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Mechanical Behaviour of Concrete Reinforced with Medical (Tablet) Strips

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Abstract - The main objective of this project work is to investigate the influence of the addition of waste materials, like medical tablet strips to improve mechanical properties of concrete and also study the strength of concrete, such as split tensile strength. It has been acknowledged that the use of fibers in concrete has considerable effects to improve strength parameters and characteristics in the project work, similar effects of waste material as reinforcing material in concrete and to assess the mechanical behaviour of concrete. Particularly, this project work aimed to investigate experimentally the effect of medical tablet strips on compressive strength . Medical tablet strips are used and added upto 5%by the weight of cement with the design mix of M 25.

Therefore, concrete cubes are prepared and cast for evaluation of compressive strength . cubes are cast with addition of fibres upto 5% respectively. Medical tablet strips are used as application of utilization of wastematerialasaparticularconstructionmaterialandalsoa nothersideit controls the solid waste and environmental pollution.

***Key Words*:** Mechanical behaviour,split tensile strength

INTRODUCTION

Concrete, a versatile and essential construction material, suffers from low tensile strength despite its high compressive strength. Traditional fiber reinforcement, often steel, contributes to environmental issues like CO2 emissions. This necessitates the exploration of sustainable, eco-friendly alternatives using waste materials. Fiber reinforced concrete, incorporating randomly distributed fibers, enhances structural performance. Utilizing waste materials not only improves concrete properties but also mitigates environmental pollution. This project aims to investigate the use of medical tablet strips as a viable, eco-friendly fiber reinforcement, contributing to the development of sustainable construction practices.

HISTORICAL BACKGROUND

The concept of fiber-reinforced concrete dates back to 1910, but its widespread adoption using waste materials is a more recent development. Researchers have explored various waste materials to enhance concrete strength, focusing on improving mechanical properties like compressive, tensile, and flexural strength. Studies have shown that adding fibers, including aluminum and medical tablet strips, can significantly impact concrete performance. Investigations into aluminum strip fibers revealed improved tensile strength with increasing fiber content, though compressive strength can be adversely affected. Similarly, studies using medical tablet strips have demonstrated enhancements in compressive and tensile strength, though optimal dosages must be determined. The ongoing research emphasizes the importance of utilizing waste materials for cost-effective and environmentally friendly construction. The goal is to reduce reliance on traditional, environmentally harmful materials while enhancing concrete durability and performance. This project aims to contribute to this body of knowledge by further examining the effects of medical tablet strip fibers on concrete's mechanical behavior..

Advantages of using recycled material as fibers in concrete

Concrete containing fibres is thus easily recycled for reuse as crushed aggregates for other projects. The environmental benefits of this shift are significant. The production of fibre materials, particularly synthetic ones, generates considerably less CO2 compared to steel production.

Using recycled materials as fibers in concrete offers several advantages, both environmentally and structurally:

Sustainability: It reduces waste by repurposing materials that would otherwise end up in landfills, supporting a circular economy.

Lower Carbon Footprint: Recycling materials typically requires less energy than producing new ones, leading to reduced greenhouse gas emissions.

Cost-Effectiveness: Recycled fibers can be more affordable compared to producing new synthetic or steel fibers, lowering construction costs.

Strength and Durability: Depending on the recycled material, these fibers can enhance the tensile strength, crack resistance, and durability of the concrete.

Environmental Benefits: Reduces demand for virgin resources, and since recycling often uses less energy than producing new materials, it lowers greenhouse gas emissions.

Economic Savings: Recycled fibers can be more cost-effective than newly manufactured ones, leading to savings in construction projects.

Enhanced Concrete Performance: These fibers can improve tensile strength, reduce shrinkage cracking, and enhance Metholoddurability, depending on the type of recycled material used.

Promotes Circular Economy: It aligns with the principles of reusing materials and reducing dependency on non-renewable resources.

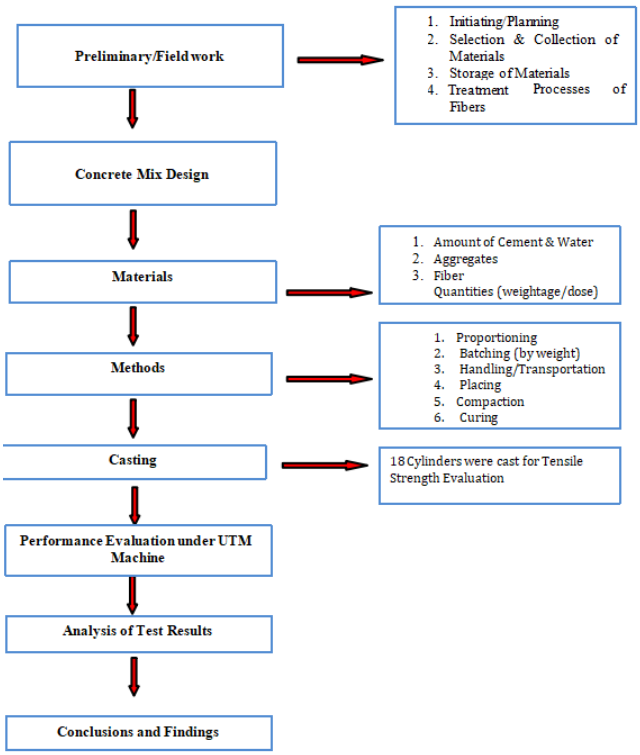
Innovative Applications: Opens up avenues for using diverse materials, allowing tailored solutions for various construction needs

OBJECTIVES

- Recycling medical tablet strips helps in reducing the amount of waste that ends up in landfills, promoting environmental sustainability.
- Utilizing waste materials like tablet strips can reduce the overall cost of concrete production by replacing some of the conventional materials.
- Adding shredded tablet strips to concrete can enhance its mechanical properties, such as compressive strength, split tensile strength, and flexural strength.
- Concrete mixed with tablet strips can exhibit improved durability, making it more resistant to various environmental factors like acid attack, sulfate attack, and alkaline attack.
- Promoting Environmental Sustainability: To reduce construction waste and encourage the reuse of materials, thereby conserving natural resources and mitigating the environmental impact.
- Reducing Carbon Footprint: To lower greenhouse gas emissions by using recycled materials, which typically require less energy to process compared to virgin materials.
- Economic Efficiency: To decrease construction costs by utilizing affordable recycled fibers in place of newly manufactured ones.
- Enhancing Material Properties: To improve the mechanical properties of concrete, such as its tensile strength, durability, and crack resistance, with the help of fiber reinforcement.
- Encouraging Innovation: To explore new possibilities in construction by finding creative uses for diverse recycled materials, advancing sustainable building practices.

Supporting the Circular Economy: To close the loop in material usage, ensuring materials are reused rather than discarded, aligning with global sustainability goals.

METHODOLOGY



MATERIALS AND METHODS

Water & Cement : Ordinary Portland cement (OPC) 33 grade was used and drinking water of urban of. Rajamahendravaram. Characteristics of cement are mentioned in Table 1.

Properties	Values
Specific gravity	3.13
Fineness (m2/kg)	225
Initial setting time	40
Final Setting time	138
Standard Consistency (%)	27

Aggregates :

sand of size less than 4.75 mm was used and nominal maximum size of 20 mm for coarse aggregates used in this study.

Properties	Aggregates	
	Fine	Coarse
Specific gravity	2.72	2.94
Fineness Modulus	2.518	2.45
Water Absorption (% age)	1.21	0.876
Unit Weight (lb/ft3)	102.5	97.5

FINE AGGREGATE (River Sand):

Sieve Analysis

Sieve analysis is the operation of dividing a sample of aggregate in to various fractions each consisting of particles of the same size. The sieve analysis is conducted to determine the particle sized is tribution in a sample of aggregate, which we call gradation. The significance of the aggregate grading is that it influences

directly many important properties of fresh concrete, such as consistency and segregation, and to a certain extent the properties of hardened concrete as well. Generally, within the permitted standard limits, the gradation of fine aggregate has a greater influence on the properties of concrete than that of coarse aggregate. At one end of the range ,unusually coarse sand tends to produce a harsh mix of low workability and with a greater liability to bleeding ,segregation of water during mixing and/or placingof the concrete .At the other end, unusually fine sand can significantly increase the water demand of a concrete mix, because of its much greater particle surface area,but it can improve cohesiveness.

Fineness Modulus

The sieve analysis is to conducted to determine the particle size distribution in a sample of aggregates.

Table – Fineness Modulus

Materials	Fineness Modulus
Fine Aggregate	2.518
Coarse Aggregate	2.45

Specific Gravity of Fine Aggregate

Specific gravity of fine aggregate (sand) is the ratio of the weight of given volume of aggregates to the weight of equal volume of water. The specific gravity of sands is considered to be around 2.65.

Apparatus for Specific Gravity Test

A balance of capacity not less than 3kg ,readable and accurate to 0.5 gm and of such a type as to permit the weighing of the vessel containing the aggregate and water .

A well ventilated oven to maintain a temperature of 100ºC to 110ºC

Pycnometer of about 1 litre capacity having a metal conical screw top with a 6mm hole at its apex . The screw top shall be watertight .

A means supplying a current warm air .

A tray of area not less than 32cm².

An airtight container large enough to take the sample.

Filter papers and funnel

Weight of sample with distilled water in pycnometer bottle	Weight of saturated surface dry sample in gms	Weight of sample oven dry in gms	Weight of sample in gms	Specific gravity	% water absorption in 24 hrs	Apparent specific gravity
1859	500	494	312.5	2.62	1.21	2.72

Flakiness Index & Elongation Index

Particle shape and surface texture influence the properties of freshly mixed concrete more than the properties of hardened concrete. Rough-textured, angular, and elongated particles require more water to produce workable concrete than smooth, rounded compact aggregate. Consequently, the cement content must also be increased to maintain the water-cement ratio. Generally, flat and elongated particles are avoided or are limited to about 15 % by weight of the total aggregate.

Passing through IS Sieve	Retained on IS Sieve	Thickness Gauge * (mm)	Length Gauge ** (mm)
63 mm	50 mm	33.9	-
50 mm	40 mm	27	81
40 mm	31.5 mm	21.5	64.4
31.5 mm	25 mm	16.95	-
25 mm	20 mm	13.5	40.5
20 mm	16 mm	10.8	12.4
16 mm	12.5 mm	8.55	25.6
12.5 mm	10 mm	6.75	20.2
10 mm	6.3 mm	4.68	14.7

Fig: Alongation Test

Fig: Elongation Test

Medical strips

The medical tablet strips, the metallic waste were collected from various places like medical shops, E-waste etc.This medical strips are used to store medicine. Nearly all the strips are made up of mostly aluminium.they were washed with detergent and cut into piece with scissors.

Fig: Medical Strips

Medical tablet strips are typically made from materials like aluminum foil or polymer films. These materials are chosen for their ability to protect the tablets from moisture, light, and air, ensuring the medication remains effective. Aluminum foil is often used in combination with other materials like PVC (polyvinyl chloride) or PVDC (polyvinylidene chloride) to create a durable and protective barrier. Strip packaging involves sealing the tablets between two layers of these materials using heat and pressure.

Fig: Selection of Materials

Fig: Selection of Materials

Fig: Mixing of Concrete with medical strips as per mix

Fig –Curing the cylinders

EXPERMNTAL RESULTS

Sr. No.	% of Fiber	Ultimate Load (N)	Average Load (N)	Average Split Tensile Strength (MPa)
1	0%	80205 81013 80580	80599.34	2.56
2	1%	80237 81198 83123	81519.34	2.59
3	2%	82655 83569 84593	83605.67	2.66
4	3%	86265 86493 84049	85602.34	2.73
5	4%	84256 85778 84658	84897.33	2.7
6	5%	83145 81458 82411	82338	2.62

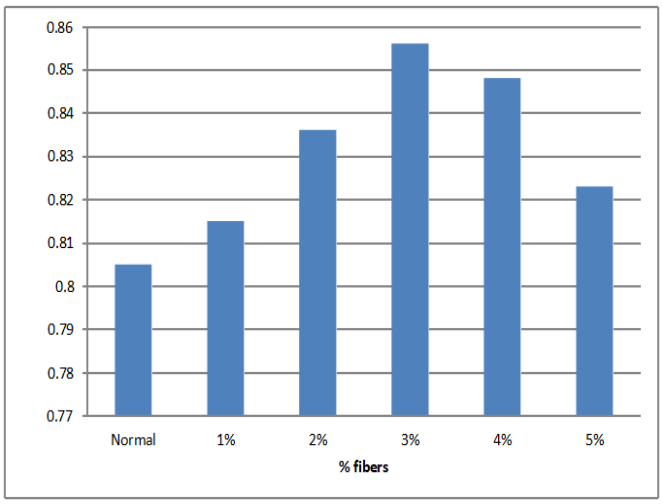


Fig. Comparison of average peak tensile load of normal concrete with average peak tensile load of fiber reinforced concrete

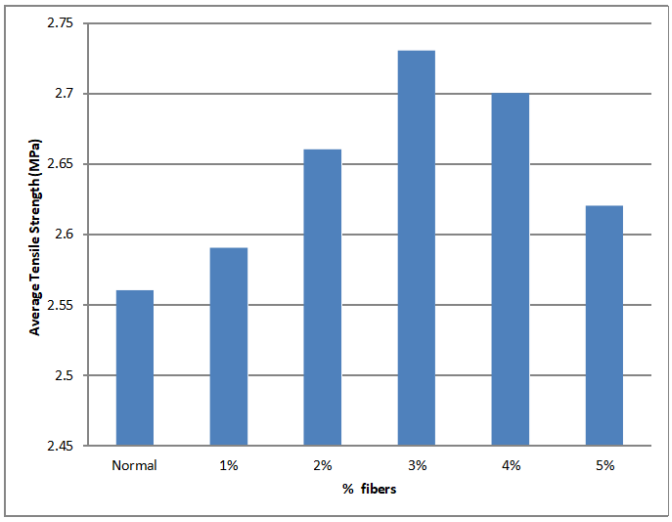


Fig: Comparison of average peak tensile load of normal concrete with average peak tensile load of fiber reinforced concrete

CONCLUSIONS AND RECOMMENDATIONS

In this study, medical tablet strips fibers are used in concrete as fibers to make fiber reinforcement concrete. Medical tablet stripes are the substitute for fibers and added to improve mechanical properties of concrete. Medical tablet stripes fibers are used in various proportions and percentages such as, 1, 2, 3 ,4 and 5% based on the weight of cement used. Based on the experimental results obtained, the following conclusions and suggestions can be drawn from the study of the effect of medical tablet stripes fibers on the concrete properties. The addition of medical tablet stripes fibers has improved the tensile strength of concrete;

With the inclusion of medical tablet stripes fibers in concrete, the concrete remained workable and workability was not affected; The results of the indirect tensile strength test on cylinders reveal that the ultimate

load-carrying capacity of the cylinder increases by 15.40 % with the addition of 4% medical tablet stripesfibers; increases by 18.50 % with the addition of 4% medical tablet stripesfibers; The use of medical tablet stripes fiber as a reinforcing material in concrete imparts strength up to 4% medical tablet stripes fiber level. A higher ratio of medical tablet stripes fiber leads to segregation consequently affects the strength; Fiber reinforced concrete mixes can yield better tensile strengths than that of control concrete mix at 28 days; Further extensive study can be carried out in control conditions; Better results can be expected by using different sizes and %age of medical tablet stripes fibers; Waste materials (medical tablet stripes fibers) can be utilized in a better way by giving special treatment and as a result, environmental pollution can be controlled.

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10. (Search for specific studies using aluminum or metallic waste): You will need to actively search databases for papers using keywords like "aluminum strips concrete," "aluminum foil concrete," "metallic waste fibers concrete," "packaging waste concrete," "medical packaging waste concrete."
11. III. Mechanical Properties of Concrete (Including Split Tensile Strength):
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16. (Search for studies on the use of shredded aluminum cans or foil in cementitious materials). Look for any research exploring the reinforcing potential of thin metallic strips.
17. (Explore studies on the use of E-waste components in concrete). Some E-waste contains metals that might have been investigated for their effect on concrete strength.
18. (Look for research on the corrosion behavior of aluminum in concrete). This is an important factor to consider for long-term durability.
19. (Search for patents related to using metallic packaging waste in construction materials). Patents can provide insights into innovative applications. Gagg, C. R., Gollop, R. S., Lester, P. J., Parker, T. J., & Waikato, R. C. (2012). Cement and concrete as inorganic resources for global sustainability. Resources, Conservation and Recycling, 60, 21-28. (Broader context of sustainability in the concrete industry.)
20. (Search for life cycle assessment (LCA) studies comparing conventional concrete with concrete incorporating recycled materials). This can provide quantitative data on environmental benefits..