Book of Abstracts

COST Action FP1407
Final Conference

LIVING WITH MODIFIED WOOD

Belgrade, Serbia
12-13 December 2018

University of Belgrade – Faculty of Forestry

COST Action FP1407

Understanding wood modification through an integrated scientific and environmental impact approach (ModWoodLife)

Living with modified wood

Final COST Action FP1407 International Conference

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Book of Abstracts

Editors: Goran Milić, Nebojša Todorović, Tanja Palija, Andreja Kutnar

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Lauri Rautkari – Finland
Goran Milić - Serbia

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Local organiser preface

It is both a pleasure and a privilege for the Department of Technologies, Management and Design of Furniture and Wood Products, Faculty of Forestry to host the final conference of COST Action FP1407. This honour has given us an opportunity to establish a more visible position within the European network of wood related institutions.

Wording of the title - “Living with modified wood” - signifies that the time in which we live has provided us with technologies of wood modification that will ensure that never again will this material be regarded as a lesser material with a short life-span. Wood, as one of the rare living materials, is experiencing a worldwide renaissance, one that could not have been considered possible just a generation ago. For these very reasons, the primary goal of this conference is to foster, forge and encourage the cooperation and exchange of ideas between wood modification researchers and experts in related fields and, hopefully, help them grow.

Belgrade, as a city with a long and rather eventful history, is an environment where sparse moments of peace and prosperity have instilled a way of thinking that appreciates the little things in life. This setting emphasises even more the pressing need of the modern age to live more organically, ethically and above all, ecologically – and what better way than living with an organic material such as wood.

Success of this event would not have been possible without the effort of the entire team of my colleagues. I would like to thank them and to express my deepest gratitude to Andreja Kutnar, Chair of COST FP1407, for leading this fantastic Action, and for her continuous help in organising this Final Conference.

Last but not least I would like to thank all of the participants and contributors of the Final COST FP1407 Conference. I wish you to have a memorable time in Belgrade.

So let us look forward to an exciting conference!

Goran Milić

Preface

Welcome to the fourth and final international conference of COST Action FP1407 "Understanding wood modification through an integrated scientific and environmental impact approach" (ModWoodLife). This conference, "Living with modified wood", held in Belgrade, Serbia December 12 and 13, 2018 brings researchers and professionals together to share and disseminate their work. Their research contributes significantly to our Action's objectives. It is especially rewarding too see contributions that have resulted from collaborations developed and strengthened through this network. Since the beginning of the Action in 2015, we have delivered new knowledge in the field of wood modification and environmental impact assessment. We can all be proud that during our Action, the European Union recognized the need to strategically approach activities, research, and policy to reduce climate change. Among the key strategies that were accepted in the past three years are the Circular Economy (2015), the Paris Agreement (2016), the Research and Innovation Roadmap 2050 – A Sustainable and Competitive Future for European Raw Materials (2018), as well as the recently renewed Bioeconomy strategy. Although our Action did not directly contribute to these documents, I am convinced that the activities of our network and its participants accelerated their adoption. At the same time, it is clear that our collaboration must continue after the Action ends on March 9, 2019. Going forward we should jointly contribute to "closing the loop" of product lifecycles through greater recycling and re-use and bring benefits for both the environment and the economy.

I would like to thank you for your great collaboration. Besides the new knowledge we created, our new friendships will continue for many years more!

Wishing you a successful and memorable conference in Belgrade.

Andreja Kutnar
Chair, COST FP1407

Thermo-hydro mechanical densification process of *Nothofagus pumilio* and *Nothofagus antarctica* and the effect of annual width ring on modulus of hardness, and dynamical mechanical properties

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Nothofagus pumilio is the most important native timber species from the southern Patagonia region of Argentina and Chile (Martínez Pastur *et al*. 2000). Since 1990, foresters are managing forests of *N*. *pumilio* to increase their economic value. To increase growth potential in the forests one of the strategies is to sustain even-aged forests, which can lead to better growing conditions (Martínez Pastur *et al*. 2009). However, fast-growing conditions affect the physical/mechanical properties of wood, sometimes negatively. *N. pumilio* (lenga) and *N. antarctica* (ñire) both belong to a group of trees collectively referred to as southern beech. These species typically have an intense red color that is attractive for use in furniture. To expand the range of applications beyond furniture, methods to improve the physical/mechanical properties of southern beech have been investigated. One such method is a densification process that uses a combination of heat and pressure. This technique has been successfully applied to other fast-growing tree species, increasing their mechanical properties (Kutnar *et al*. 2008; Kutnar *et al*. 2015). Schwarzkopf *et al*. (2017) used a similar process to design 3-layer composites from lenga and ñire wood. They evaluated mechanical properties and showed that densification increased modulus of elasticity (MOE), modulus of rupture (MOR), and modulus of hardness (MOH). Based on these results, this study will further investigate and optimize the use of densification with lenga and ñire for in-depth understanding of modification in wood structure. The objective of this study is to apply densification treatments to lenga and ñire assessing key mechanical properties correlated with annual growth ring width.

The approach taken in this study is to apply two densification treatments developed in previous studies and assess: MOH, set-recovery (SR) after submerging and drying cycles and dynamic mechanical properties. These results will then be analyzed with respect to annual growth ring width to assess the effect that the forest management regime had on them.

Samples of lenga and ñire originating from Tierra del Fuego, Argentina were provided by foresters in that region. A total of ninety-six specimens were manufactured with dimensions of 46 mm x 5 mm x 300 mm (width x thickness x length). Before densification, specimens were conditioned at 20°C and 65% relative humidity (RH), weighed, and measured at three locations for the width and thickness. Sections for ring width measurement were cut and measured. The remaining parts of the specimens were densified with a hot-press using two temperatures (160 °C and 170 °C). Thin steel plates (2 mm) were used as

hard stops to achieve a target thickness. Immediately after the densification process was completed, measurements were taken to assess the densification. Additionally, after one week of conditioning, specimens were measured for the last time to assess the spring-back effect. Due to the low thickness of densified specimens, standardized hardness testing is not ideal and MOH will be measured. To achieve this, specimens for MOH will be prepared from four square parts of each board and glued together into 4-layer composites. A Janka imprint ball will then be used to assess MOH. Two specimens from each board were cut for dynamic mechanical analysis with two orientations. Specimens for set recovery test will be used to assess the set-recovery over time exposed to water.

Average annual ring width for ñire and lenga was 2.315 mm and 1.135 mm respectively. On average, specimens from ñire had initial density of 646 kg/m^3 and specimens from lenga 548 kg/m^3. After the densification a density ratio of 1.85 for ñire and 2.12 for lenga was calculated. In general both wood species exhibited higher spring back for densification process using 160 °C as compared to 170 °C.

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