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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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

Experimental and numerical analysis of fracture toughness of thermally modified beech in mode II

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Thermally modified timber (TMT) has been long recognized as an efficient and eco-friendly alternative to tropical species and wood treated by other techniques. Nevertheless, the range of feasible applications for TMT is limited by undesired side effects, such as reduction of mechanical properties including the fracture properties such as energy release rate (Majano-Majano *et al.* 2012). For examination of the fracture properties of wood in shear mode II, there has been developed a unique procedure based on so-called equivalent crack length to obtain fracture energies from global mechanical response (Wang and Qiao 2004, de Moura *et al.* 2006). The procedure is implemented in end-notched tests with three-point bending set-up. Such tests provide R-curves and may also be used to derive cohesive zone models for finite element analyses of fracture problems (Arrese *et al*. 2010). Therefore, this paper aims to evaluate the fracture properties TM beech wood in mode II by coupling three-point bending test and optical technique based on digital image correlation (DIC) and implementing the experimental data into the numerical model for later assessment.

As depicted in Fig. 1 right, the forces and deflections of the non-treated wood samples are greater than the thermally modified specimens. Additionally, the image data from the 3-D DIC provided additional data such as displacement and strains helping in the analysis of the crack development. Fig. 1 left shows distribution of the shear strain (ε_{xy}) at maximal force (at effective strength). We see the highest shear strain is allocated at the crack tip. The crack development is not possible to see by naked eye, but using DIC, we may obtain the opening by listing horizontal displacements below and above the crack. The single-factor Analysis of Variance (ANOVA) on a level of $\alpha = 0.05$ showed that all three groups (reference, modified at 180 °C and 200 °C) differ significantly in terms of maximal strain energy release rate. Further, a numerical model of crack propagation was built based on the experimental data of cohesive law obtained using results from standard testing and

DIC. The numerical model uses special adhesive finite elements that enable to define bi-linear behaviour of crack propagation.

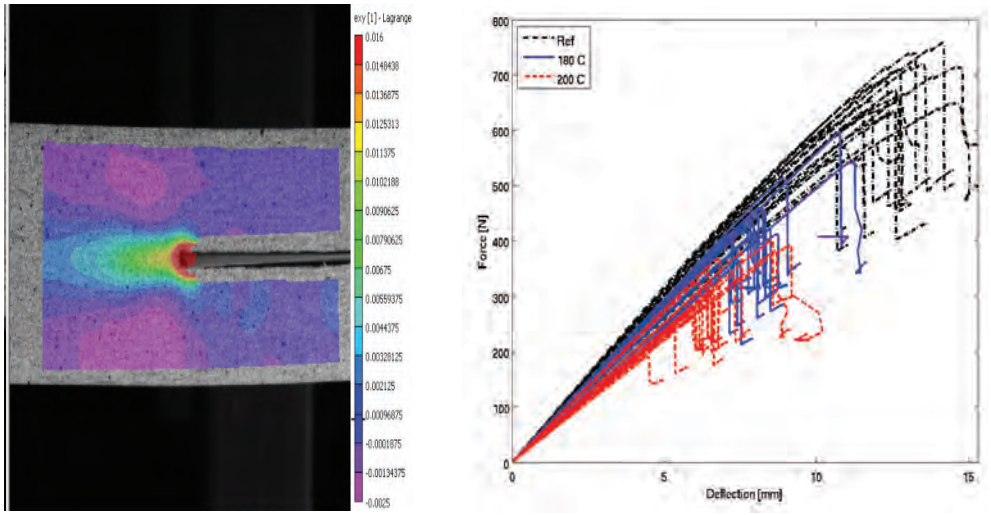

Figure 1: Shear strain at crack tip obtained using DIC (left) and force vs. deflection diagrams for all three tested groups.

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