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INTERNATIONAL TINKER INNOVATION & ENTREPRENEURSHIP CHALLENGE (i-TIEC 2025)

"Fostering a Culture of Innovation and Entrepreneurial Excellence"



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Electrical Engineering Studies, College of Engineering
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Kampus Pasir Gudang
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A-ST054: HYBRID FIBRE BREEZE BLOCK: A SUSTAINABLE AND LIGHTWEIGHT INNOVATION FOR MODERN CONSTRUCTION

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ABSTRACT

The Hybrid Fibre Breeze Block is an innovative product intended to transform semi-structural wall applications by integrating the complementary advantages of polypropylene (PP) and nylon fibres. This lightweight solution overcomes the shortcomings of traditional lightweight concrete, providing improved compressive strength, decreased porosity, and greater durability. The Hybrid Fibre Breeze Block is designed to fulfil the increasing need for ecological, economical, and high-performance building materials, marking a notable progression in contemporary construction technology. This product is experimented with for up to 56 days by incorporating hybrid fibres into lightweight foamed concrete (LFC), enhancing the material's microstructure and performance. The blocks demonstrate enhanced fracture resistance, superior load distribution, and heightened moisture resistance due to sophisticated material engineering. This invention offers significant benefits, including decreased structural weight, minimal material use, and improved thermal and fire resistance. These characteristics enable energy-efficient and environmentally sustainable construction methods that minimize carbon footprints while adhering to green building standards. The Hybrid Fiber Breeze Block, with its scalable manufacturing capabilities, presents significant commercialization opportunities in the construction industry, especially for sustainable housing and infrastructure projects. This product facilitates socio-economic development by lowering building expenses while simultaneously advancing environmental sustainability, in accordance with global green construction trends.

Keywords: Lightweight Foamed Concrete, Hybrid Fibres, Sustainable Materials, Breeze Block

1. Product Description

The Hybrid Fibre Breeze Block integrates a unique combination of micro-synthetic fibres such as PP and nylon within LFC, providing improved structural integrity and durability for semi-structural wall applications. This novel product incorporates a 0.2% volume fraction of hybrid fibres, resulting in a substantial weight decrease relative to traditional concrete while enhancing mechanical attributes, including compressive strength and impact resistance. The Hybrid Fibre Breeze Block is an optimal choice for home and commercial wall construction, providing exceptional thermal insulation, soundproofing, and sustainability. Optimised

hybrid fibre integration guarantees increased longevity, allowing the blocks to function consistently under all climatic situations, making them appropriate for both indoor and outdoor wall applications. This product meets the industry's need for eco-friendly construction materials, reducing the environmental effect of traditional concrete and fostering energy-efficient and sustainable practices. The Hybrid Fibre Breeze Block is lightweight and manageable, offering builders a cost-efficient option that minimises shipping and labour expenses, while ensuring durability.

2. Development and Performance Analysis of Hybrid Fibre Breeze Block for Sustainable Construction

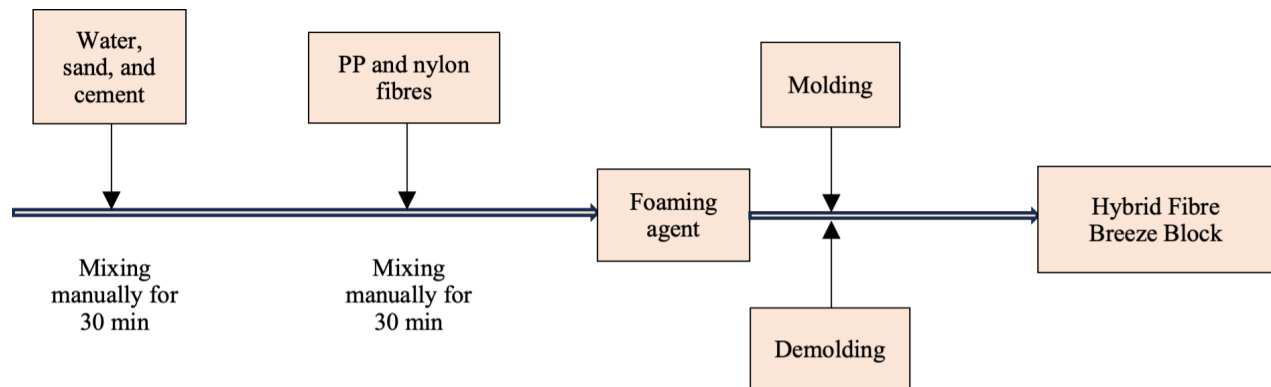
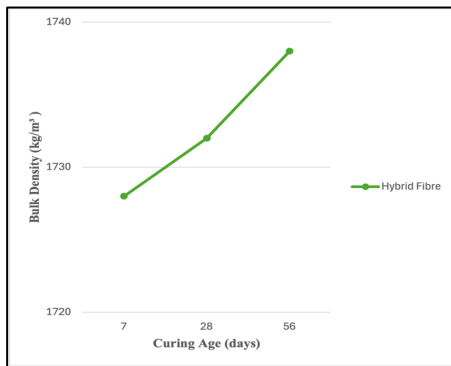
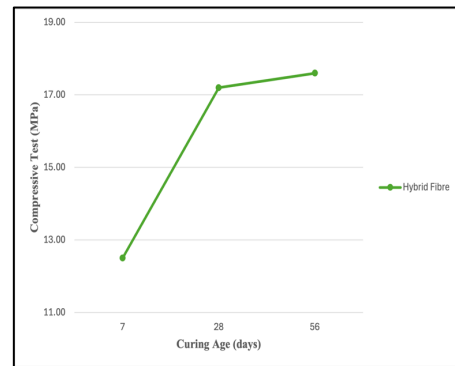
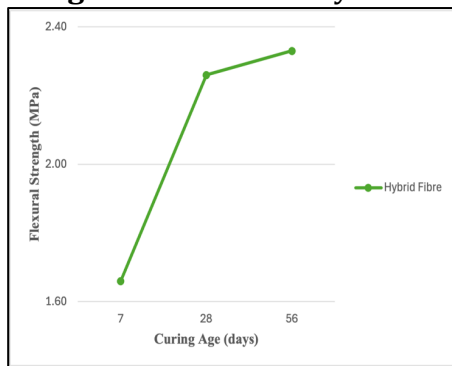
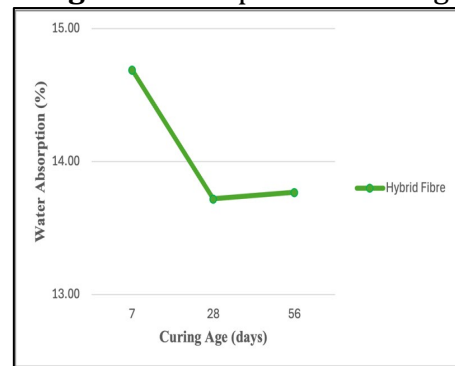


Figure 1. The Process of the Hybrid Fibre Breeze Block

Table 1. Details of Mixing Proportion for Hybrid Fibre Breeze Block

<i>Targeted Density (kg/m³)</i>	<i>Targeted Compressive Strength</i>	<i>Cement (kg/m³)</i>	<i>Sand (kg/m³)</i>	<i>Water (kg/m³)</i>	<i>Foam (kg/m³)</i>	<i>Volume Fraction of Fibre (%)</i>	
						<i>PP</i>	<i>Nylon</i>
800-1350	7-14 MPa	583.62	583.62	262.63	58.36	0.2%	0.2%

**Figure 2.** Bulk Density**Figure 3.** Compressive Strength**Figure 4.** Flexural Strength**Figure 5.** Water Absorption**Table 2.** Mechanical and Durability Properties of the Hybrid Fibre Breeze Block

<i>Curing Age (days)</i>	<i>Buik Density (kg/m³)</i>	<i>Compressive Strength (MPa)</i>	<i>Flexural Strength (MPa)</i>	<i>Water Absorption (%)</i>
7	1728	12.50	1.66	14.69
28	1732	17.20	2.26	13.72
56	1738	17.60	2.33	11.71



Figure 6. Production of LFC

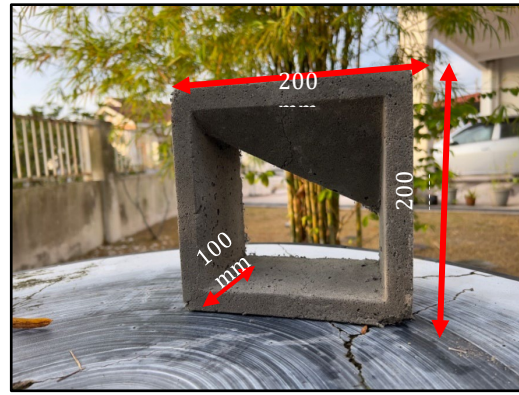


Figure 7. Hybrid Fibre Breeze Block

3. Novelty and uniqueness

The Hybrid Fibre Breeze Block is an innovative building material that utilises the combined advantages of PP and nylon fibres to improve the performance of LFC. This revolutionary product has a unique hybrid fibre structure that enhances both mechanical and durability properties, overcoming the shortcomings of conventional LFC. Through the meticulous combination of PP and nylon fibres in appropriate volume fractions, the block attains enhanced compressive strength, decreased porosity, and greater fracture resistance, distinguishing it from traditional construction materials. The innovation consists of using micro-synthetic fibres to improve the cement matrix and efficiently bridge micro-cracks, resulting in increased structural cohesion and durability. In contrast to conventional LFC, the Hybrid Fibre Breeze Block exhibits superior thermal insulation, acoustic attenuation, and fire resistance, making it a multifaceted option for many applications. The lightweight design minimises shipping and handling expenses while preserving the necessary strength for semi-structural wall applications. The product's distinctiveness also includes its sustainability attributes. It fosters environmentally sustainable building techniques by decreasing dependence on conventional thick concrete and minimising material waste. The Hybrid Fibre Breeze Block is an innovative amalgamation of lightweight properties, durability, and sustainability, delivering a revolutionary solution for contemporary construction requirements and environmentally conscious building projects.

4. Benefit to mankind

The critical need for sustainable, durable, and cost-effective construction materials is addressed by the Hybrid Fibre Breeze Block, which provides substantial benefits to humanity. These blocks reduce material usage, energy consumption, and transportation costs by reducing structural weight, thereby making construction more eco-friendly and accessible. Their improved thermal insulation and fire resistance, which contribute to more sustainable and resilient housing solutions, enhance energy efficiency and safety. The blocks' durability, which is attained through the integration of composite fibres, guarantees a prolonged service life and minimal maintenance, thereby reducing the long-term expenses of householders and building operators. Their lightweight nature enables the more efficient progress of affordable housing initiatives and disaster recovery projects, as it enables speedier and

simpler construction. The Hybrid Fibre Breeze Block enhance living standards and contribute to global efforts in combating climate change by promoting green construction practices and reducing environmental impact. Ultimately, this supports healthier and more sustainable communities.

5. Innovation and Entrepreneurial Impact

The reduced shipping costs and faster, more efficient installations made possible by their lightweight construction immediately translate to speedier project schedules and lower operations expenditures. Adding hybrid fibres make it more resistant to cracking, shrinking, and water absorption, which means it will last longer without splitting and will cost building owners less to maintain. This invention offers better thermal insulation and fire resistance, which is in line with worldwide green construction objectives. Along with lowering energy use, these features help make cities better places to live in the long run. The owners may take advantage of this product's commercial scalability to meet the growing need for sustainable, high-performance building supplies. This product is going to revolutionise the building industry by lowering costs, decreasing environmental impact, and providing unmatched performance. This breakthrough heralds a new age for the building sector, where entrepreneurs may earn while simultaneously making a positive impact on the built environment.

6. Potential commercialization

Innovative design and sustainable attributes are the driving forces behind the immense commercialisation potential of the Hybrid Fibre Breeze Block in the construction industry. This product is suitable for both residential and commercial applications, as there is an increasing global demand for energy-efficient and eco-friendly building materials. Developers who are in search of cost-effective solutions are attracted to them due to their lightweight nature, which reduces transportation and labour costs. Furthermore, this product is positioned as a long-term investment for infrastructure projects due to their minimal maintenance requirements and improved durability. The appeal of this product is expanded in a variety of construction scenarios due to their adaptability in semi-structural applications, such as walls and partitions. The block is compatible with green building certifications, which makes them an attractive option for environmentally conscious consumers and businesses.

7. Acknowledgment

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8. Authors' Biography



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