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Habilitation thesis title: Lignocellulosic materials. Characterization, properties and applications

Domain: Forestry Engineering

SUMMARY

The habilitation thesis presents four areas of the author's research, started in 2018 after the preparation of her PhD thesis at the Technical University of Zvolen, Slovakia. The main focus of the research is the superior valorisation of wood, wood waste products and lignocellulosic materials in the current context of eco-design and circular economy.

The thesis is structured in three parts: scientific and professional achievements (B-i), career development plans (B-ii), and references (B-iii). Chapter B-i contains four distinct topics that are the most important aspects of the author's research, conducted from 2018 to 2023. Chapter B-ii includes the evolution of professional experience, teaching and research, also the development plans of the activities in these areas.

The topics presented in this thesis are part of projects carried out at the Salzburg University of Applied Sciences (FH Salzburg), resulting from partnerships with international business and academia. The basic research was mainly carried out at FH Salzburg, in collaboration with Transilvania University of Brasov, Technical University of Zvolen (Slovakia), University of Biotechnology of Ljubljana (Slovenia), University of Forestry of Sofia (Bulgaria), University of Tennessee in Knoxville (USA), University of Zagreb (Croatia), Faculty of Forestry of Ukraine, Lvov, University of Agriculture of Nitra (Slovakia) and National Forestry Centre of Slovakia. In this way were generated datasets on the characterisation of lignocellulosic materials and their integration into the bioeconomy as value-added products and efficient reuse.

The research topics presented in the habilitation thesis are in the areas of engineering and cascading use of wood, circular economy and bioeconomy.

The first chapter includes paradigms for the higher value valorisation of bark-based biomass, a broad theme that has branched out into studies of the various properties and uses of this material.

The first theme (Tudor et al. 2020d) deals with industrial-scale shredding systems for spruce, larch and pine bark; the results were published in the Journal of Cleaner Production (IF=9,927 in 2020). The aim of this research was to determine the most suitable industrial equipment to efficiently shred bark in order to generate particles that in turn serve as feedstock for composite products used for thermal, acoustic insulation (Kristak et al. 2021), decorative tiles, wear layers for flooring (Tudor et al. 2018) or fire-resistant cement-based bioaggregates (Urstöger et al. 2021).

The second and third themes concern the thermophysical and acoustic properties of larch bark composites in which the particles are oriented parallel and perpendicular to the panel plane. The results of the study (Kristak et al. 2021), published in Polymers (IF=4.967, in 2021) showed the significant influence of density, size and orientation of the bark particles on the thermal conductivity of the materials. This topic is the subject of the article (Tudor et al. 2021), published in Polymers.

The fourth theme addresses to what extent spruce bark and larch bioaggregates are suitable for the manufacture of low-density cement-based composites by determining the compatibility between materials (analysing hydration behaviour) and testing compressive strength. The results of the study (Ursöger et al., 2021) were published in *Polymers* (IF=4.967, in 2021).

In the second chapter, an example from the bioeconomy is presented on the valorisation of malt residues from breweries into particleboards and the analysis of the physical, mechanical and structural properties of these materials. The paper (Barbu et al. 2021) was published in *Polymers* (IF=4,967 in 2021).

The third chapter deals with alternative tannin and casein-based adhesives. The results of the first study (Tudor et al. 2020a), published in the *International Journal of Environmental Research and Public Health* (IF=3.39), demonstrate the importance of using sustainable resources (tannin adhesives) in the manufacture of products with a small environmental footprint, aiming for zero net emissions. The use of a protein-based adhesive, namely casein, is the second theme in this chapter, that presents the results of the study concerning glue-laminated timber glued with casein adhesives and pressed with high-frequency equipment. The results of this study (Herzog et al. 2021) were published in *Polymers* (IF=4,967).

The fourth chapter deals with a fast-growing tree from China, naturalised in Europe, namely Paulownia. The physico-mechanical properties of wood from plantations in Spain, Serbia and Bulgaria have been published by (Barbu et al. 2022) in the journal *Forests* (IF=3.282 in 2022). Paulownia wood has a high potential for applications where low material density is required, in modelling and for thermal insulation.

Chapter B-ii presents the progress and career development plans from the professional, scientific and academic point of view. The scientific works coordinated by the author during her activity and the lectures held at Salzburg University of Applied Sciences are listed. Research experience is reflected by the number and type of international projects and publications in which the habilitation candidate was established as a manager, first author, corresponding author or co-author.

Career development plans are focused on maintaining and developing agreements with universities in Europe, Asia and North America, with the main focus that stresses the collaboration between Faculty of Furniture Design and Wood Engineering and Salzburg University of Applied Sciences.

The use of online platforms as MOODLE and MsTeams for the learning environment, communication, evaluation, pools and tests is also one objective that can be successfully integrated in project management for research activities conducted between Romania and Austria. This will lead to the optimization of supervising doctoral theses by facilitating remote communication between tutor/coordinator and student/doctoral candidate. In this way, the supervision of scientific research can be discussed, improved and closely monitored. Project meetings can take place remotely, which saves time and other resources.