AN EXPERIMENTAL STUDY OF REINFORCED CONCRETE WITH COCONUT FIBERS

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ABSTRACT

This research explores the mechanical robustness of concrete specimens reinforced with coconut fibers through a series of diverse examinations, encompassing tests for Strength under compression, resilience to bending, tensile resistance during splitting, and capacity to withstand shear forces. Coconut fibers of lengths 25mm, 50mm, and 75mm were incorporated at percentage of 0.5%, 1%, 1.5%, and 2% against the cement mass. The study reveals reinforced concrete coconut fibre exhibits notable improvements in mechanical properties, particularly in shear strength, showing a 25% to 30% enhancement for both 50mm and 75mm long fibers.

KEYWORDS: *Coconut fibre, RCC, Mechanical Properties*

1. INTRODUCTION

Traditionally, steel is added to simple concrete to enhance its characteristics and allay brittleness and very low tensile strength. However, the production of synthetic fibers, such as steel, involves high energy consumption and environmental concerns. This has led the engineering industry to seek alternatives, and natural fibers like coconut fiber have emerged as viable options due to their availability, biodegradability, cost-effectiveness, and non-toxic nature. Studies have shown that fiber of coconut possess excellent physical and mechanical properties, making them comparable to synthetic fibers. Various investigations of different researcher show the concussion of coconut fibers on the properties of cement composites, demonstrating improvements in flexural behavior, impact resistance, and longevity.

1.1 Section snippets

Materials

The study utilized ordinary Portland cement, locally available M Sand, and crushed granite stone. Coconut fibers, obtained from the husk of coconuts, were used at different lengths and proportions. The fibers were processed and treated to enhance their characteristics.

Table: 1. Materials

SN	Materials
1	Ordinary Portland Cement
2	M Sand
3	Crushed Granite Stone
4	Coconut Fiber

1.2 Workability

Workability tests, including slump cone and vee-bee tests, were conducted to assess the flow and consistency of coconut fiber reinforced concrete. The result shows that after addition of fibers influenced workability, with longer fibers leading to reduced slump values.

Table: 2. Workability test result

Concrete Grade	Specified Slum (mm)	Minimum Slum at site (mm)	Maximum Slum at site (mm)
C25	160 ± 40	190	200
C30	110 ± 30	130	140
C40	180 ± 40	200	220
C50	180 ± 40	180	210
C60	200 ± 40	220	240
C60 [Slump Flow]	650 - 800	650	750

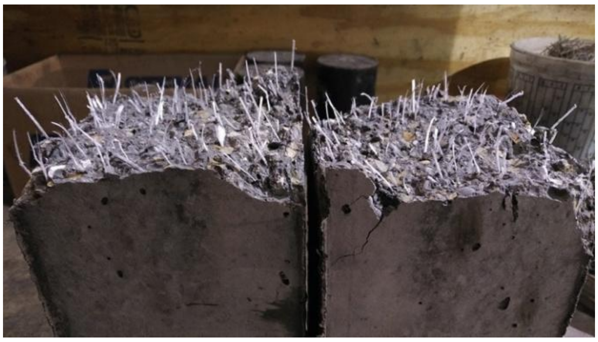

Figure : 1

1.3 Conclusion

The study concludes that coconut fibers of 75mm length with a 0.5% fiber content are optimal for coconut fiber reinforced concrete, exhibiting improved long-term strength gain. This research mainly emphasizes the potential of coconut fiber as a sustainable and effective reinforcement in concrete applications.

2. Evaluation of Breakage Characteristics and Flexural Attributes in Polymer Concrete Enhanced with Natural Fiber Reinforcement

ABSTRACT

This study investigates of the mechanical analysis of polymer concrete fortified with natural fibers, encompassing materials for Utilizing coconut, sugar cane bagasse fibers, and fibres of bananas. The fibers were used in their raw, recycled form, making them economical and environmentally friendly option. The comparative study investigates polymer epoxy concrete strengthened with naturally occurring fibers in comparison to both plain concrete and concrete enhanced with synthetic fibers. The study explores the fracture properties of the composites using the two-parameter model and provides insights into the manufacturing process of polymer concrete with natural fibers.

2.1 Introduction

The growing trend in utilizing natural fibers sourced from plants and agricultural by-products as strengthening elements in polymer concrete. This research specifically centers on Coconut husk, fibers extracted from sugar cane bagasse, and banana plant fibers, aiming to assess how these natural reinforcements influence the fracture and flexural characteristics of epoxy polymer concrete.

Advantages of using naturally available fibers comprise renewability, cost-effectiveness, and reduced safety concerns during handling.

Figure 2

2.2 Section Snippets

Fibers Derived from Coconuts

Fibers derived from coconuts are termed as coir, derived from the tough coconut husk, it possesses a notable abundance of lignin, contributing to its resilience, strength, and long-lasting durability. The hollow central cavity of fibers derived from coconuts contributes to their lightweight and insulation properties.

2.2.1 Analysis of Test Findings and Subsequent Discussion

The study presents test results for unreinforced epoxy-based polymerized concrete, composite with coconut fiber reinforcement, sugar cane biogases fiber-strengthened matrix, and polymer concrete enhanced by banana pseudo-stem fibers. The outcomes emphasize how natural fibers affect fracture attributes and the flexural performance.

Table: 3. Tests

SN	Name of tests
1	Compressive Strength
2	Transverse rupture strength
3	Diagonal tensile strength
4	Elastic modulus

Table: 4. Results

Mechanical Properties	**Compressive Strength (MPa)**				
	0.0	0.5	1.0	1.5	2.0
Compressive Strength (MPa)	30.79	31.91	34.89	35.32	35.15
Transverse rupture strength (MPa)	3.02	3.79	4.09	4.36	4.51
Diagonal tensile strength (MPa)	2.94	3.23	3.31	3.37	3.36
Elastic modulus (MPa)	19213	20250	21864	22267	22177

2.3 Conclusions

The research results underscore the positive influence of integrating diced coconut and sugar cane bagasse fibers on the fracture characteristics of polymer concrete. In contrast, the addition of banana pseudo-stem fiber does not result in a notable improvement in fracture toughness, although it did contribute to an enhancement in fracture energy.

3. Influence of Coconut Coir Fiber on Concrete Performance

ABSTRACT

This research explores the use of utilizing Coconut Fibers to Enhance Concrete Strength, considering cost and environmental factors. Different fiber contents were evaluated, and various strength parameters were studied, including bending, compression, and tensile strength. The study investigates influence of Fiber Geometry on Strength Characteristics, emphasizing the optimization of processed fiber yarn versus unprocessed fiber nets in concrete mixtures.

3.1 Introduction

Natural fibers, including coconut fibers, are increasingly considered as alternatives to steel or synthetic fibers for reinforcing concrete. The primary emphasis of this investigation is on leveraging coconut coir fiber to augment the strength attributes of concrete. This study takes into account the geometry of fibers, composition, and the impact of pre-treatment on fiber properties.

3.2 Section Snippets

3.2.1 Aggregate Tests

Various tests were conducted on aggregates, a vital component in concrete, including specific gravity, bulk density, and sieve analysis. The experimental procedure followed standard methods to determine mix proportions and assess workability through slump tests.

Table: 5. Aggregate test to determine mix proportion

Fine aggregate source	Trials	W/C ratio	Mix ratio	Slump (mm)	Avg. slump	Slump value	Slump type (TS=True slupm)
Lapai-Gwari	1	0.6	1:2:4	70	70	70	TS
	2	0.6	1:2:4	70			
Maikunkele	1	0.6	1:2:4	30	29	30	TS
	2	0.6	1:2:4	28			
Boso	1	0.6	1:2:4	42	41	40	TS
	2	0.6	1:2:4	40			
Chanchaga	1	0.6	1:2:4	45	43.5	45	TS
	2	0.6	1:2:4	42			
Garatu	1	0.6	1:2:4	40	39	40	TS
	2	0.6	1:2:4	38			

3.2.2 Compression strength of nominal concrete

The study evaluated the compression strength of nominal concrete and compared it with concrete reinforced with processed CCF. The results indicated that, addition of 0.6% coconut fiber improved compression strength, with 1.2% fiber content also showing positive results.

Table: 6. CCF paving block at 7 days

S.No	Parameter	Weight (kg)	Maximum Weight (KN)	Surface area (mm$^{2)}$
1.	Coconut Coir Fiber 0.0%	2.33	490	19.68
2.	Coconut Coir Fiber 0.1%	2.34	510	19.68
3.	Coconut Coir Fiber 0.2%	2.36	460	19.68
4.	Coconut Coir Fiber 0.3%	2.29	430	19.68

Table:7. Compressive Strength Test at 7 days

S.No.	Parameter	Compressive strength	
		(MPa)	(kg/cm^2)
1.	Coconut Coir Fiber 0.0%	24.8	248
2.	Coconut Coir Fiber 0.1%	25.7	256
3.	Coconut Coir Fiber 0.2%	23.5	236
4.	Coconut Coir Fiber 0.3%	21.9	217

3.3 Conclusion

The study concludes that incorporating 0.6% coconut fiber in concrete enhances its compression strength, and further research is recommended to explore the impact of coconut fibers on high-strength concrete, corrosion resistance, and thermal properties.

4. Robustness and Longevity of Concrete Enhanced by Coconut Fiber in Harsh Conditions

4.1 Introduction

This research focuses on assessing the Robustness and Longevity of Concrete Reinforced with Coconut Fibers in Challenging Environmental Conditions, particularly marine structures exposed to seawater and tropical climates. High-strength concrete (HSC) is commonly used in such structures, and the study aims to assess the contribution of coconut fibers in enhancing strength and durability parameters.

4.2 Empirical Investigation Plan

Portland Cement Type I and Silica Fume Concentrate, river sand, and crushed granite were used in the experimental program. This research assesses that compressive strength and longevity indicators of reinforced concrete with coconut fiber exposed to tropical climate settings.

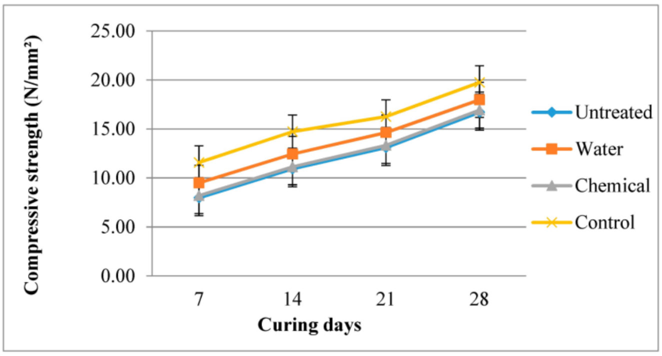

Figure 3

4.3 Conclusions

The study's findings suggest that the introduction of a minimal quantity of coconut fiber (0.6%) shows an advancement of about 12% in the compressive concrete strength when subjected to tropical climates. Coconut fiber demonstrates effectiveness in mitigating the adverse impacts of expansion and contraction during cycles of wet and dry conditions.

5. FUTURE SCOPE

The future scope of Coconut Fiber Reinforced Concrete (CFRC) holds significant promise, with ongoing research and advancements suggesting a range of potential applications and improvements.
In conclusion, the future of Coconut Fiber Reinforced Concrete is dynamic and multifaceted. As research continues to unfold and technology advances, CFRC has the potential to become a mainstream construction material, offering sustainable and high-performance alternatives to conventional reinforced concrete. Continued investment in research, standardization efforts, and educational initiatives will play crucial roles in realizing this potential.

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