8. UPV test for crumb rubber

% of crumb rubber	Pulse velocity (m/s) @ 28 days
0%	4450
3%	4595
6%	4674
9%	4639
12%	4586

Table 10. UPV test for combined replacements

Combined replacements	Pulse velocity (m/s) @ 28 days
0%	4450
%15HDPE+%6cr	4840

6. CONCLUSION

1. The maximum compressive strength of concrete using crumb rubber of 6% at 28, 56 and 90 days are 51.40, 55.86 and 59.69N/mm^2.
2. The maximum split tensile strength of concrete using crumb rubber of 6% at 28, 56 and 90 days are 4.90, 5.32 and 5.71N/mm^2.
3. The maximum compressive strength of concrete using plastic aggregate of 15% at 28, 56 and 90 days are 64.10, 69.45 and 74.80N/mm^2.
4. The maximum compressive strength of concrete using %15hdpe+%6cr at 28, 56 and 90 days are 65.67, 71.16 and 76.23N/mm^2.
5. The maximum split tensile strength of concrete using plastic aggregate of 15% at 28, 56 and 90 days are 6.02, 6.52 and 6.98 N/mm^2.
6. The maximum split tensile strength of concrete using %15hdpe+%6cr at 28, 56 and 90 days are 6.36, 6.87 and 7.38N/mm^2.
7. The UPV of 15% with HDPE, 6% of crumb rubber and their combination are 4728, 4674 and 4840 m/s.

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