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Opposition review

on the PhD thesis „Microwave modification of wood " submitted by Ing. Jakub Dömény, the Institute of Wood Science of the Faculty of Forestry and Wood Technology of the Mendel University in Brno.

This review has been elaborated on the written request from the Dean of the Faculty of Forestry and Wood Technology of the Mendel University in Brno Doc. Ing. Radomír Klvač, Ph.D., dated on 19.2. 2016 (Letter No. 3624/2016).

Ing. Jakub Dömény is submitting his thesis as a set of 6 co-authored papers. In five of them, J. Domény is the first author, in one the second author. Four of these papers have already been published in the journal BioResources, indexed in the Current Content, 1 paper in the journal Pro Ligno, and one paper is ready for publication.

The PhD student presents his approach to the problem (MW heating theory and implementation of this heating on wood) on 29 pages of the thesis, involving a comprehensive literature review, research goal specification and short method description. The results obtained are presented in form of the papers mentioned above.

Assessment of the aims – defining and meeting

The goal of the thesis (p. 3) was to enhance the basic understanding of MW heating of wood and to specify suitable methods for wood modification working with MW heating. The particular aims show that the PhD student was focussing on two research subjects:

- Development, analysis and optimisation of various MW treatment techniques
- Study of influence of MW treatment on changes in physical and mechanical properties of wood.

A short description of the methods designed is on the pages 25–29. More details can be found in the particular papers. The methods for experimental verification of the modified wood properties have been chosen correctly.

The goals and aims are adequate for a dissertation thesis. Having studied the papers enclosed, I may declare that these goals and aims have been met in principle.

However, I cannot understand why some experiments were carried out on beech wood only while other ones on spruce or on poplar, Why the same species (a single species or all species) was not used for all experiments? Parallel experiments would provide a better insight into the problem in question.

The PhD thesis results, PhD student´s contribution, and importance of the thesis for practical use and for further research in the given branch

Having read the papers in the thesis we can see that, apart from designing a device for continual wood heating, the PhD student also investigated the influence of MW heating on permeability and impregnability of false heartwood in beech, alteration of mechanical properties of spruce wood induced by MW heating, acetylation of beech and poplar wood and implementation of microwave treatment in beech wood shaping by pressing.

The PhD student presents several interesting results concerning MW heating application for wood. In most cases, his results not only confirm the facts already known from literature, but they represent significant extensions of these facts. The quality of the results obtained is evident: four papers have been published in the journal BioResurses and one in the journal Pro Ligno. The papers discuss pros and cons of microwave heating. My comments are not necessary as the papers had been reviewed prior to the publishing.

The thesis also suggests suitability of continual MW heating in process of wood plasticization as the pre-treatment for shaping by compression. Setting up the optimum parameters for plasticization as pre-treatment for wood shaping by pressing is also very important from the practical viewpoint. The proposed method of continual heating together with specified parameters can also be implemented directly in the production process.

Comments, recommendations and questions

- The term permeability of liquids is not correct. The term axial permeability of wood for liquids is to substitute.
- The declaration that the literature does not provide facts concerning false heartwood permeability in beech does not seem very well founded.
- More correct term for false heartwood in beech is red heartwood. False is the term used for heart attacked by decay.
- The cause of increased permeability of false heartwood after MW heating has not been explained satisfactorily. Considerable reduction of permeability of false heartwood in beech induces creation of tyloses in early wood vessels, principal conductive elements. Did microwave heating impair tyloses or the permeability increased due to micro-cracks probably originated during heating?

- Fig. 1.4 has no description value compared to Fig.1.2 and 1.3. The information in 1.4 can even be confusing for the reader.
- Why the hardness was determined according to Brinell and to according to Janka?
- What do radial and tangential specimens mean? Perhaps the wood pressing direction would be more appropriate.
- The comparison of properties of wood compressed after plasticization by MW heating and conductive heating would be useful.
- Did not you consider using both heating modes in the same plasticization process?
- The list of the references is worthy of respect. Has the PhD student become acquainted with all of them? I ask for a candid answer.
- The quality of the English text in the thesis is considerably below the quality of the English in the papers.

Conclusion

Based on the thorough study and assessment of this PhD thesis, I may recommend this thesis for defence, and, in case of positive result, I recommend awarding Ing. Jakub Dömény with the PhD (Philosophiae Doctor) degree in the branch Wood Processing Technology.

Zvolen, 24. 3. 2014