

Final Cost Action FP0904 Conference Recent Advances in the field of TH and THM Wood Treatment

May 19-21, 2014, Skellefteå, Sweden

The Final International Cost Action Conference was held in Skellefteå, Sweden, from May 19th to May 21st. The conference provided a forum and an opportunity for experts and young researchers from worldwide academia and industry to present their latest research, exchanging and developing new ideas within the field of Thermo-Hydrous (TH) and Thermo-Hydro-Mechanical (THM) wood treatment.

The final International Cost-Action Conference was dedicated to upholding and furthering the objectives and achievements of the previous seminars in the series. Cost-Action has been of particular interest to all people who wished to learn about and discuss the latest developments in Thermo-Hydrous (TH) and Thermo-Hydro-Mechanical (THM) wood treatment by leading researchers and engineers from around the world.

The objectives of this conference have been to present and discuss the state-of-the-art of Thermo-Hydrous (TH) and Thermo-Hydro-Mechanical (THM) wood treatment in open and closed systems and the

challenges faced in wood characterization for scaling-up from laboratory to full industrial production.

The key objective of this Final Action FP0904 Conference has been to present the main results of the Action, to summarise the scientific progress achieved and formulate open questions and further challenges.

The seminar consisted of two and half days of oral and poster presentations, combined with local laboratory tours. The abstracts have been published in the "Book of Abstracts" and are ready for download on conference website.

COST Action FP0904 www.cost-fp0904.ahb.bfh.ch

Thermo-Hydrous (TH) and Thermo-Hydro-Mechanical (THM) treatments are increasing in popularity not only at a research level but also at a commercial level across Europe and worldwide. The range of applications associated with these processing tools is considerable, including heat treatment, welding of wood, wood moulding, densification, bending, profil-



Figure 1. Participants in front of the conference hall

ing, artificial ageing surface densification and composite wood panel construction.

The main topics of the conference were:

- Thermo-Hydro-Mechanical (THM) and Thermo-Hydrous (TH) wood treatment in open and closed systems.
- Innovation and development of new products.
- Improvements in the scaling-up of research findings to full industrial production, and market applications of TH-and THM-treated wood.

The following papers were presented:

Session 1: Chemical degradation of wood under thermo-hydrous treatments

- Callum Hill: Thermally Modified Wood – the Role of Hemicelluloses
- Wim Willems: Characterisation of Thermally Modified Wood by a Novel Means of Moisture Sorption Isotherm Analysis
- Wieslaw Olek, Patrick Perré, Jerzy Weres, Romain Rémond: Water Diffusivity of Thermally Modified Beech Wood
- Michael Altgen, Jukka Ala-Viikari, Timo Tetri, Antti Hukka, Holger Militz: The Impact of Elevated Steam Pressure during the Thermal Modification of Scots Pine and Norway Spruce
- Iris Brémaud, Sandrine Bardet, Joseph Gril, Patrick Perré: Effects of Water Re-Saturation Conditions and Associated Extractives Leaching on Thermal Softening of Wet Wood
- Lukas Brösel, Lothar Clauder, Alexander Pfriem: Flammability Tests on Thermally Modified and Untreated Timber
- Mohamed Tahar Elaieb, Kevin Candelier, Anélie Pettrissans, Stéphane Dumarcay, Philip Gerardin, Mathieu Pettrissans: Chemical Modification during Heat Treatment of Tunisian Soft Wood Species
- Lorenzo Barnini, Giacomo Goli, Marco Fioravanti: Effect of Steam Saturated Atmosphere on Some Physical and Mechanical Properties of Poplar Wood
- Olov Karlsson, Ola Dagbro, Kurt Granlund: Soluble Degradation Products in Thermally Modified Wood
- Maria-Cristina Popescu, Carmen-Mihaela Popescu: An NIR and XPS Study of the Lime Wood Samples Modified for Different Periods at Lower Temperature and Relative Humidity
- M. Hakki Alma, Eyyup Karaogula, Tufan Salanb, Nasir Narlioglu, H. İbrahim Şahinc, Cengiz Güler: Effect of Thermal Treatment on XRD, ATR-FTIR AND SEM Analysis of Several Wood Species

Session 2: Modeling of THM processing and predicting the behavior of THM

- Eiichi Obataya: Recoverable Effects of Heat Treatment
- Sung-Lam Nguyen, Omar Saifouni, Jean-François Destrebecq, Rostand Moutou Pitti: An Incremental Model for Wood Behaviour Including Hydro-Lock Effect
- Andreja Kutnar, Frederick A. Kamke, William Gacitúa: Elastic Cell Wall Modulus and Hardness of S2 Lay-

er and Middle Lamella in Viscoelastic Thermal Compressed Wood

- Giacomo Goli, Bertrand Marcon, Marco Fioravanti: Wood Heat Treatment Modifications: Effects of Initial Moisture and Air Exchange Rate on Kinetic and Final Product Characteristics
- Patrick Perre, Romain Remond: A Comprehensive Dual-Scale Computational Model Able to Simulate the Heat-Treatment of a Thick-Bed of Particles or Boards
- Hassen Riahi, Rostand Moutou Pitti, Frédéric Dubois: Numerical Analysis of Timber Fracture Due to Mechanical and Thermal Loads: an Approach Based on Invariant Integral A
- Hassen Riahi, Rostand Moutou Pitti, Alaa Chateaneuf, Frédéric Dubois: Stochastic Analysis of Mixed Mode Fracture in Timber Material Using Polynomial Chaos Expansion
- Dang Djily, Rostand Moutou Pitti, Evelyne Toussaint, Michel Grédiac: Experimental Evidence of Water Diffusion Gradient in Wood Using the Grid Method
- Emilia-Adela Salca, Salim Hiziroglu: Evaluation of Roughness and Hardness of Heat Treated Wood Species
- Bogdan Bedeleian, Daniela Sova: Influence of Air Parameters on Drying Time and Energy Consumption during Thermo-Hydro Processing of Wood
- Alexey Vorobyev, Nico van Dijk, Ingela Bjurhager, E. Kristofer Gamstedt: Determination of Elastic Behaviour of Precious Samples from Large Wooden Structures of Cultural Heritage Including Screening Potential in Process Treatment
- Cécilia Gauvin, Kaoru Endo, Delphine Jullien, Eiichi Obataya, Joseph Gril: Effect of Hygrothermal Treatments on the Physical Properties of Wood
- Mojgan Vaziri, Sven Berg, Dick Sandberg: Three-Dimensional Finite Element Modelling of Heat Transfer for Linear Friction Welding of Scots Pine

Session 3: Innovation and new products in THM treatments

- Otto Th. Eggert, Solid Wood Bending – a Stunning Production System
- Jörg Wehsener, Jens Hartig, Peer Haller: Investigations on the Recovery Behaviour of Beech (*Fagus sylvatica*) Wood Densified Transverse to the Grain
- Lars Blomqvist, Jimmy Johansson, Dick Sandberg: Modification of Surface Veneer to Reduce Damage in Laminated Veneer Products during Manufacturing
- Róbert Németh, József Ábrahám, Mátyás Báder: Effect of High Temperature Treatment on Selected Properties of Beech, Hornbeam and Turkey Oak Wood
- Alexander Pfriem: Thermally Modified Wood for Use in Musical Instruments – a Review
- Nozomi Takemura, Aoi Hirano, Eiichi Obataya, Koji Adachi: Compressive Elasticity of Compressed Wood and its Application to Flexible Wooden Beam



Figure 2. Poster presentation

Aleš Straže, Miljenko Klarić, Stjepan Pervan, Silvana Prekrat, Željko Gorišek: Accelerated Artificial Ageing of Thermally Treated Ash Wood

Lothar Clauder, Alexander Pfriem: Comparative Durability Tests on TMT Beech – Preliminary Results

Veikko Möttönen, Juhani Marttila, Jukka Antikainen, Henrik Heräjärvi, Erkki Verkasalo: Colour, MOE and MOR of Silver Birch and European Aspen Wood after Compression and Thermal Modification in an Industrial Scale Modification Chamber

Ali Akbar Enayati, Fatemeh Taheri, Razieh Mosayyebi: Effect of Heat Treatment Conditions (Heat-Temperature and Initial (Moisture Content) on the pH Value and Buffer Capacity of Poplar Wood (*Populus Alba*)

Marek Grześkiewicz: Effect of Thermal Modification of Beech Wood on its MOE and other Mechanical Properties

Session 4: Environmental impact assessment of THM products & STSM presentations

Kévin Candelier, Characterization of Physical and Chemical Changes Occurring during Wood Thermal Degradation. Influence of Treatment Intensity, Wood Species and Inert Atmosphere

Michael Burnard, Andreja Kutnar: Restorative Environmental Design: a Design Paradigm for Thermally Modified Wood

José Sánchez del Pulgar, Illaria Santoni, Luca Cappellin, Anrea Romano, Cuccui Ignazia, Franco Biasioli, Ottaviano Allegretti: Rapid Assessment by PTR-ToF-MS of the Effect on Volatile Compound Emission of Different Heat Treatments on Larch and Spruce

Carmen-Mihaela Popescu, Maria-Cristina Popescu, Petronela Gradinariu: Soft and White Rot Degradation Resistance of Thermo-Hydro-Mechanical Processed Hardwood Evaluated by Infrared Spectroscopy

Ekaterina Sidorova, Sheikh A. Ahmed, Diego Elustondo: Wood Thermal-Modification at Luleå University of Technology

Carmen Cristescu, Dick Sandberg: Self-Bonding of Veneers with Heat and Pressure– a Full Scale Test

Nebojša Todorović, Goran Milić, Zdravko Popović: Estimation of Heat-Treated Beech Wood Properties by FT-NIR Spectroscopy: Effect of Radial and Cross Sectional Surface

Jonaz Nilsson, Jimmy Johansson, Dick Sandberg: Densified and Thermally Modified Wood as Outer Layers in Light-Weight panels for Furniture and Joinery

Sandak Jakub, Riggio Mariapaola, Pauliny Dusan, Sandak Anna: Densified Wood as a Resource for Novel Nail-Like Connectors

Wim Willems, Joël Hamada, Mathieu Pétrissans, Philippe Gérardin, Characterization of Thermally Modified Wood by Oxygen Bomb Calorimetry

Mirko Kariz, Manja Kitek Kuzman, Milan Sernek, Mark Hughes, Lauri Rautkari, Frederick A. Kamke, Andreja Kutnar: Influence of Temperature of Thermal Modification on Compressive Densification of Spruce

Lothar Clauder, Alexander Pfriem, Maria Rådemar, Lars Rosell, Marcus Vestergren: Emissions from TMT Products

Kristiina Laine, Lauri Rautkari, Mark Hughes, Kristoffer Segerholm, Magnus Wålinder: Set-Recovery and Micromorphology of Surface Densified Wood

Susanna Källbom, Lauri Rautkari, Magnus Wålinder, Dennis Jones, Kristoffer Segerholm: Water Vapour Sorption Properties and Surface Chemical Analysis of Thermally Modified Wood Particles

Professor Stjepan Pervan, Ph.D.
Associate Professor Silvana Prekrat, Ph.D.