

Enhancement of the technological and physio-mechanical properties of mycelium grown materials

Summary

The overall goal of the project is to examine novel mycelium biobased composites physical and mechanical properties using experimental approaches for promoting institutional innovations in the biobased composites. The project addresses the following research questions: What are the main expected mechanical and physical properties of the novel mycelium composites developed from different lignocellulosic substrates? What are the heat insulation and fire safety classes of these mycelium composites? How to enhance mycelium composites process into larger scale product prototype level?

Research field:	Chemical, materials and energy technology
Supervisors:	Prof. Dr. Jaan Kers Dr. Heikko Kallakas
Availability:	This position is available.
Offered by:	School of Engineering Department of Materials and Environmental Technology
Application deadline:	Applications are accepted between October 01, 2024 00:00 and October 25, 2024 23:59 (Europe/Zurich)

Description

The research

This PhD project focuses on enhancing the technological and physio-mechanical properties of mycelium-grown materials, aiming to develop innovative and sustainable alternatives to conventional composites. Mycelium, the root structure of fungi, has gained attention for its potential to create biodegradable, renewable, and eco-friendly materials. However, to fully realize their application potential, there is a need to optimize their physical and mechanical characteristics.

The project will address the following key areas:

1. **Mechanical and Physical Properties:** The study will evaluate the mechanical properties such as tensile strength, compressive strength, and elasticity of mycelium composites. By using different lignocellulosic substrates, the project aims to identify the optimal combinations that result in materials with superior performance.
2. **Thermal Insulation and Fire Safety:** The project will assess the heat insulation capabilities and fire resistance of mycelium-based composites. Understanding these properties is critical for potential applications in industries like construction and packaging, where thermal management and safety are essential.
3. **Scale-Up and Process Optimization:** To facilitate the commercial use of mycelium composites, the project will explore methods to enhance the production process, focusing on scalability. This includes developing techniques to produce larger-scale prototypes while maintaining or improving material quality.

The outcomes of this research are expected to advance the development of mycelium-based materials by improving their mechanical strength, thermal properties, and manufacturability. By providing environmentally friendly alternatives with enhanced properties, this project aims to drive innovation in the field of biobased composites and contribute to the sustainable materials industry.

Responsibilities and (foreseen) tasks

- Compile an analytical framework for examining experimental approaches to analyze novel mycelium composites physical- mechanical properties.
- Study the coating effect of the mycelium composites
- Test and characterize the thermal properties of the mycelium composites
- Use case thermal insulation material. The sagging of the insulation material in the wall under its own weight – the gravity load.

- Examine the perspective applications of the mycelium composite material and corresponding standards and required properties on the data sheets of the materials on the market.
- Study of state of the art value chain and production technologies and scale up for the large scale insulated panels and also wall tests.
- Find answers to technological questions on how to bond the mycelium material to the timber frame construction. Adhesives needed for bonding. Cost of the technology: Amount of FR chemical substance needed, the cost of it and correlation with the effect.
- Develop scale-up and process optimization for the mycelium composites.
- Writing and publishing scientific papers of the project results in peer reviewed journals and conference presentations.
- Contribute to the organization of research and practitioner workshops where project findings are presented

Applicants should fulfil the following requirements:

- Master's degree in the field of biochemistry, wood chemistry, materials technology, wood technology or wood science.
- Familiar with methods, procedures and safety of biochemistry, wood chemistry, wood technology or composite material technology, which allows to work independently
- Excellent communication skills (written and spoken) in English
- A clear interest in the topic of the position
- Strong and demonstrable writing and analytical skills
- Capacity to work both as an independent researcher and as part of an international team
- Capacity and willingness to provide assistance in organizational tasks relevant to the project

(The following experience is beneficial:)

- Previous experience in wood technology or natural fibre based composite materials would be highly appreciated.
- Previous experience in the most relevant characterization methods (surface roughness, contact angle measurement, tensile and flexural tests) is also expected.
- Previous knowledge about veneer-based products and their technologies.
- Working knowledge of data analysis and statistics.
- Data visualization and analysis in R

The candidate should submit a research plan for the topic, including the overall research and data collection strategy. The candidate can expand on the listed research questions and tasks, and propose theoretical lenses to be used.

We offer:

- 4-year PhD position in one of the largest, most internationalized and leading engineering and technology research centers in Estonia.
- Opportunities for conference visits, research stays and networking with globally leading universities and research centers in the fields of wood and natural fibers based composite materials technology and wood chemistry.

About the department

Department of Materials and Environmental Technology is an interdisciplinary research center of Tallinn University of Technology that focuses to lead the high-level, internationally recognized teaching, research and development in Estonia in the field of materials and environmental technology.

(Additional information)



For further information, please contact Prof. Heikko Kallakas heikko.kallakas@taltech.ee and Prof. Jaan Kers jaan.kers@taltech.ee or visit <https://taltech.ee/en/departments-materials-and-environmental-technology>



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