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Research Article

Evaluation of the Performance of Cement Concrete with the Incorporation of Plastic Waste as Fiber Reinforcement

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Abstract

Introduction: *The disposal of plastic waste has become one of the most significant environmental challenges in recent years. In response, various studies have explored alternative uses of plastic waste, particularly in construction materials. This research investigates the performance of cement concrete when plastic waste is used as fiber reinforcement. The study focuses on assessing the mechanical properties of concrete such as compressive strength, flexural strength, and workability, alongside the environmental benefits of utilizing plastic waste in construction. The results indicate that the incorporation of plastic waste as fibers enhances certain properties of cement concrete, offering a promising solution for both waste management and sustainable construction practices. By incorporating plastic waste fibers, the cost of aggregates is reduced, while providing enhanced strength for structures and roads. This approach also helps decrease landfill waste and conserves energy. Plastic waste fibers are derived from discarded plastic bottles, which are non-biodegradable, and can serve as a partial replacement for either coarse or fine aggregates in construction.*

Objective: *The objective of the study is to evaluate the impact of incorporating plastic waste as fiber reinforcement in cement concrete, focusing on its effects on the concrete's physical and mechanical properties. This includes assessing changes in compressive strength, flexural strength, workability, and durability. The study also aims to explore the environmental benefits of using plastic waste as a sustainable alternative to traditional reinforcement materials in concrete.*

Result: *Rebound Hammer Test: The rebound hammer test showed that the surface hardness of concrete samples with plastic waste fibers was comparable to that of conventional concrete, indicating similar compressive strength. The rebound values were consistent with the compressive strength measurements obtained from the CTM.*

Compressive Strength Test: *The compressive strength of concrete decreased with the incorporation of plastic waste fibers. The reduction in compressive strength was observed to be 46%, 55%, and 58% for 10%, 12%, and 15% plastic aggregate replacement, respectively.*

Conclusion: *Using recycled plastic in concrete not only helps in reducing environmental pollution by utilizing non-biodegradable waste but also contributes to the reduction in the unit weight of concrete, making it suitable for lightweight applications such as façade panels. While the addition of plastic waste lowers the density, compressive strength, and tensile strength of concrete, its impact on strength development is less significant compared to conventional concrete, due to the reduced bond strength between the plastic aggregates and the cement paste. This leads to failure at the bond interface rather than within the concrete matrix itself. Overall, while plastic waste can serve as a partial substitute for aggregates, its effect on concrete strength should be carefully considered for structural applications.*

Keywords: Cement Concrete, Plastic Waste, Fiber Reinforcement, Mechanical Properties, Sustainability, Waste Management

1. Introduction

Plastic waste is one of the most pressing environmental issues globally, with millions of tons discarded annually in landfills, oceans, and urban environments. As the demand for sustainable solutions increases, research has shifted towards recycling plastic waste into usable materials, including construction products. The cement concrete industry, a major consumer of natural resources, is increasingly seeking eco-friendly alternatives to traditional reinforcement methods. Waste plastic bottles, primarily made from Polyethylene Terephthalate (PET, PETE, or polyester), are a significant contributor to solid waste disposal. PET is widely used for packaging carbonated beverages and water, posing environmental concerns due to its difficulty in degradation and the complex processes required for recycling and reuse. The rapid growth of PET usage can be attributed to factors such as its low density, high strength, ease of fabrication, user-friendly designs, long lifespan, lightweight nature, and, most notably, its low cost.

The Indian concrete industry currently consumes around 400 million tons of concrete annually, with projections indicating that this figure could reach a billion tons within the next decade. The materials required to produce such large quantities of concrete are sourced from the earth's crust, leading to the depletion of natural resources each year and creating ecological pressure. Meanwhile, human activities continue to generate waste plastics, with the use of plastics in packaging materials, including bottles, polythene sheets, containers, and packing strips, steadily increasing.

PLASTIC TYPE	SOURCE
PET or PETE (Polyethylene Terephthalate)	Bottles for soda, water, jars, oil container
HDPE (High Density Polyethylene)	Milk jugs, shampoo bottles, detergent bottles
PVC (Polyvinyl Chloride)	Plastic tubing, toys, trays, furniture
LDPE (Low Density Polyethylene)	Grocery bags, sliced bread loaves
PP (Polypropylene)	Straws, rope, carpets, bottle caps.
PS (Polystyrene)	Disposable cups, packing peanuts,

Table 1: Plastic Waste Types

1.1 Plastic Recycling

Recycling involves the process of retrieving used materials from the waste stream and reintroducing them into the manufacturing cycle. In today's environmentally conscious era, recycling has become a key practice (Hay-Yong Kang et al., 2005). There are three primary reasons for recycling:

1. It helps conserve valuable natural resources.
2. It reduces transportation needs and the associated costs.
3. It mitigates the environmental burden caused by waste materials, such as the space required for disposal.

1.2 Objective

1.2.1. To assess the physical and mechanical properties of concrete when natural aggregates are partially substituted with plastic in the form of PET.

1.2.2. To compare the strength characteristics of conventional concrete with those of concrete incorporating waste plastic.

Recent studies have suggested that incorporating plastic waste in concrete mixes, specifically as fiber reinforcement, can help improve certain mechanical properties while simultaneously addressing the environmental concerns posed by plastic waste. This research aims to evaluate the performance of cement concrete when plastic waste is used as a fiber reinforcement material, focusing on properties such as compressive strength, flexural strength, workability, and durability.

2. Literature Review

Plastic waste has been found to have potential benefits in the reinforcement of cement-based materials. Numerous studies have examined the inclusion of various forms of plastic waste, such as polyethylene terephthalate (PET) bottles, polypropylene (PP), and high-density polyethylene (HDPE), in concrete to improve the material's mechanical properties. Knur Hanis Zulkernain et al, May 2021 Utilization of plastic waste as aggregate in construction materials. This paper evaluates on the use of plastic as aggregate in terms of the physical, mechanical and durability properties of the construction materials as well as the environmental and cost analyses. Besides, a general SWOT analysis to highlight the advantages and disadvantages of plastic waste utilization was also conducted [1]. Gurbir Kaur and Pavia, Jan 2021 Durability of Mortars Made with Recycled Plastic Aggregates: Resistance to Frost Action, Salt Crystallization, and Cyclic Thermal–Moisture Variations. This study aimed to investigate the use of polymeric end-of-waste materials, including polyethylene-terephthalate (PET) and other plastic types that have not been comprehensively studied to date, namely, acrylonitrile-butadiene-styrene (ABS), polycarbonate (PC), ABS/PC blend, and polyoxymethylene (POM), to improve the durability of cement mortars. Mohammed Belmokaddem et al, April 2020 Mechanical and physical properties and morphology of concrete containing plastic waste as aggregate. This paper show, that plastic waste has a positive effect by decreasing the density. The use of plastic wastes in concrete allows developing a composite material with interesting acoustic insulation characteristics. Recycling waste plastics, to be used in the formulation of concrete, promising solution to reduce the impact of plastics on the environment and consequently fight pollution and global warming. S. Suriya and Kumar Dec 2020 Strength studies on FRC with partial replacement of plastic waste as coarse aggregate.

This paper deals with investigating the Properties and behavior of M30 concrete with partial replacement of coarse aggregate with steel fiber and plastic aggregate. A set of different concrete mixtures were casted with different coarse aggregate replacement levels (5%, 10% and 15%). K. Hamsavathi et al, Jan 2020 Green high strength concrete containing recycled Cathode Ray Tube Panel Plastics (E-waste) as coarse aggregate in concrete beams for structural applications. In this research, an attempt has been made to reuse the ever-growing electronic waste (E-waste) based materials as filler in order to improve the structural strength of concrete beams, which can be utilized in the construction of buildings. Nirdesh Shah et al, May 2019 Impact Assessment of Plastic Strips on Compressive Strength of Concrete. This work attempts to analyze the impact of plastic strips on the compressive strength of concrete. Three sets of concrete mixes, one of conventional concrete (CC) and the other two modified concrete with plastic polyethylene terephthalate (PET)] strips, viz., horizontally oriented plastic strips (MC-H) and randomly oriented plastic strips (MC-R) were tested. IRJET July 2018 Analysis on Use of Super plasticizer Content on Mix Design of High Strength Concrete

(M100) [2,3]. This research paper includes the variation of super plasticizer on the strength on M100 grade concrete whose compressive strength at 28 days will be111.8 N/mm2 according to IS 456:2000 [4].

Togay Ozbakkaloglu et al, Aug 2017 Short-Term Mechanical Properties of Concrete Containing Recycled Polypropylene Coarse Aggregates under Ambient and Elevated Temperature [5]. In this paper, the first experimental study on the properties of concretes manufactured using recycled polypropylene (PP) coarse aggregates is presented. Eight batches of concretes were manufactured with different RPA contents. Ehsan Yaghoubi et al, Oct 2017 Stiffness Properties of Recycled Concrete Aggregate with Polyethylene Plastic Granules in Unbound Pavement Applications. In this research, RCA was blended with low-density polyethylene (LDPE) and high-density polyethylene (HDPE) plastics. A range of geotechnical tests such as California bearing ratio (CBR), unconfined compressive strength (UCS), and repeated load triaxial (RLT) tests were conducted on RCA–HDPE and RCA–LDPE blends [6]. Fahad K. Alqahtani et al, May 2017 Novel lightweight concrete containing manufactured plastic aggregate. In this paper, an investigation of a manufactured plastic aggregate as a replacement for volcanic lightweight aggregate and Lytag aggregate in concrete is presented. The influence of replacement level on the fresh, hardened and microstructure properties of concrete was investigated [7]. Fahad K. Alqahtani et al, June 2016 Production of Recycled Plastic Aggregates and Its Utilization in Concrete.

This paper shows that various composition RPA was used in concrete, and the resulting properties of both fresh and cured concrete were measured. For a given water to cement (w/c) ratio, it was possible to achieve slump of between 40 and 220 mm and fresh density of between 1,827 and 2,055 kg=m3. Further, 28-day strengths of between 14 and 18 MPa were achieved. Ashwini Manjunath et al, Jan 2016 Partial replacement of E-plastic Waste as Coarse- aggregate in Concrete. An experimental study is made on the utilization of E-waste particles as fine and coarse aggregates in concrete with a percentage replacement ranging from 0 %, 20% to 30% i.e. (0%, 10%, 20% and 30%) on the strength criteria of M20 Concrete [8]. Feng Liu et al, May 2014 Performance of Recycled Plastic-Based Concrete. This paper reports an experimental study on recycled plastic concrete (RPC) that uses recycled acrylonitrile-butadiene-styrene/ polycarbonate copolymer (ABS/PC) plastic particles to replace 5, 10, 15, and 20% (in volume) of fine aggregate sand. The plastic particles used in this research were recycled from waste plastic [9].

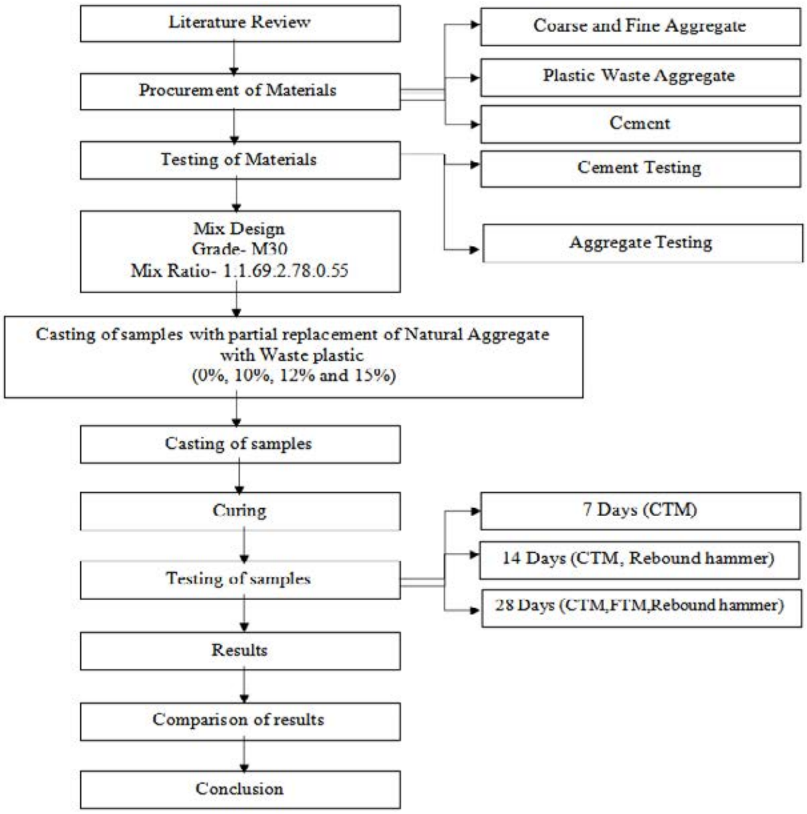
Kinda Hannawi et al, June 2013 Strain Capacity and Cracking Resistance Improvement in Mortars by Adding Plastic Particles. The present paper focuses on the design of a mortar exhibiting a high straining capacity before macro cracking localization. It was assumed that the incorporation of aggregates with high deformability could be a solution. Two types of plastic wastes (PET and PC) available in large quantities were used as a partial replacement for natural aggregates in mortar [10]. Nabajyoti Saikia and Jorge April 2012 Use of plastic waste as aggregate in cement mortar and concrete preparation: A review. This paper presents a review on the recycling plastic waste as aggregate in cement mortar and concrete productions. In this different types of plastics and types of methods used to prepare plastic aggregate as well as the methods of evaluation of various properties of aggregate and concrete were briefly discussed [11]. Mariaenrica Frigione et al Feb 2010 Recycling of PET bottles as fine aggregate in concert. In this paper an attempt to substitute in concrete the 5% by weight of fine aggregate (natural sand) with an equal weight of PET aggregates manufactured from the waste un-washed PET bottles (WPET), is presented [12].

Semiha Akçaozog et al, Oct 2009 An investigation on the use of shredded waste PET bottles as aggregate in lightweight concrete. In this work, the utilization of shredded waste Polyethylene Terephthalate (PET) bottle granules as a lightweight aggregate in mortar was investigated. Investigation was carried out on two groups of mortar samples, one made with only PET aggregates and, second made with PET and sand aggregates together [13]. Elzafraney et al, Dec 2005 Development of Energy-Efficient Concrete Buildings Using Recycled Plastic Aggregates [14]. Both experimental and SUNREL program results showed that the recycled plastic concrete building exhibited higher levels of energy efficiency and comfort when compared with the normal concrete control building [15]. Papayianni et al, February 2004 Influence of super plasticizer type and mix design parameters on the performance of them in concrete mixtures Measurements of workability, slump loss, air content, as well as of strength development have been made to reach a conclusion about super plasticizers performance with the use of two kinds of aggregate: one natural (river) and one crushed limestone. Apart from this, it seems that the quantity of fines in a mixture influences the performance of super plasticizers. K. Senthil Kumar and Baskar 2003 Development of Ecofriendly Concrete Incorporating Recycled High-Impact Polystyrene from Hazardous Electronic Waste [16].

This paper shows concrete specimens made using HIPS aggregate were found to be capable of retaining 50% strength under all of the test conditions, when 50% coarse aggregates are replaced by HIPS aggregate. Various volume percentages of HIPS aggregate replacement show a linear relation between the loss of strength and increase in HIPS content. Furthermore, the impact of plastic waste on the durability of concrete, including its resistance to cracking, shrinkage, and thermal stability, has been another area of focus. Research on the environmental impact of plastic waste recycling in construction materials has highlighted the potential for reducing landfill waste and the carbon footprint associated with cement production.

3. Proposed Methodology

The methodology of the present study is summarized below



3.1. Materials Selection

3.1.1. Cement: Ordinary Portland Cement (OPC) of grade 43 will be used for the concrete mix.

3.1.2. Aggregates: Fine aggregate (sand) and coarse aggregate (gravel) conforming to IS standards will be used.

3.1.3. Plastic Waste: Shredded plastic waste in the form of polyethylene terephthalate (PET) fibers will be incorporated as a partial replacement for fine or coarse aggregates.

3.1.4. Water: Clean, potable water will be used for mixing and curing.

3.2. Mix Design

3.2.1. Concrete will be mixed with a target grade of M30, based on IS 10262:2019 guidelines for mix design.

3.2.2. The percentage of plastic waste fiber used will vary, with 0%, 0.5%, 1%, and 1.5% being considered as partial replacements for aggregates by weight.

3.2.3. The water-cement ratio will be kept constant across all mix designs for consistency in performance testing.

3.3. Sample Preparation

3.3.1. Concrete specimens in the form of cubes (150mm x 150mm), beams (500mm x 100mm x 100mm), and cylinders (150mm diameter x 300mm height) will be prepared.

3.3.2. The plastic waste fibers will be mixed into the concrete at the designated replacement percentages (0%, 0.5%, 1%, and 1.5%).

3.3.3. The specimens will be properly cured in a water tank for 7, 14, and 28 days.

3.4. Testing of Fresh Concrete

3.4.1. Workability: The workability of fresh concrete will be determined using the slump test to assess how easily the concrete can be placed and compacted.

3.4.2. Air Content: Air content may also be measured to understand the effect of plastic fibers on the air-entrainment of the mix.

3.5. Testing of Hardened Concrete

3.5.1. Compressive Strength: Compressive strength tests will be conducted on concrete cubes at 7, 14, and 28 days using a Compression Testing Machine (CTM) to evaluate the effect of plastic fibers on the concrete's load-bearing capacity.

3.5.2. Flexural Strength: Flexural strength tests will be conducted on beams at 7, 14, and 28 days using a universal testing machine (UTM) to assess the bending resistance and ductility of the concrete.

3.6. Non-Destructive Testing

3.6.1. Rebound Hammer Test: A rebound hammer will be used to measure the surface hardness of the concrete, providing an indication of its compressive strength.

3.6.2. Weight Change: The weight change of the concrete specimens will be monitored to study the impact of plastic fiber incorporation on the density and durability of concrete.

3.7. Durability Testing

3.7.1. Water Absorption Test: The water absorption capacity of the concrete samples will be tested to evaluate the permeability and resistance to moisture ingress.

3.7.2. Shrinkage & Cracking: Observations will be made to identify any shrinkage or cracking behavior that could be affected by the plastic fiber inclusion.

3.8. Data Analysis

3.8.1. The results of the tests on physical and mechanical properties will be analyzed to determine how the inclusion of plastic waste fibers affects the concrete's overall performance.

3.8.2. Comparisons will be made between conventional concrete (without plastic waste fibers) and concrete incorporating plastic waste fibers at different replacement levels (0%, 0.5%, 1%, and 1.5%).

3.9. Environmental and Economic Impact Assessment

3.9.1. The environmental benefits of using plastic waste in concrete will be evaluated, including the reduction in landfill waste and the savings in natural resources.

3.9.2. A cost analysis will be carried out to assess the economic feasibility of using plastic fibers as a partial replacement for aggregates in concrete production.

3.10. Conclusion

The findings will be summarized, highlighting the optimum percentage of plastic waste fiber replacement for improving concrete performance, along with its environmental and economic advantages.

This methodology aims to thoroughly evaluate the effects of incorporating plastic waste as fiber reinforcement in cement concrete, focusing on the balance between enhanced concrete properties and environmental sustainability.

4. Materials and Methods

4.1. Materials Used

The materials used in this study include Ordinary Portland Cement (OPC) as the binder, fine aggregates (sand), coarse aggregates (gravel), and plastic waste fibers. The plastic waste used in the experiment consists of shredded PET plastic bottles, with fiber lengths ranging from 20 mm to 50 mm and a diameter of approximately 0.5 mm. The plastic fibers were cleaned, shredded, and prepared for incorporation into the concrete mix.

4.1.1. Cement: Ordinary Portland cement of 43 grade is used for the construction of concrete cubes and beams. It is most commonly used for construction works as plastering, pathways, etc. Traditionally, compressive strength of grade 43 cement will be attained only after 28th day. Specific gravity was found out to be 3.15.

4.1.2. Coarse Aggregate (CS): The aggregate is the important structural filler that determines the strength of the concrete. The composition, shape, and size of the aggregate play a significant role over the workability, durability, strength, weight, and shrinkage of concrete. Its specific gravity was found out to be 2.78. Herein the stone gravels are partially replaced using plastic waste fiber and further utilized as aggregate.

4.1.3. Fine Aggregates (FS): Natural coarser sand was used in current research work. Its specific gravity was found out to be 2.65.

4.1.4. Plastic Aggregates: Polyethylene terephthalate (PET) is thermoplastic polyester with tensile and flexural modulus of elasticity of about 2.9 and 2.4GPa, respectively, tensile strength up to 60 MPa and excellent chemical resistance. The plastic (PET) used was supplied in shredded form by a local supplier who collects all types of waste plastics from the local vicinity and treats them.

4.2 Mix Proportions

Suitable mix design of M 30 was carried out for the concrete. Different water cement ratios were tested before finalising the control mix. W/C ratio was 0.55 which was kept constant for all the mixes. Four different mixes of concrete were made with 0%, 10%, 12%, 15% replacement of aggregates with waste plastic aggregates. A total of 21 cubes and 7 beams were casted using the material.

Partial Replacement of Aggregate with Plastic Fibre	Cement Kg	Fine Aggregate Kg	Coarse Aggregate Kg	Plastic Kg	Superplasticizer Kg	Water Kg
0%	10.36	21	35	0	0.1	5.2
10%	10.36	19.5	33.6	2.8	0.1	5.2
12%	10.36	19	33.1	3.5	0.1	5.2
15%	10.36	18	32.5	4.3	0.1	5.2

Table 2: Mix Proportion

Citation: Verama, K., Kumar, A. (2025). Evaluation of the Performance of Cement Concrete with the Incorporation of Plastic Waste as Fiber Reinforcement. *Electr Electron Eng Open Access, 2(1)*, 1- 10.

4.3 Experimental Procedure

The experiment involved the preparation of concrete specimens, including cubes (150 mm x 150 mm), beams (500 mm x 100 mm x 100 mm), and cylinders (150 mm diameter x 300 mm height). The fresh concrete was tested for its workability using the slump test, and the hardened concrete was subjected to compressive strength tests (using cubes) and flexural strength tests (using beams) at 7, 14, and 28 days of curing. The specimens were also tested for durability, including water absorption and resistance to crack propagation.

5. Tests on Concrete

5.1. Compressive Strength Test

Compressive strength refers to the ability of a material or structure to withstand applied loads on its surface without experiencing cracks or deformation. When a material is subjected to compression, it tends to decrease in size, whereas under tension, it elongates. The formula for compressive strength is the load applied at the point of failure divided by the cross-sectional area of the surface where the load was applied. A total of 21 cubes, each measuring 150mm x 150mm x 150mm, were cast and tested using a Compression Testing Machine (CTM).

Value were obtained in KN and were converted into MPa

Compression Strength = Load / Cross-section Area

Figure 1: Testing of Cube by CTM

5.2 Flexural Strength Test

Flexural strength is an indirect measure of the tensile strength of concrete. It is a measure of the maximum stress on the tension face of an unreinforced concrete beam or slab at the point of failure in bending. It is measured by loading (100mm X 100mm X 500mm) concrete beams. The flexural strength is expressed as Modulus of Rupture (MR) in MPa

Figure 2: Testing of Beam by FTM

5.3. Rebound Hammer Test

As per the Indian code IS: 13311(2)-1992, the rebound hammer test has the following objectives:

i. To determine the compressive strength of the concrete by relating the rebound index and the compressive strength

ii. To assess the uniformity of the concrete

iii. To assess the quality of the concrete based on the standard specifications

iv. To relate one concrete element with other in terms of quality

Figure 3 Rebound Hammer Test

6. Results and Discussion

6.1 Rebound Hammer Test

Rebound Hammer test is a Non-destructive testing method of concrete which provide a convenient and rapid indication of the compressive strength of the concrete. When the plunger of rebound hammer is pressed against the surface of concrete, a spring-controlled mass with a constant energy is made to hit concrete surface to rebound back. The extent of rebound, which is a measure of surface hardness, is measured on a graduated scale. This measured value is designated as Rebound Number (rebound index). A concrete with low strength and low stiffness will absorb more energy to yield in a lower rebound value

% of plastic Aggregates	Rebound Number		Compressive strength (kg/cm^2)	
	14 Days	28 Days	14 Days	28 Days
0	30	34	250	310
10	20	25	125	180
12	18	21	105	135
15	16	19	90	115

Table 3: Rebound Hammer Test

Table 3 shows the values of Rebound Number and Compressive Strength obtained by various mixes of concrete cubes. It is seen that as the percentage of plastic aggregate increases from 0% to 15% there is gradual decrease in rebound number and compressive strength.

6.2. Compressive Strength Test

The compressive strength of the concrete cube test provides an idea about all the characteristics of concrete. Compressive strength of concrete depends on many factors such as water-cement ratio, cement strength, quality of concrete material, and quality control during the production of concrete, etc. These specimens are tested by compression testing machine after 7, 14 and 28 days curing. Load should be applied gradually at the rate of 140 kg/cm2 per minute till the specimens fails. Load at the failure divided by area of specimen gives the compressive strength of concrete.

Citation: Verama, K., Kumar, A. (2025). Evaluation of the Performance of Cement Concrete with the Incorporation of Plastic Waste as Fiber Reinforcement. *Electr Electron Eng Open Access, 2(1)* , 1- 10.

% of plastic Aggre gates	Weight in Kg			Peak Load (KN)			Compressive Strength (MPa)		
	7 Days	14 Days	28 Days	7 Days	14 Days	28 Days	7 Days	14 Days	28 Days
0	7.980	7.900	7.930	385	590	680	16.55	26.22	30.07
10	7.300	7.250	7.300	200	270	380	8.66	11.99	16.87
12	7.195	7.155	7.200	165	230	300	7.33	10.21	13.33
15	7.030	6.995	7.120	155	200	260	6.88	8.88	11.54

Table 4: Compressive Strength Result

Table 4 shows the values of compressive strength, peak load and weight of concrete cubes. It is shown that there is very less reduction in weight of concrete cubes of different mixes. It is seen that concrete rapidly gains its strength in initial days of casting. The maximum strength is shown by 10% replacement amongst all the replaced proportions and it is seen that the strength keeps on decreasing as plastic proportion is increasing.

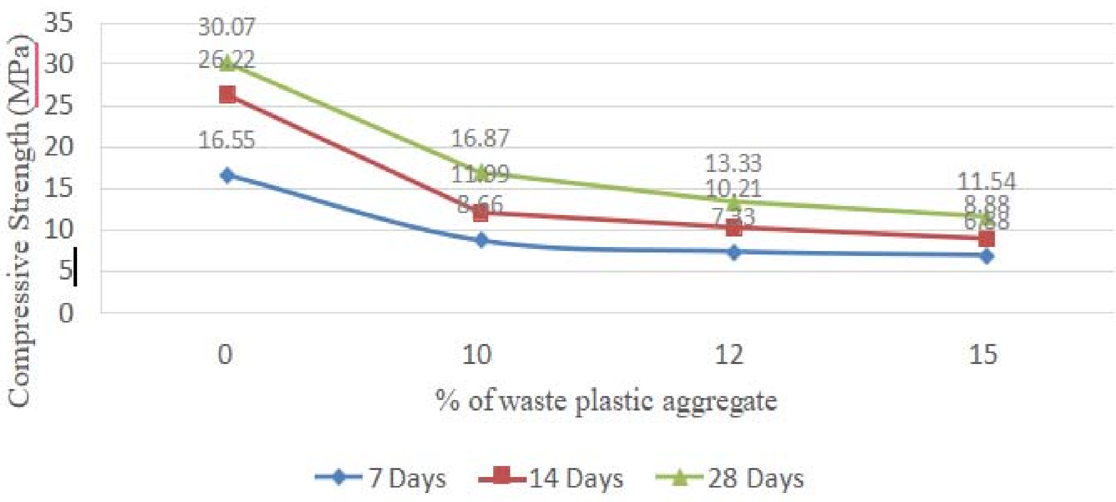


Figure 4: Compressive Strength Graph of Cubes with Different Percentage

6.3 Flexural Strength Test

Flexural strength is an indirect measure of the tensile strength of concrete. It is a measure of the maximum stress on the tension face of an unreinforced concrete beam or slab at the point of failure in bending. It is measured by loading 150 x 150-mm (or (100 x 100-mm) concrete beams with a span length at least three times the depth.

% of plastic Aggregates	Weight in Kg	Peak Load(KN)	Flexural Strength(MPa)
	28 Days	28 Days	28 Days
0	11.10	6.25	3.12
10	10.80	5.00	2.50
12	10.65	4.25	2.12
15	10.51	4.00	2.00

Table 5: Flexural Strength Result

Table 5 shows us the flexural strength, peak l5oad and weight of beams. It is seen that flexural strength decreases as we increase the plastic waste proportion.

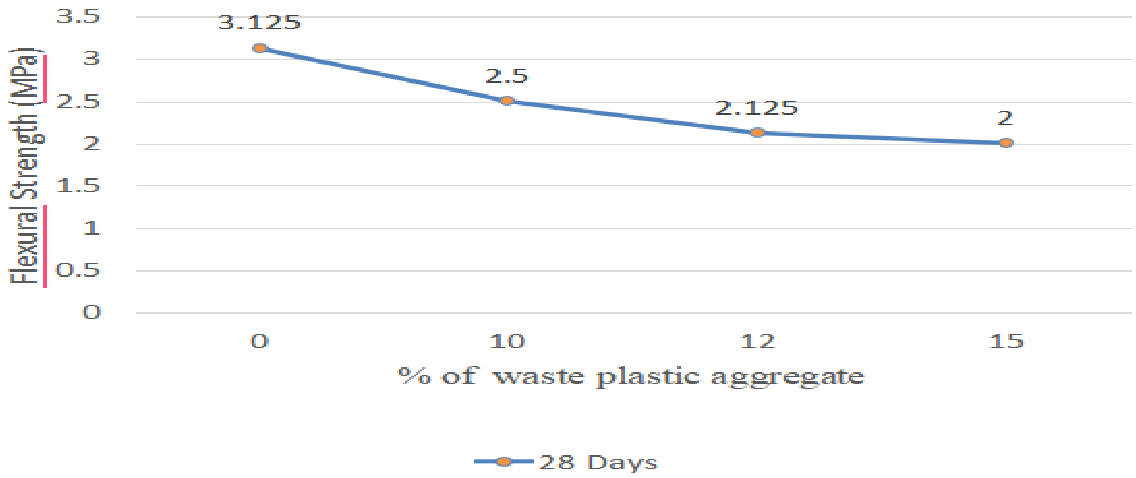


Figure 5: Flexural Strength Graph of Beam

Comparison on between Compressive Strength obtained by CTM and Rebound Hammer Test

% of plastic Aggregates	Compressive Strength (kg/cm2)			
	Compressive testing machine		Rebound hammer test	
	14 Days	28 Days	14 Days	28 Days
0	257.15	308.11	250	310
10	122.31	172.14	125	180
12	104.19	135.90	105	135
15	90.6	117.79	90	115

Table 6: compressive Strength by Rebound Hammer Test and CTM

Table 6 shows that compressive strength obtained by both methods (CTM and Rebound hammer test) comes out to be almost same.

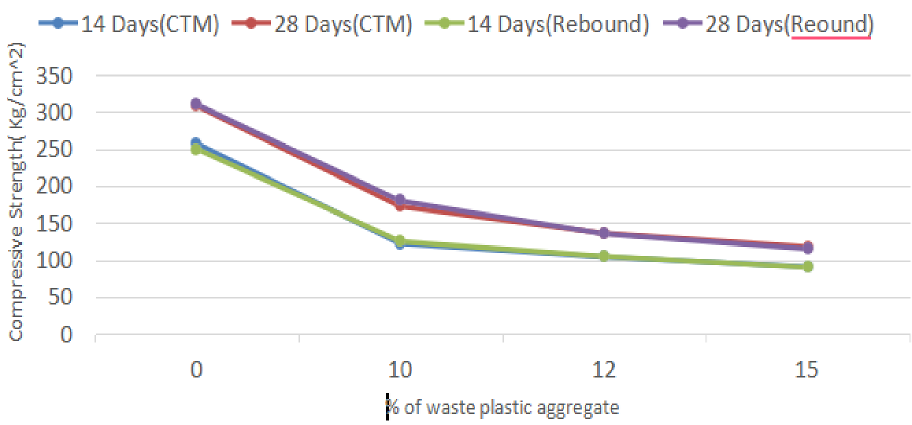


Figure 6: Comparison of Rebound Hammer and CTM Results

7. Conclusion

In conclusion, using plastic waste as fiber reinforcement in concrete presents a promising path toward reducing environmental impact, while also offering improvements in certain concrete properties.

7.1. The compressive strength of concrete decreased by 46%, 55%, and 58% when plastic aggregates replaced 10%, 12%, and 15% of the total aggregates, respectively.

7.2. The flexural strength of concrete decreased by 20%, 32%, and 36% for 10%, 12%, and 15% replacement of plastic aggregates, respectively.

7.3. The compressive strength results obtained from both the Compression Testing Machine (CTM) and the rebound hammer test were nearly identical.

7.4. Using recycled plastic in construction can set a precedent by utilizing non-biodegradable waste, ultimately reducing environmental pollution. Plastics can replace some of the aggregates in concrete, contributing to a reduction in the unit weight of the material. This is particularly beneficial for applications requiring non-load-bearing lightweight concrete, such as façade panels.

7.5. For a given water-cement ratio, incorporating plastics in the mix lowers the density, compressive strength, and tensile strength of the concrete.

7.6. The effect of water-cement ratio on strength development is less pronounced in plastic concrete, as the plastic aggregates reduce the bond strength between the cement paste and the aggregates. Consequently, the failure of the concrete occurs due to the bond failure between the cement paste and the plastic aggregates [17-22].

Future research should focus on optimizing fiber content, improving bonding between plastic and cement, and evaluating the long-term durability of concrete containing plastic fibers.

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