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COMPARATIVE ANALYSIS OF CONVENTIONAL CONCRETE WITH FIBER-REINFORCED CONCRETE

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ABSTRACT

This research paper aims to provide a comprehensive comparison between conventional concrete and plastic bottle fiber concrete (PBFC) in terms of their mechanical properties, durability, and sustainability. Conventional concrete has been the dominant construction material for decades, but the emergence of PBFC as a sustainable alternative has sparked significant interest in recent years. This paper will delve into the composition and properties of both materials, highlighting the use of plastic bottle fibers as reinforcement in concrete. The review will cover the impact of plastic bottle fibers on the compressive, tensile, and flexural strength of concrete, as well as their influence on cracking, toughness, and ductility. Additionally, it will explore the potential benefits of using PBFC, such as reduced environmental impact through recycling of plastic waste and improved sustainability. The paper will also address the challenges associated with the use of plastic bottle fibers in concrete, including issues related to fiber dispersion, compatibility with cementitious materials, and long-term durability.

Keywords: Polyethylene Terephthalates, PET Bottle Fibers, Compressive Strength, Aggregate Replacement.

I. INTRODUCTION

This aims to explore the potential of incorporating plastic bottle fibbers in concrete as a sustainable solution for waste management and to enhance the mechanical properties of the concrete. The study investigates the effects of different parameters such as fiber content, aspect ratio, and surface treatment on the performance of plastic bottle fiber-reinforced concrete (PBFC). This also highlights the environmental benefits of using plastic waste in construction materials, emphasizing the reduction of plastic pollution and carbon emissions. Experimental testing, including compressive strength, flexural strength, and durability tests, is conducted to evaluate the mechanical properties and durability of PBFC compared to traditional concrete. The findings of this research contribute to the development of sustainable construction practices and provide valuable insights into the feasibility of utilizing plastic bottle fibers in concrete. PET bottle fiber concrete is a sustainable and eco- friendly building material that incorporates recycled PET fibers from plastic bottles into concrete. By utilizing PET bottle fibers, this type of concrete offers a solution to both waste management and construction.

Mastan Vali N (2017) The solid w2016ith PET waste significantly reduces the cement weight and this helps in the preparation of concrete technology with reduced amount of unit weight. The compressive quality expanded up to 10% supplanting of the fine total withPET container filaments and it step by step diminished for 15 % and 20% substitutions. Thus supplanting of fine total with 10% substitution will be sensible. The flexural quality expanded up to 10% supplanting of the fine total with PET container waste and it slowly diminished for 15% and continues as before for 20% substitutions. It was watched that the spilt rigidity expanded up to 10% supplanting of the fine total with PET container waste and it step by step diminished for 15% and continues as before for 20% substitutions. Thus, the supplanting of the fine total with 5% of PET jug waste will be sensible than other substitution rates like 10%,15%and 20% as the pressure and flexural quality lessens step by step. **[7]**

Khemlata Sahu 2016) The concrete with PET fibers reduced the weight of concrete and thus if mortar with plastic fibers can be made into light weight concrete based on unit weight It was observed that the compressive strength increased up to 2percent replacement of the fine aggregate with PET bottle fibers and it gradually decreased for 4 and 6 percent replacements. Hence replacement of fine aggregate with 2percent replacement will be reasonable. **[9]**

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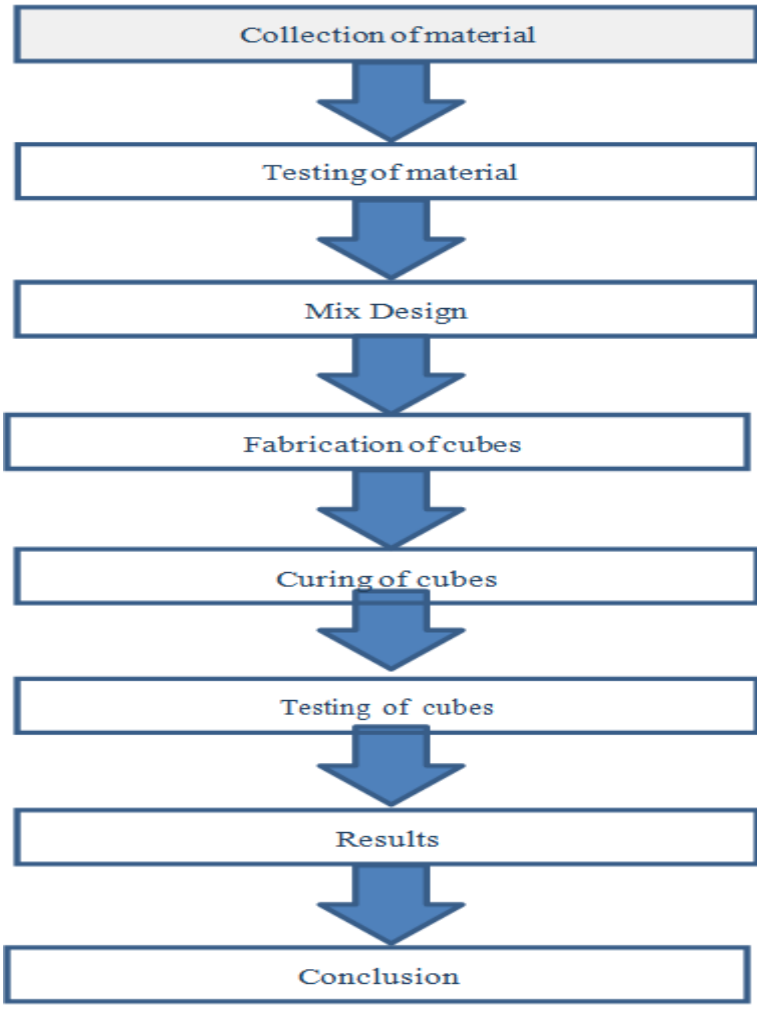
Jasiya J (2023) The compressive strength of concrete is improved by 11.1% than plain cement concrete. Flexural and split tensile strengths 3are lower plain cement concrete on 14th day but on 28th day test both strengths are improved by 2.7% and 1.5%. **[1]**

Asha and Resmi (2015) Fibers used as direct inclusion by volume of concrete ranging from 0.5 % to 1.5 % Workability decreased by fiber addition at all addition levels as well as aspect ratios. Slump values were relatively higher for straight fibers than crimped ones. Strength becomes optimum at 1% volume fraction. Strength was higher for aspect ratio 15 than others. Crimped fibers provide greater strength than straight ones. **[12]**

II. METHODOLOGY

This flow chart provides the different steps that include in our experiment:



Flow Chart 1: Methodology

Research has indicated that replacing coarse aggregate with PET bottle fiber at a dosage of 1.25% and 1.75% by weight of total aggregate content can lead to significant improvements in the performance of concrete. The addition of PET bottle fiber can enhance the workability of the mix, reduce water absorption, and increase the resistance to cracking and shrinkage.

In this we make three type of mix and each mix have 6 cubes, so we produced total 18 cubes. The dimension of the cube are 150mm×150mm×150mm. Before the making mix we tested the properties of the coarse aggregate, river sand (fine aggregate) and cement (OPC 53 grade).

For gaining the maximum strength of concrete we put cubes under the water for 7, 14 and 28 days for the proper curing. The strength was increased after the proper curing and the cement was properly hydrated with all materials that used in concrete.

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Calculation for M25 grade of concrete (1:1:2)

Size of cube = 150×150×150 mm Volume of cube = 150×150×150 mm

= 0.15×0.15×0.15 m

= 0.003375 m^3

Wet volume =1.54*dry volume

=1.54*0.003375 m3

=0.0051975 m3

For M25 grade of concrete M25 = 1:1:2

∑of ration =1+1+2=4

For cement = 1/4*0.005197

=0.001299 m3

W= volume *density

W (in kg) = 0.001299 *1440 (density of cement)

=1.87 kg

For sand =1/4*(0.0051975)

=0.001299 m3

W (in kg) = 0.001299*1600 (density of sand)

= 2.07 kg

For aggregate = 2/4 (0.0051975)

= 0.002598 m3

W (in kg) = 0.002598*1500 (density of aggregate)

= 3.89 kg

Fig 1: Materials used

Fig 2: Mixing of materials

Fig 3: Mixing of Concrete in CT lab

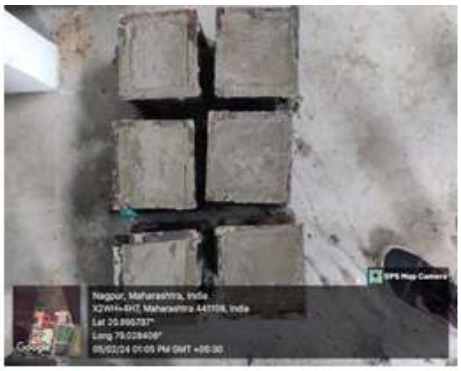

Fig 4: Cube casting in CT lab

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Fig 5:

Fig 6:

III. RESULTS

Compressive Testing

Strength gain by the concrete cube			
Days	Normal Concrete	Fiber Concrete (1.25%)	Plastic Fiber Concrete (1.75%)
7 Days	450 KN	470 KN	480 KN
14 Days	475 KN	495 KN	490 KN
28 Days	490 KN	590 KN	560 KN

Results of compressive test after 7, 14, 28 days of curing:

Replacement	Specimen Sample	Load (KN)	C/S Area(mm^2)	Compressive strength= Max. load carried by specimen/Top surface area of the specimen(N/mm^2))	Average
	1 (7 days)	450	22500	20	
Normal	2 (14 days)	475	22500	21.11	20.96 N/mm^2
	3 (28 days)	490	22500	21.78	
	1 (7 days)	470	22500	20.88	
1.25% of Plastic Fiber	2 (14 days)	495	22500	22	23.03 N/mm^2
	3 (28 days)	590	22500	26.22	
	1 (7 days)	480	22500	21.33	
1.75% of Plastic Fiber	2 (14 days)	490	22500	21.78	22.67 N/mm^2
	3 (28 days)	560	22500	24.89	

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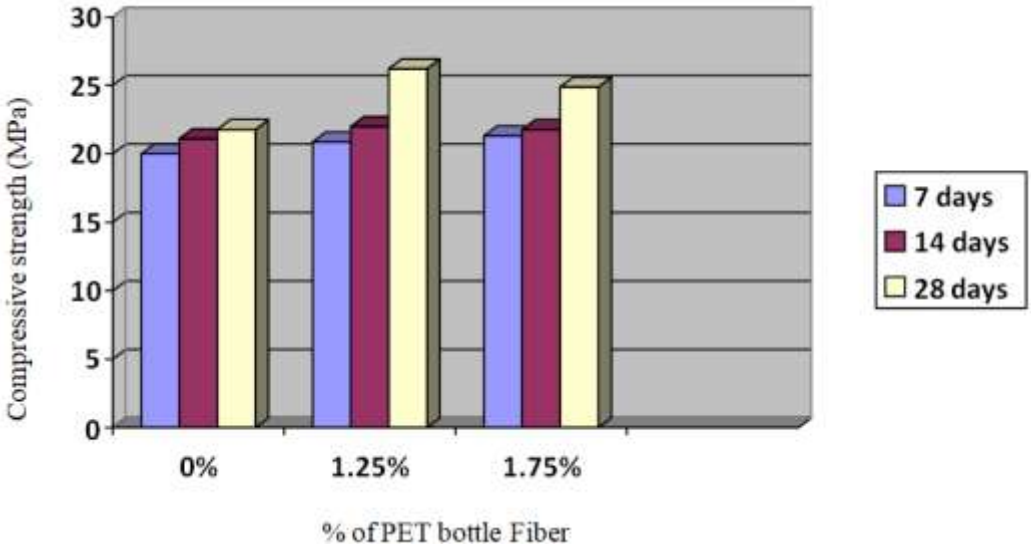

Chart 1: Compressive strength Vs %Plastic fibers for M25 grade of concrete

IV. CONCLUSION

PET bottle fibers can effectively enhance the mechanical properties of concrete, including its compressive strength, flexural strength,and impact resistance. The addition of these fibers can also improve the durability and crack resistance of concrete structures.

The use of pet bottle fibers in concrete can contribute to sustainable construction practices by reducing the amount of plastic waste thatends up in landfills or oceans. This promotes environmental conservation and helps to address the global plastic pollution problem.

Studies have indicated that incorporating PET bottle fiber at certain dosage levels can lead to improvements in compressive strength byup to 2-3 N/mm^2 compared to conventional concrete.

This demonstrates the potential of PET bottle fiber to be a sustainable and effective solution for enhancing the performance of concretewhile also contributing to environmental sustainability by utilizing recycled materials.

V. FUTURE SCOPE

Standardization: Developing industry standards and regulations for the use of PET bottle concrete in construction projects to ensurequality and safety.

Research and development: Continued research into optimizing the mix design and production process of PET bottle concrete to enhanceits mechanical properties and durability.

Large-scale adoption: Increasing awareness and acceptance of PET bottle concrete among architects, engineers, and contractors topromote its widespread use in various construction applications.

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