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## A Study on Mycelium Brick Production and Testing as a Building Insulation Material Using Mycelium Technology

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**Abstract:** Mycelium composites are emerging bio-based materials with potential applications in sustainable construction, particularly as insulation and other non- or semi-structural components. This study investigates the production of mycelium bricks using agricultural waste and sawdust as substrates and evaluates their performance through compressive strength, efflorescence, and water absorption tests. The experimental work involved substrate sterilization, mycelium colonization, moulding, drying and heat treatment. Initial trials showed inadequate hardening; a subsequent trial incorporated 30% white cement to obtain a testable brick. The tested mycelium bricks showed compressive strengths of 12.2, 13.5 and 14.7 N/mm<sup>2</sup>, compared with 7.2, 8.0 and 9.1 N/mm<sup>2</sup> for the standard tile brick samples. Water absorption of the mycelium brick was reported as 10.50%, compared with 11.56% for the standard brick. Efflorescence was slight for the mycelium brick. The results indicate potential for low-weight, waste-derived building products, while the study also identifies the need for further research on durability, moisture resistance, standardized testing and optimization of mycelium growth and composition.

**Keywords:** Mycelium composite, mycelium brick, agricultural waste, insulation, compressive strength, water absorption, sustainable construction.

### I. Introduction

#### 1.1 Background

Mycelium is the vegetative network of fungi and consists of branching, thread-like structures called hyphae. The mycelial network grows through organic substrates and obtains nutrients by breaking down complex organic matter. Its ability to colonize agricultural and lignocellulosic materials makes it suitable for developing bio-based composites. The source document highlights applications in insulation, panelling, flooring, furniture and other products, with particular potential arising from low thermal conductivity, acoustic absorption and fire-safety characteristics.

#### 1.2 Need for the Study

Conventional brick production depends on extraction of mineral resources and thermal processing and is associated with energy use, emissions and environmental impacts. The study therefore explores a cultivated material route in which mycelium binds waste-derived substrates into a shaped product. Agricultural waste and sawdust provide a potential feedstock while the biological growth process offers a route toward lightweight construction materials.

#### 1.3 Problem Definition

The study identifies the environmental burden associated with conventional brick manufacture, including resource extraction, fuel consumption and emissions. It investigates whether mycelium-based products can provide a practical alternative for suitable applications while reducing dependence on conventional materials.

### 1.4 Objectives and Scope

The main objectives are to develop mycelium bricks from waste-derived substrates, study the effect of substrate and processing conditions on colonization, produce a hardened specimen suitable for testing, and evaluate compressive strength, efflorescence and water absorption. The work is positioned primarily toward sustainable, non- or semi-structural applications such as insulation and panel products.

## II. Materials and Methodology

### 2.1 Materials

The materials used were mushroom seeds, straw, wooden logs, sawdust, formalin, fungicide, cellophane sheet, brick mould, water and white cement. Mushroom seeds, agricultural waste and sawdust were obtained from an agricultural source in Thiruvananthapuram, Kerala. The reported quantity of mushroom seed purchased was 300 g.

### 2.2 Substrate Preparation

Agricultural waste and sawdust were prepared as growth substrates. Sterilization was adopted to reduce microorganisms that could interfere with mycelium colonization. Formalin and fungicide were used in the reported experimental procedure to control contamination.

### 2.3 Mycelium Growth and Brick Formation

Sterilized agricultural waste was placed in a plastic bag together with formalin and fungicide, followed by the addition of mushroom

seeds. The bag was closed and kept in a dark environment for several days to initiate mycelial growth. The colonized mixture was subsequently transferred to a brick mould. Cellophane was used to cover the mould. After further growth, the formed material was removed from the mould and dried.

## 2.4 Experimental Trials

Three trials were reported. In Trial 1, the moulded mixture did not develop adequate strength. In Trial 2, wheat flour, water and sugar were introduced as additional components and both airtight and partially ventilated mould conditions were examined. Mycelial growth occurred, but the resulting material remained insufficiently hard for compressive testing. In Trial 3, 30% white cement was added to improve hardening. The hardened specimen was then oven-treated and prepared for testing.

## 2.5 Testing

The reported evaluation included compressive strength, efflorescence and water absorption. The document states that brick testing was undertaken with reference to IS 1077:1992 and IS 3495:1992. The compressive strength test was conducted using a compression testing machine. Efflorescence was assessed by observing salt deposits after exposure to water and sunlight. Water absorption was evaluated from the change in specimen weight after water exposure.

### III. Experimental Procedure

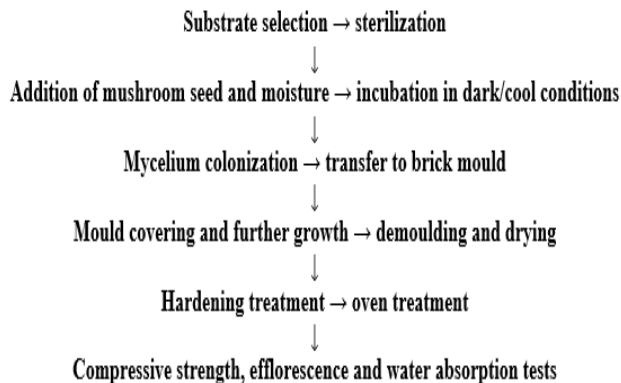


Figure 1: Experimental Procedure for Mycelium-Based Brick Preparation and Testing

### IV. Results and Discussion

#### 4.1 Compressive Strength

The reported compressive-strength observations are summarized below. The mycelium brick specimens recorded 12.2, 13.5 and 14.7 N/mm<sup>2</sup>, while the standard tile brick specimens recorded 7.2, 8.0 and 9.1 N/mm<sup>2</sup>. The mean compressive strength calculated from the three reported observations is approximately 13.47 N/mm<sup>2</sup> for the mycelium brick and 8.10 N/mm<sup>2</sup> for the standard tile brick.

| Sample | Mycelium Brick (N/mm <sup>2</sup> ) | Standard Tile Brick (N/mm <sup>2</sup> ) |
|--------|-------------------------------------|------------------------------------------|
| 1      | 12.2                                | 7.2                                      |
| 2      | 13.5                                | 8.0                                      |
| 3      | 14.7                                | 9.1                                      |
| Mean   | 13.47                               | 8.10                                     |

The reported results show higher compressive strength for the tested mycelium-brick specimens than for the standard tile-brick specimens used for comparison. However, the source also indicates that 30% white cement was incorporated in the final successful trial; therefore, the measured strength represents the tested composite formulation rather than a mycelium-only brick.

#### 4.2 Comparison with White Cement Brick

The reported comparison gives mycelium-brick values of 12.2, 13.5 and 14.7 N/mm<sup>2</sup> and white-cement-brick values of 13.1, 13.8 and 14.5 N/mm<sup>2</sup>. The corresponding means are approximately 13.47 N/mm<sup>2</sup> and 13.80 N/mm<sup>2</sup>, respectively, indicating similar compressive-strength performance within the reported test series.

| Sample | Mycelium Brick | Mycelium Brick with White Cement |
|--------|----------------|----------------------------------|
| 1      | 12.2           | 13.1                             |
| 2      | 13.5           | 13.8                             |
| 3      | 14.7           | 14.5                             |

#### 4.3 Efflorescence

The source reports slight efflorescence for the mycelium brick, compared with moderate efflorescence for the standard brick. In the comparison with the white-cement brick, both were reported as having slight efflorescence.

| Comparison         | Reference Brick | Mycelium Brick |
|--------------------|-----------------|----------------|
| Standard brick     | Moderate        | Slight         |
| White-cement brick | Slight          | Slight         |

#### 4.4 Water Absorption

The reported water absorption of the mycelium brick was 10.50%, compared with 11.56% for the standard brick and 12.15% for the white-cement brick in the stated comparison. Lower absorption in the tested mycelium specimen is favorable for moisture-related performance, although longer-term durability and repeated wetting-drying behavior were not established by the reported experiments.

| Comparison         | Reference (%) | Mycelium Brick (%) |
|--------------------|---------------|--------------------|
| Standard brick     | 11.56         | 10.50              |
| White-cement brick | 12.15         | 10.50              |

### V. Key Findings

- Agricultural waste and sawdust can serve as substrates for mycelium colonization after appropriate preparation.
- Initial moulding trials did not produce a sufficiently hard brick, demonstrating the importance of formulation and processing conditions.
- The successful reported trial used 30% white cement to obtain a hardened, testable specimen.
- The three tested mycelium bricks showed compressive strengths of 12.2–14.7 N/mm<sup>2</sup>.
- The mean compressive strength of the reported mycelium-brick samples was approximately 13.47 N/mm<sup>2</sup>.

- The reported water absorption of the mycelium brick was 10.50%, lower than the reported values for the comparison bricks.
- Efflorescence was reported as slight for the mycelium brick.
- The study indicates potential for sustainable insulation and other non- or semi-structural applications, subject to further validation.

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## VI. Conclusion

The study demonstrates the feasibility of producing a mycelium-based brick composite using agricultural waste and sawdust as growth substrates. After unsuccessful initial trials, the addition of 30% white cement enabled production of a hardened specimen suitable for laboratory testing. The reported compressive strength, water absorption and efflorescence results indicate promising performance for selected sustainable building applications. Nevertheless, the present results should be interpreted within the limits of the experimental formulation and small test series. The source notes that Indian Standards specific to mycelium bricks were not available for this emerging material at the time of the study, reinforcing the need for systematic characterization and standardization.

## VII. Future Scope

Further work should optimize substrate composition, mycelium growth conditions, binder content and curing/heat-treatment conditions. Research is also required on moisture resistance, dimensional stability, thermal and acoustic performance, fire behavior, durability, biodegradation, life-cycle impacts and scale-up. Development of standardized testing procedures and a larger experimental dataset would support comparison with conventional bricks and establish suitable application limits.

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