Development of highly reproducible model surfaces of wood to enhance the implementation of new bio-based adhesives

Summary

TalTech Laboratory of Wood Technology is offering PhD position to well-qualified individual to work on a PhD research project, which aim is to create highly reproducible model surfaces through the controlled technological processing. Model surface will be used to study systematically the interactions of wood and adhesive in order to understand the mechanisms involved. In any adhesion related study the highly reproducible surface is a key for successful research, however it is challenging task, especially in case of natural polymer materials. Subsequently model surface will facilitate the development of new test methods and implementation of new environmentally friendly adhesives. TalTech has excellent facilities and staff to accomplishing this research. TalTech has a wide range of analytical techniques for surface imaging and has a laboratory scale veneer peeling and veneer-based prducts production line. This laboratoty-scale line allows controlling processing parameters and create high quality veneers for engineered veneer products. The individual assigned to this position will be enrolled to the doctoral study program "Engineering Sciences" in speciality "Chemical-, Materials-, and Energy Technology" and employment as early-stage researcher by the Department of Materials and Environmental Technology.

Research field:	Chemical, materials and energy technology
Supervisors:	Prof. Dr. Jaan Kers Dr. Anti Rohumaa
Availability:	This position is available.
Offered by:	School of Engineering Department of Materials and Environmental Technology
Application deadline:	Applications are accepted between June 01, 2022 00:00 and June 30, 2022 23:59 (Europe/Zurich)

Description

An essential component of veneer-based products is an adhesive. Moreover, almost all engineered wood products (EWP) on the market today use synthetic, petroleum-based adhesives, which have proven inexpensive, durable, and reliable. However, these traditional, petrochemical adhesives are under threat from changes in regulation and customer demands. The desire for low carbon/carbon sequestering materials, healthy living environments, and a circular economy are all driving EWP use, but block the continued use of the petrochemical adhesives that are currently critical to their performance. Therefore, development of high-performance, new bio-based resins for EWPs is essential.

A significant barrier to bio-based adhesive development is the extensive time and cost required for testing. Final product performance depends not only on the cohesive strength of the adhesive, but on dozens of other interactions with wood must be tested e.g. flow characteristics when applied to the wood, tack, penetration, curing kinetics etc. Unfortunately, wood bonding tests also suffer from high variability. This high variability increases testing costs significantly because of the high number of replicate specimens that must be tested, as well as unknown systematic changes in test conditions between lots of veneer, storage conditions or other uncontrolled effects. There is a pressing need to decrease bond test variability in veneers in order to reduce the amount of testing needed and increase the confidence level of the resulting data. Improving testing reliability and repeatability would not only accelerating development of biobased wood adhesives and of Estonian underutilized bio-resources, but of all kinds of bonded wood products.

A significant source of this variability causing a high testing burden is the wood surface. Therefore, the aim of the research is to create highly reproducible model surfaces through the controlled technological processing. The model surface will be used to study systematically the interactions of wood and adhesive in order to understand the mechanisms involved. Subsequently model surface will facilitate the development of new test methods and implementation of new environmentally friendly bio-based adhesives.

Objectives and responsibilities:

1. To define relationships between wood material processing parameters, veneer surface properties and bond quality with a variety of bio-based adhesives.

2. To develope highly reproducible model surfaces.
3. To demonstrate the impact of veneer properties and processing parameters on bond performance by improving the evaluation methods and increasing reproducibility.

Tasks:

1. Review the existing knowledge in the field of veneer-based product processing and understanding of the role of wood surface in wood adhesive interaction.
2. Preparation and execution of a research plan.
3. Define relationships between wood material processing parameters, veneer surface properties and bond quality.
4. Improving the evaluation methods and increasing reproducibility in adhesive bond testing.

Qualifications:

The applicants should fulfil the following requirements:

- Master´s degree in the field of wood technology, wood science, wood chemistry or materials technology
- Excellent communication skills (written and spoken) in English
- Deep knowledge in the field of wood properties, adhesive bonding of wood based materials and research and development methods for engineered wood products.

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