STRENGTH STUDIES ON CONCRETE USING E-PLASTIC WASTE AS COARSE AGGREGATE

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GRAPHICAL ABSTRACT

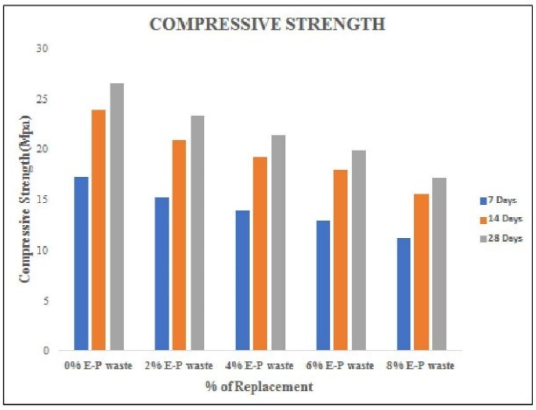

Fig 3.1: Compressive Strength Relation

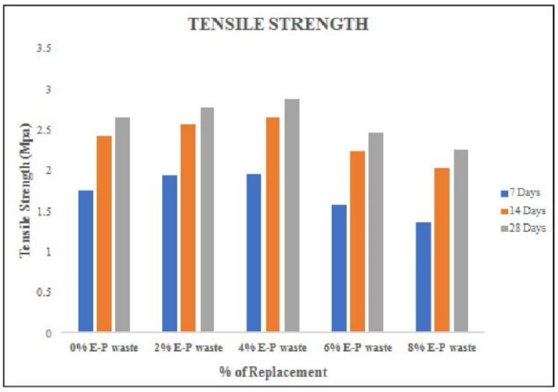

Fig 3.2: Tensile Strength Relation

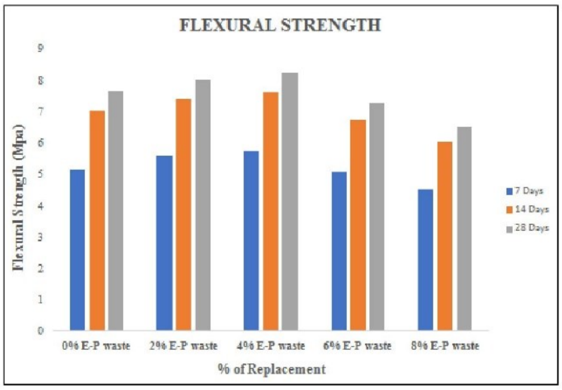

Fig 3.3: Flexural Strength Relation

ABSTRACT

As an important resource for the IT sector and due to the extremely hazardous elements it contains and the low recycling rate, e-plastic waste management and recycling are growing swiftly. E-plastic waste utilization reduces aggregate costs, landfill costs and energy prices. Rapid population growth coexisted with industrialization and a dynamic shift in the volume of garbage produced. These dangerous wastes and other types of waste represent a serious threat to the ecosystem as well as human health. Therefore, the issue of efficient waste management is essential to the preservation of the environment, human health and livelihood. Concrete coarse aggregate made from plastic and recovered e-waste is being tested for feasibility. Testing was done to find out the characteristics of electronic plastic waste when used as coarse aggregate (2%, 4%, 6%, & 8%). These characteristics included specific gravity, water absorption, fineness test, compressive strength, tensile strength and flexural strength of the concrete.

Keywords: Compressive Strength, Coarse Aggregate Replacement, Plastic waste, E-waste

1. Introduction

The biggest and strongest industrial effluents, which are made of plastic and outdated electrical and computer goods, have been affected by the quick advancement of technology, the upgrading of these advances, and the substantial rate of decline in the manufacturing industry. Numerous manufacturing and usage patterns pose a significant threat to the ecosystem and the general public's health. Concerns like the most effective utilizing natural resources effectively, waste reduction, the creation of greener goods, environmentally beneficial reprocessing and trash removal must be handled by all parties concerned while guaranteeing economic expansion and raising standards of living life. More than 7.5 Metric tonnes of dangerous waste from industry, Electronic waste weighing 4.2 lakh tonnes, 1.9

metric tonnes of plastic waste, medical refuse weighing 1.7 metric tonnes, and 50 metric tonnes of township refuse are produced in the nation each year, according to a survey conducted by the Comptroller and Auditor. Therefore, the larger proportion of electronic plastic waste in urban solid refuse is planned to be an issue of great importance due to growing consumerism and a predicted increase in the revenues of plastic and computerized goods in nations that are rapidly developing socially and commercially. In India, there are no large-scale organized trash recycling facilities, and all recycling is done in the unorganized sector. It is important to take into account an integrated waste management strategy that includes effective recycling, disposal, and usage of plastic and electronic materials. The best use for this waste is to replace coarse aggregate in concrete mixtures because coarse aggregate is a resource with economic value as well and cannot be easily replaced by natural means on a level comparable to its consumption. This will produce concrete that is both affordable and sustainable.

2. Experimental Work

The mechanical properties of e-waste are identified as representative parameters for the modified concrete to be able to characterize the e-waste in the concrete mix. Now, using the alternative mixing method, replace the coarse aggregate with a weighing ratio of 2%, 4%, 8% and 10% of E-Plastic waste, then conduct additional tests on the mix's strength.

2.1 Material

According to the chemical composition and particle size, industrial byproducts can be used in concrete as a full or partial aggregate replacement or a partial cementitious substance. The disposal of significant amounts of electrical and plastic garbage can be solved economically and technically by using electronic plastic waste as coarse aggregate in concrete. E-Plastic waste depending on its size and chemical composition, discarded items can be utilized as coarse or fine in concrete. E-plastic garbage has been gathered from commercial unofficial recyclers and was reduced in size from loosely discarded, surplus, out-of-date, damaged electric gadgets and plastic water bottles. The physical characteristics of coarse aggregate, plastic garbage and E-waste are shown in Table 2.1.

Properties	Coarse Aggregate	Plastic Waste	E-waste
Specific Gravity	2.78	1.31	1.12
Water Absorption	0.4%	0.3	0.35
Shape	Angular	Angular	Angular
Crushing Value	16.43%	15.19%	14.2%
Impact Value	19.29%	20.76%	18.1%

Table 2.1: Physical Properties of Coarse Aggregate, Plastic Waste and E-Waste

2.2 Concrete Mix

The weight-based calculation for the E-Plastic trash content in the traditional mix is as follows: A coarse aggregate with varying amounts of plastic and E-waste is found to have a fineness modulus of 6.54. It is estimated that the split particle size ranged between 10 and 20 mm. The residual mix proportions are shown in Table 2.2 below, and e-plastic waste particles can therefore be used as a partial substitute for coarse aggregates. The M25 grade concrete mix's strength requirements were examined.

Mix Specification	Conventional Mix	2% EP Waste	4% EP Waste	6% EP Waste	8% EP Waste
Proportion of E-Plastic waste	0%	2%	4%	6%	8%

Table 2.2: Mix Specification

Using the wire basket method, the water absorption test and the specific gravity test were conducted. At 7, 14, and 28 days old, respectively, a compressive strength test was performed to assess the strength development of concrete containing varying E-Plastic waste components. For each mix formulation, the compressive strength, tensile strength, and flexural strength of specimens were measured on 7, 14, and 28 days using the cube, cylindrical and beam specimens cast by standard test procedures.

3. Results

3.1 Compressive Strength

S. No	Mix	Grade of Concrete	% of Replacement (E-Plastic Waste)	f_{ck} 7 Days (Mpa)	f_{ck} 14 Days (Mpa)	f_{ck} 28 Days (Mpa)
1	Mix1	M25	0	17.21	23.84	26.49
2	Mix2		2	15.10	20.91	23.24
3	Mix3		4	13.86	19.19	21.33
4	Mix4		6	12.90	17.87	19.86
5	Mix5		8	11.12	15.45	17.15

Table 3.1: Compressive Strength of Mix

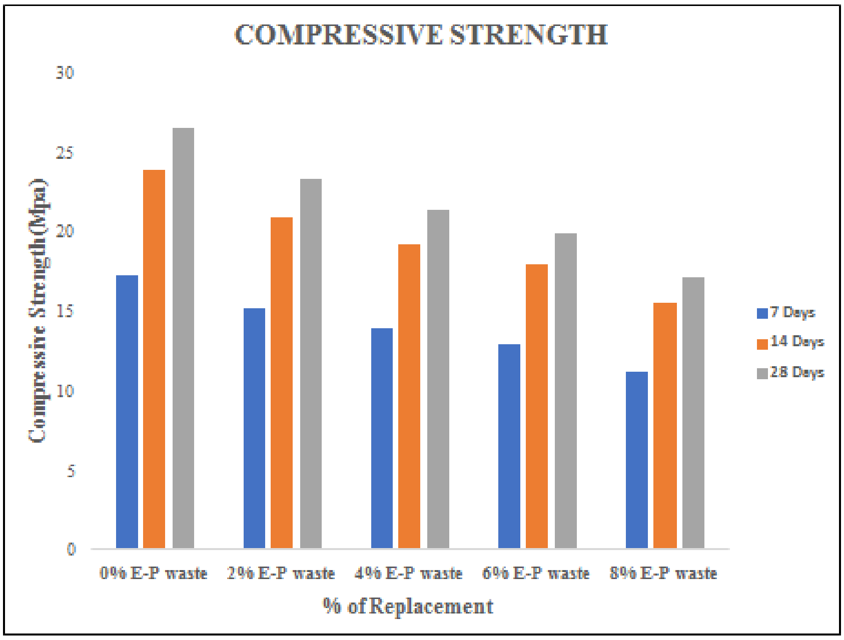

Fig 3.1: Compressive Strength Relation

3.2 Tensile Strength

S. No	Mix	Grade of Concrete	% of Replacement (E-Plastic Waste)	f_t 7 Days (Mpa)	f_t 14 Days (Mpa)	f_t 28 Days (Mpa)
1	Mix1		0	1.75	2.42	2.64
2	Mix2		2	1.94	2.56	2.77
3	Mix3	M25	4	1.95	2.64	2.87
4	Mix4		6	1.56	2.23	2.46
5	Mix5		8	1.35	2.02	2.25

Table 3.2: Tensile Strength of Mix

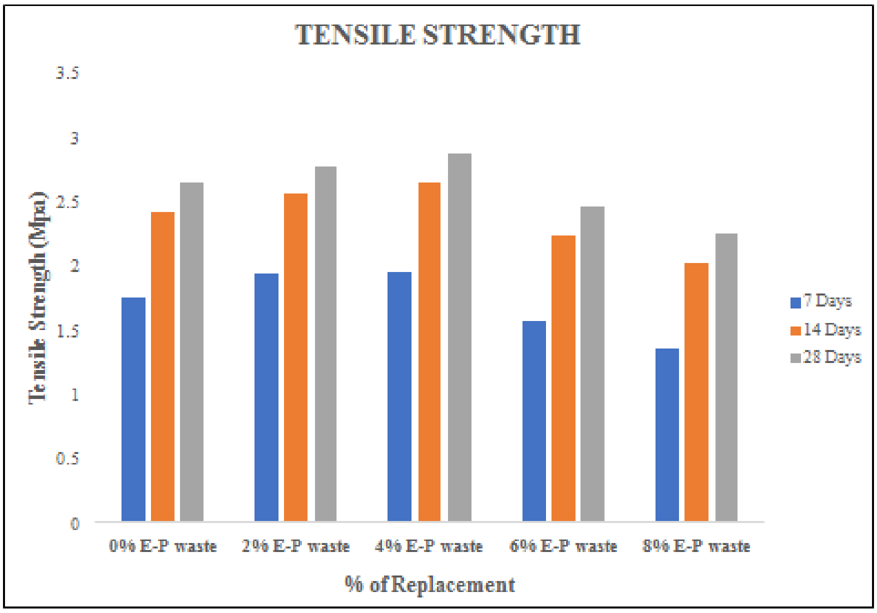

Fig 3.2: Tensile Strength Relation

3.3 Flexural Strength

S. No	Mix	Grade of Concrete	% of Replacement (E-Plastic Waste)	f_{cr} 7 Days (Mpa)	f_{cr} 14 Days (Mpa)	f_{cr} 28 Days (Mpa)
1	Mix1	M25	0	5.12	7.01	7.64
2	Mix2		2	5.57	7.38	7.99

3	Mix3		4	5.72	7.59	8.21
4	Mix4		6	5.05	6.71	7.26
5	Mix5		8	4.51	5.99	6.48

Table 3.3: Flexural Strength of Mix

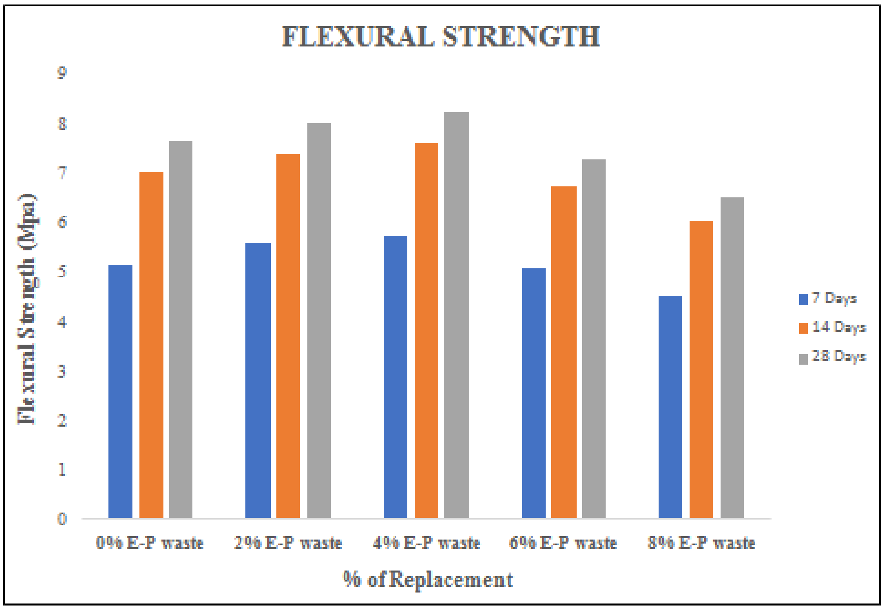

Fig 3.3: Flexural Strength Relation

4. Conclusion

i. The material properties of cement, aggregates, and water were tested and were found to be within their permissible limits according to IS standards.

ii. The goal of this research was to identify effective techniques for using plastic and hard e-waste waste particles as coarse aggregate.

iii. It has been observed that as the proportion of replacement increases, the compressive strength of the mixture containing coarse aggregate and E-plastic waste decreases.

iv. The compressive strength of concrete with 2% and 4% of Electronic Plastic waste replacement, respectively, is reduced by 13% and 24.19% at 28 days when compared to normal concrete.

v. When compared to standard concrete at 28 days, tensile strength is increased by 5% and 8.7% for replacements of 2% and 4% of E-Plastic waste, respectively.

vi. Flexural strength is enhanced by 15% and 7.5% for 2% and 4% of E-Plastic waste replacement, respectively, when comparing the result with conventional concrete at 28 days. Therefore, 2% is the optimal mix of E-plastic refuse to use as coarse particles in concrete.

vii. Concrete made with E-plastic waste aggregate can lower the cost of building materials. Utilizing these waste products helps the construction business develop sustainably.

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