Development of Fire-Retardant Treatment Methods and Effects on Mycelium Material Fire Resistance

Summary

PhD position is opened for characterization of lignocellulosic substrates for mycelium applications and for development of fire-retardant treatment methods for mycelium material. Mycelium grows the skin that covers the lignocellulosic substrate, thereby inhibiting any fire retardant pre-treatment, thus, treatment with fire retardants after the mycelium material has grown is more effective.

Research field:	Chemical, materials and energy technology
Supervisors:	Prof. Dr. Jaan Kers Dr. Percy Festus Alao
Availability:	This position is available.
Offered by:	School of Engineering Department of Materials and Environmental Technology
Application deadline:	Applications are accepted between June 01, 2024 00:00 and June 30, 2024 23:59 (Europe/Zurich)

Description

The goal of this PhD project is to enhance fire resistance properties of mycelium composite materials to be used as insulation/architectural materials for green buildings. Fire retardant treatment effectiveness by using various application method

Characterization of substrate material: hardwood/softwood scrap, hemp shives, reed, milled bark from different wood species could be used.

- physical methods (density, MC, colour?)
- elemental analysis/ash content (does it contain any substances (metals, e.g.,)
- compositional analysis: cellulose, lignin, hemicelluloses, extractives.

Study and selection of the fire retardant (conventional FR liquid, additives such as $CaCO_3$, Mg CO_3, etc) and the methods for the treatment.

- Dry mix of the substrate with fire retardant.
- Treatment of the substrate before inoculation with fungi strain.
- Spray technology and pressure impregnation FR treatments.
- Mycelium panels compression and then FR treatment by surface coating or impregnation under pressure.
    - Issues to evaluate – the mycelium grown materials will be mechanically cut and then used in panels without treatment of the cut edges. Is fire spreading between the timber frame and not FR treated edges (can we test this with Conical burner.?

Responsibilities and (foreseen) tasks

- Characterization of the properties of the hemp and woody biomass cultivated in Estonia and if required sourced from other regions (Latvia, Lithuania).
- Examining the most viable, environmentally positive approach to improve the product fire performance.
- Tests related to material properties i.e., thermal conductivity, acoustic, fire reaction, moisture and mechanical performance.
- Analysis of the performance of the panels from lab to pilot scale i.e., testing in real-life applications.
- Composing comprehensive literature survey of the state of the art in the field hemp fand other natural materials based mycelium composite materials
- Publishing of the results as journal articles 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 wood technology, wood science, wood chemistry or materials technology
- Familiar with methods, procedures and safety of 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 statistics.

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. Jaan Kers: jaan.kers@taltech.ee or Dr. Percy Festus Alao: percy.alao@taltech.ee or visit the https://taltech.ee/en/department-materials-and-environmental-technology

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