FCBA INSTITUT TECHNOLOGIQUE

FPInnovations FORINTEK

ISCHP09

2nd international scientific conference on hardwood processing

September 28th-29th, 2009

Paris, FRANCE

PROCEEDINGS

ISCHP 09
2nd International Scientific Conference on Hardwood processing

Programme

Monday, September 28

08:30-09:00 Registration

09:00-09:30 **OPENING SESSION**

Daniel Guinard and Frédéric Rouger, FCBA, France

09:30-13:00 SESSION 1 – MARKETS

Moderators: Torsten Lihra and Elisabeth Le Net

09:30-10:15 **Patrick Langbour (Keynote Speaker), CIRAD, France** p. 9
Market trends for tropical woods

10:15-11:00 **William Luppold (Keynote Speaker), USDA Forest Service, USA** p. 10
The North American Hardwood Market: past, present and future

11:00-11:25 **Erkki Verkasalo, METLA The Finnish Forest Research Institute, Finland** p. 11
Potential of European birch species for product development of veneer and plywood - recovery, grades and mechanical properties and future market requirements

11:25-11:45 Coffee break

11:45-12:10 **Bruno Couture, Q-WEB, Canada** p. 12
Wood products Marketing and design in Canada : from humble potato to Gratin Dauphinois

12:10-12:35 **Torsten Lihra, FPInnovations - Forintek, Canada** p. 13
Consumer perception of mass customized furniture

12:35-13:00 **Myriam Drouin, University of Laval, Canada** p. 14
Sources of variability of red heartwood in paper birch (Betula papyrifera Marsh.) wood and its impact on grade recovery and product value

13:00-14:00 Lunch

Monday, September 28

14h00-18h15 SESSION 2 – PRODUCT DEVELOPMENT

Moderators: Rosilei Garcia and Erkki Verkasalo

14:00-14:45 **Jean-Pierre Haluk (Keynote Speaker), ENSAIA, France** *p. 16*
Perfum trees

14:45-15:30 **Les Fils de Georges, France**

15:30-15:55 **Jean-Denis Lanvin, FCBA, France** *p. 17*
Simplified strength properties assessment for tropical hardwoods in view to CE marking

15:55-16:15 *Break*

16:15-16:40 **Alfred Teischinger, BOKU University, Austria** *p. 18*
Customization of parquet production by naturally designed hardwood floors

16:40-17:05 **Pierre Blanchet, FPInnovations, Canada** *p. 19*
OSB panel as substrate for engineered wood flooring

17:05-17:30 **Hermann Pleschberger, Wood K plus, Austria** *p. 20*
Fracture energy along the grain of teakwood under mode I loading after selected drying schedules

17:30-18:15 1st poster session

Christian HANSMANN, Wood K plus, Austria *p. 34*
Small diameter hardwood - New potentials using hardwood with small diameters in forestry and timber industry

Anna Sandak, IVALSA/CNR, Italy *p. 35*
Assessment *of the willow (Salix sp.) clones with near infrared spectroscopy*

Gaetano Castro, CRA-PLF, Italy *p. 36*
Technological characteristics and attitude to plywood production of the wood of six new Poplar clones

Jean-François Bouffard, FPInnovations, Canada *p. 37*
Use of HDF as substrate in floating engineered wood parquet

20:00 *GALA DINNER*

Tuesday, September 29

08:30-13:00 SESSION 3 –PROCESS OPTIMIZATION

Moderators: Pierre Blanchet and Maryse Bigot

08:30-09:15	**Antonio Pizzy (Keynote Speaker), ENSTIB, France** *New joining techniques for hardwood species*	*p. 22*
09:15-10:00	**Attilio Griner (Keynote Speaker), ACIMALL, Italy** *Working centres for the primary and secondary transformation of solid wood*	*p. 23*
10:00-10:25	**Marco Fellin, Universita Degli Stufi di Padova, Italy** *Surface process effect on PVAc glued joints*	*p. 24*
10:25-10:50	**Mariella De La Cruz - Lefevre, FCBA, France** *Reducing shrinkage defaults and/or drying time thanks to oscillating drying conditions*	*p. 25*
10:50-11:15	*Break*	
11:15-11:40	**Rado Gazo, Purdue University, USA** *Hardwood Log CT Scanning - Proof of Concept*	*p. 26*
11:40-12:05	**Veronic Landry, FPInnovations, Canada** *Water-based Nanocrystals cellulose coatings*	*p. 27*
12:05-12:30	**Mathew Leitch, Lakehead University, Canada** *Effect of high temperature on wood properties of canadian boreal hardwood species: case study of black ash from northwestern Ontario*	*p. 28*
12:30-13:00	**Georgina Renée Rodriguez Baca, Canada** *Dowel – welded wood bonding application to Canadian species*	
13:00-14:00	*Lunch*	

Tuesday, September 29

14:00-17:30 SESSION 4 – SUSTAINABLE DEVELOPMENT

Moderator: Gérard Deroubaix

14:00-14:45 **Ed Pepke (Keynote Speaker), UNECE/FAO Timber Section, Switzerland** *p. 30*
Forest certification in the context of sustainable development

14:45-15:30 **Frank Werner (Keynote Speaker), Werner Environment and Development, Switzerland** *p. 31*
Greenhouse gas dynamics of different forest management and wood use scenarios in Switzerland

15:30-15:55 **Eva Haviarova, University of Purdue, USA** *p. 32*
Promoting sustainable forest industry development - forest products web community

15:55-16:15 *Break*

16:15-17:00 2nd poster session

Marco Fellin, Universita Degli Studi di Padova, Italy *p. 38*
Influence of spreading rate and gluing pressure on PVAc glue joints effectiveness

Ignazia Cuccui, IVALSA/CNR, Italy *p. 39*
Mid-Term colour change of finished and non-finished temperate hardwood due to natural and artificial ageing

Andrea R. Proto, IVALSA/CNR, Italy *p. 40*
Dust exposures in the wood processing industry in Northeast Italy

Christian Hansmann, Wood K plus, Austria *p. 41*
Young plantation teak from Costa Rica - Material assessment of young teak grown on reforested fallow pastures

17:00-17:30 **Conclusion and perspectives**

Frédéric Rouger (France)

PARTICIPANTS

PLESCHBERGER Hermann	Wood K Plus	**Austria**
TEISCHINGER Alfred	Boku University	**Austria**
DE MESEL Koen	Belgian Woodforum	**Belgium**
DEFAYS Manu	Belgian Woodforum	**Belgium**
DENEUFBOURG François	Valbois RN	**Belgium**
FRERE Hugues	Houtinfobois	**Belgium**
GARCIA Rosilei	Universidade Federal Rural do Rio de Janeiro	**Brazil**
ARMSTRONG Catriona	Natural Resources Canada	**Canada**
BLANCHET Pierre	FPInnovations	**Canada**
BOUFFARD Jean-François	FPInnovations	**Canada**
COUTURE Bruno	Quebec Wood Export Bureau	**Canada**
DROUIN Myriam	Laval University/Forintek	**Canada**
HERNANDEZ Roger	Centre de recherche sur le bois (CRB)	**Canada**
LANDRY Veronic	FP Innovations/Forintel	**Canada**
LEITCH Mathew	Faculty of Forestry and the Forest Environment	**Canada**
LIHRA Torsten	FPInnovations - Forintek	**Canada**
OUELLET Denis	Natural ressources Canada	**Canada**
RODRIGUEZ BACA Georgina Renée		**Canada**
VERKASALO Erkki	Finnish Forest Research Institute	**Finland**
BIGOT Maryse	FCBA	**France**
CHAROY Pascal	Le Bois International	**France**
COLLET Robert	ARTS	**France**
CROISEL Jean	Conseil Général de Bourgogne	**France**
DE LA CRUZ LEFEVRE Mariella	FCBA	**France**
DEROUBAIX Gérard	FCBA	**France**
HALUK Jean-Pierre	ENSAIA	**France**
JOSLET Jean-Paul	Scieries JOSLET	**France**
LANGBOUR Patrick	CIRAD	**France**
LANVIN Jean-Denis	FCBA	**France**
LE NET Elisabeth	FCBA	**France**
PIZZI Antonio	ENSTIB-LERMAB	**France**
ROUGER Frédéric	FCBA	**France**
ROUX Marie-Lise	FCBA	**France**
VARET Anne	FCBA	**France**
OHNESORGE Denny	University of Freiburg	**Germany**
PAREDES ALVARADO Angela Cristina	Forest Utilization Institute – Univ. of Freiburg	**Germany**
BERTI Stefano	IVALSA/CNR	**Italy**
CUCCUI Ignazia	IVALSA/CNR	**Italy**
FELLIN Marco	Universita Degli Sudi di Padova	**Italy**
GRINER Attilio	ACIMALL	**Italy**
PROTO Andrea R.	IVALSA/CNR	**Italy**
RAVENSHORST Geert	Delf University of Technology	**Netherlands**
PEREZ CAMPOS Mariano	AIDIMA	**Spain**

CHERBUIN Pierre	Etat de Vaud	**Switzerland**
PEPKE Ed	UNECE Trade and Timber Division	**Switzerland**
WERNER Frank	Werner Environment and Development	**Switzerland**
GAZO Rado	Purdue University	**USA**
HAVIAROVA Eva	Purdue University	**USA**
LUPPOLD William	USDA Forest Service	**USA**

SESSION 1

MARKETS

Moderators: Torsten Lihra and Elisabeth Le Net

Tendance du marché pour les forêts tropicales

Dr Patrick LANGBOUR – Dr Jean GERARD

CIRAD / UR Bois tropicaux

Les forêts tropicales occupent près de moitié de la surface forestière mondiale (1,87 milliards d'hectares, FAO 2006) et les principales régions naturelles de production sont le Bassin de l'Amazone, le Bassin du Congo et l'Asie du Sud Est. Les plantations forestières augmentent mais représentent encore moins de 5 % de la surface forestière totale. Ces régions forestières subissent une déforestation importante et régulière sous l'effet de l'exploitation forestière, de la progression des terres agricoles, de la croissance démographique et de l'urbanisation. Compte tenu des enjeux liés à la dégradation de la biodiversité et aux aléas climatiques planétaires, les différents états forestiers concernés et contraints par leur développement spécifique, sont sous la pression internationale d'organisations écologistes, d'institutions financières ou d'exigences réglementaires pour progresser vers la démarche d'aménagement forestier durable, sur la certification et la légalité des bois.
Les bois tropicaux sont essentiellement destinés à l'énergie, contrairement aux bois tempérés valorisés principalement en bois d'industrie ou bois d'œuvre ; ainsi au niveau mondial, au cours de l'année 2006, sur un volume de 1,8 milliard de m3 environ de bois énergie consommé, 72 % était d'origine tropicale et sur un volume de 1,6 milliard de m3 de bois d'industrie et de bois d'œuvre consommés, 19% était constitués de bois tropicaux.
En 2006, les bois tropicaux constituent 10 % de la production mondiale de grumes, 11% de la production mondiale de sciage et 28 % de la production mondiale de contreplaqués.

Pour les grumes tropicales, l'Asie est à la fois le producteur et le consommateur dominant, avec près 60 % des volumes dans les deux cas. Après l'Asie, l'Amérique latine, le Brésil principalement, occupe la deuxième place avec moins de 30% de la production et de la consommation, alors que l'Afrique (14% de la production et 12% de la consommation) exerce une influence encore limitée mais croissante. L'Europe représente 1% de la consommation mondiale de grumes tropicales.
Pour les sciages tropicaux, l'Asie et l'Amérique latine sont les producteurs dominants avec plus de 80 % de la production des sciages, alors que l'Afrique ne produit que 11% du volume. Alors que l'Europe, importateur de grumes, voit sa production de sciages tropicaux diminuer régulièrement pour atteindre 1% de la production, la Chine augmente sa production qui atteint 1,6 % de la production mondiale. La plus grande part de la consommation des sciages tropicaux est le fait des pays producteurs : en 2006, cela représente 43% du volume pour l'Amérique latine, 36% pour l'Asie et 7,5 % pour l'Afrique. La Chine a consommé 7,2 %, l'Europe 5,3% et l'Amérique du Nord 1%. Les producteurs d'Asie du Sud Est destinent leurs exportations de sciages vers plusieurs pays d'Asie (Chine, Japon,….) et vers l'Europe. Les pays producteurs d'Amérique latine (Brésil, Pérou,…) partagent leurs exportations entre l'Europe, l'Amérique du nord et l'Asie. Les producteurs africains dépendent de l'Europe et de plus en plus de la Chine.
Pour les panneaux contreplaqués tropicaux, le continent asiatique est à la fois le producteur et le consommateur essentiel. Il représente 85% de la production et 78 % de la consommation mondiale. L'Amérique latine joue un faible rôle en assurant 11% de la production et 11% de la consommation. Le rôle de l'Afrique est moindre que celui de l'Europe qui réalise 2,4 % de la production et consomme 7,6% alors que la production de l'Afrique est de 2,2% et la consommation de 1,8%.

Par le passé, les pays importateurs achetaient des grumes et du bois ayant subi une transformation primaire (sciages, panneaux) afin de conserver les avantages qu'ils tiraient de la transformation plus poussée (emplois et valeur ajoutée). Ces dernières années, ces flux de produits primaires prennent moins d'importance dans le commerce international ; la tendance est aux échanges de produits issus de la transformation plus poussée (bois profilés, menuiseries et meubles). Les principaux pays producteurs de produits résultant de la transformation plus poussée du bois (Malaisie, Indonésie, Thaïlande, Brésil,…) qui ont des marchés intérieurs relativement demandeurs, ont développé la seconde transformation pour répondre aux marchés internationaux.
Ces dernières années, les principaux pays producteurs d'Asie et d'Amérique latine ont modifiés leurs exportations et aujourd'hui exportent davantage de meubles que de menuiseries ou de bois profilés. Par ailleurs, l'industrialisation de l'Afrique est décalée par rapport aux autres régions tropicales et les principales exportations de produits transformés concernent des bois profilés.
Enfin, les pays producteurs les plus performants qui sont en général des pays en développement réussissent à participer plus largement au commerce international aux dépends des nations industrialisées européennes comme la France.

The North American Hardwood Market: Past, Present, and Future

William Luppold[1]

1. Economist, U.S. Forest Service, Northern Research Station, 241 Mercer Springs Road, Princeton, West Virginia 24740

The North American market for hardwood products has been in a state of evolution during the past 30 years and will continue to evolve over the next several decades. The changes in hardwood markets are perhaps best exemplified by the changes in the eastern U.S. hardwood lumber industry. In 1977, wood household furniture manufacturers consumed 35 percent more lumber than the wood flooring, kitchen cabinet, and millwork industries combined. During this year U.S. hardwood lumber production approached 20 million cubic meters (MCM) and Canadian production was approximately an additional 1 MCM. With the exception of a few mills in Canada and the southern United States, hardwood lumber was manufactured by small mills with an annual production of less than 12,000 cubic meters (CM). U.S. hardwood consumption peaked in the late 1990s and hardwood lumber production peaked at 29.6 MCM in 1999. In 2008, hardwood lumber consumption by the flooring, kitchen cabinet, and millwork industries was equal to or greater than the amount used by the wood household furniture industry. During this year U.S. hardwood lumber production was 21.7 million MCM and Canadian production was an additional 1.1 MCM. The majority of this lumber was produced by mills with capacities exceeding 12,000 CM. To remain competitive in global markets, North American secondary hardwood processors will have to foster more direct connections with the consumers, and will become increasingly reliant on just-in-time delivery to manufacture semi-custom and custom products.

Potential of European Birch Species for Product Development of Veneer and Plywood – Recovery, Grades and Mechanical Properties and Future Market Requirements

Erkki Verkasalo, Henrik Heräjärvi

METLA The Finnish Forest Research Institute, Joensuu Research Unit, Finland

Potential of product development for veneer and plywood products is reviewed for European silver birch (*Betula pendula* Roth.) and white birch (*Betula pubescens* Ehrh.). The review is based on selected empirical results from three large projects of the Finnish Forest Research Institute on the properties of birch wood materials and value of products, and putting them in proportion to the perspectives of future product segments, selection criteria among customers and log supply.
The empirical results cover:
1) volumetric yield, visual grades and commercial value of veneers from experimental rotary cutting from timber stands of silver birch and white birch,
2) with the reference of logs of planted silver birch from Finland and both species from north-western Russia,
3) static bending properties and Brinell hardness of wood from logs of silver birch and white at different sites and age classes in Finland.
The perspectives of product markets are evaluated based on focused discussions with experts from Finnish veneer and plywood industries and complementary knowledge from recent scientific literature.

Wood Products Marketing and Design in Canada:

From Humble Potato to Gratin Dauphinois

Bruno Couture[1] *and RyoichiTakahashi*[2]

The hardwood industry could be characterized as conservative. Over the years, international exports by the Quebec Wood Export Bureau have been B2B (Business to Business). It conducted an experiment to promote hardwood products to a new clientele: designers, architects and other contract givers. (www.canadahardwoods.com)

[1] *The co-author is the Hardwood and Flooring sector manager from the Quebec Wood Export Bureau, Quebec, Canada, bcouture@quebecwoodexport.com.*
[2] *The co-author is the Japanese office manager for the Quebec Wood Export Bureau*
Thanks to CANADA WOOD for financial subsidiary.

Consumer perception of mass customized furniture

Torsten Lihra[1] and Urs Buehlmann[2]

1. *FPInnovations-Forintek, Québec, Canada*
2. *Virginia Tech, VA, USA*

The North American furniture industry is facing critical challenges to stay competitive. Product differentiation through mass customization has been identified as a potentially profitable strategy. A survey has been conducted in the North-Eastern U.S. to assess the importance consumers assign to seven ways to customize their furniture. Results showed that customization is important to certain consumer segments and colour choice was the most highly ranked option when purchasing bedroom furniture.

Sources of variability of red heartwood in paper birch (Betula papyrifera Marsh.) wood and its impact on grade recovery and lumber value.

Myriam Drouin[1], Robert Beauregard[1] et Isabelle Duchesne[2]

1. Centre de recherche sur le bois, Université Laval, Québec

2. FPInnovations - Division Forintek, Québec

Paper birch (*Betula papyrifera* Marsh.) as is an interesting alternative to the high-value species traditionally used by the Québec hardwood sawmilling industry. Its pale and homogeneous sapwood is appreciated for many indoor uses. However, paper birches grow a false heartwood, also called discolored wood or red heartwood, contrasting in coloration with the surrounding sapwood. The objective of this study was firstly to analyse the distribution of discolored wood at the stem and at the log levels. Tree age, tree dimension (DBH), tree vigor, log height class and log quality class were examined as explicative variables affecting the proportion of discolored wood in paper birch boards. Secondly, the impact of this color variability on grade recovery and lumber value was assessed. Results show that tree diameter and tree vigor were statistically found to influence the proportion of discolored wood; larger and less vigorous trees presented more discoloration on their boards. Tree age influence was not strong enough to impact directly the proportion of discolored wood; its influence was indirect through tree diameter. Neither log height class nor log quality class had a significant impact on red heartwood presence in boards. Results showed that tree diameter was the most important variable affecting board quality; larger trees were associated with higher board quality. Concerning board value, once again tree diameter was an important variable but also tree vigor. It was found that most vigorous trees produced higher board values with an average of 316.62 $/m³, middle vigor classes showed averages of 218.28$/m³ and 251.84 $/m³ while the less vigorous trees had the lowest average with 165.94$/m³. When selected for color, the majority of the board surface area fell under the sap category (50%), while 28 % were classified as regular presenting simultaneously both colorations and finally only 4% of the board area was classified as red. It was found that the most important variable affecting this board color distribution was mostly tree diameter whereas tree vigor and tree age had also a significant but lesser impact. In general, older, larger and less vigorous trees tend to present higher proportions of boards classified in the red category and less boards in the sap category. Finally the results obtained in this study are favoring longer harvesting rotations in order to produce large trees that can be transformed in higher value and quality boards but at the same time these same trees will also produce higher proportions of discolored wood in their boards.

SESSION 2

PRODUCT DEVELOPMENT

Moderators: Rosieli Garcia and Erkki Verkasalo

Les arbres à parfums

HALUK[1] Jean Pierre

[1]Laboratoire de Biochimie Appliquée

Ecole Nationale Supérieure d'Agronomie et des Industries Alimentaires (ENSAIA)

NANCY (France)

Les constituants chimiques responsables de l'odeur du bois (et de ses organes constitutifs) sont des composés volatils classés en deux catégories : les terpénoides (monoterpènes à 10 atomes de carbone et sesquiterpènes à 15 atomes de carbone) et les composés aromatiques et phénoliques en C_6-C_1 et C_6-C_3 (phénylpropanoïdes ou cinnamiques).

Les substances odorantes du bois considérées comme des extraits ou métabolites secondaires formés par des mécanismes biosynthétiques spécifiques des espèces, comme pour les substances colorantes.

Leur extraction peut être effectuée par distillation à la vapeur d'eau (huiles essentielles = HE) ou par extraction avec des solvants polaires (concrètes, résinoides, absolus). On peut observer que des quantités non négligeables d'HE sont libérées lorsque l'arbre sur pied est blessé, ce qui permet de suggérer que ces HE doivent protéger l'arbre de sa biodégradabilité et de l'attaque par les insectes (actions « imperméabilisante »). L'extraction au CO_2 supercritique est parfois utilisée mais souvent accompagnée d'une modification de l'odeur initiale, non applicable en parfumerie.

Après l'abattage, le bois frais a une odeur caractéristique qui diminue avec le temps. Cependant, certaines espèces forestières retiennent l'odeur plus longtemps, ce qui leur confère une certaine valeur ajoutée. L'odeur du bois peut être utilisée pour l'identification de certaines espèces. Outre le bois, d'autres parties de l'arbre sont concernées par l'odeur (écorces, aiguilles, feuilles, rameaux, fleurs, fruits, gommes-résines).

Les odeurs des arbres feuillus sont plus variées que celles des conifères et ce sont surtout les bois des zones tropicales qui sont les plus riches en constituants odorants (santal, cannelier, liquidambar, …).

Il est important de préciser que le parfum « produit final commercial » résulte de l'alchimie étonnante de diverses molécules odorantes d'origine naturelle et synthétique. Il revient au créateur-parfumeur d'harmonier toutes les senteurs (rassemblées dans l'orgue à parfums) en accords olfactifs qui s'épanouiront dans une création unique et originale avec ses trois notes caractéristituqes (tête, cœur et fond ou sillage).

Enfin, l'aromathérapie est un autre domaine concerné par les HE en raison de leurs propriétés antiseptiques, antifongiques, antibactériennes et même antivirales (trois méthodes d'utilisation : orale, aérienne et cutanée).

Simplified strength properties assessment for tropical hardwoods in view to CE marking

Jean-Denis Lanvin[1] ; Didier Reuling[1] ; Frédéric Rouger[1],

Jan-Willem van de Kuile [2] ; Geert Ravenshorst[2]

Gregory Reinbol [3]; Hervé Bourguignon[3]

Jean Gérar [4]; Daniel Guibal[4]; Michel Verna [4]

Eric Boilley[5],

1. FCBA, Allée de Boutaut, BP 227, 33028 Bordeaux Cedex, France

2. TU Delft, Stevinweg 1 2628 CN Delft, PO Box 5048, 2600 GA Delft, The Netherlands

3. ATIBT – IFIA, 6 Av de St Mandé, 75012 Paris, France

4. CIRAD PERSYST, 73 rue JF Breton, 34398 Montpellier Cedex , France

5. Le Commerce du Bois, 6 Av de St Mandé, 75012 Paris, France

Strength properties link to visual grading rules specified in national standards (NF B 52-001, BS 5756 and NPR 5493) are currently available for 36 tropical hardwood species which can be used in construction. As experiments can not be done for all tropical hardwood species in due time of CE marking which will be effective in the EEC market, simplified rules given in EN 384 have been used to derive strength properties for a certain amount of other tropical hardwood species of moderate use. They are based on bending tests on small clear specimens and on full size specimens. That relationship has been applied to the one hundred selected species allowing their strength properties to be assessed. In addition, a simplified grading visual rule is proposed. At the moment of writing, results are under review by the CEN TC 124/TG1 in order to get the strength class assignment approval.

Customization of parquet production by naturally designed hardwood floors

Alfred Teischinger[1], Manfred Gronalt[2]

1- Institute of Wood Science and Technology, Department of Material Science and Process Engineering, University of Natural Resources and Applied Life Science, BOKU Vienna, Peter Jordan Strasse 82, 1190 Vienna, Austria

[2] - Institute of Production and Logistics, Department of Economics and Social Sciences, University of Natural Resources and Applied Life Science, BOKU Vienna, Feistmantelstrasse 4, 1180 Vienna, Austria

The current appearance grading system of hardwood does not meet the specific demands for the appearance of the wood in the final products such as parquet floors or furniture. The standards are aimed at reducing the number of characteristics which define the various grading classes with regard to appearance. The “customized wood design of parquet floors” aims at the transfer of natural patterns of wood into the final product by involving the customer in the design process. Natural patterns and features which would not be used in a standard driven production process shall be allowed. Within the production process parquet lamellas with various features are to be arranged in a way so that certain, individually designed patterns are achieved. The target and advantage of the system is the higher added value of a low grade material and probably fewer complaints about defects of the final product by the customer.

OSB panel as substrate for engineered wood flooring

Pierre Blanchet[1,2], Costel Barbuta[1] , Alain Cloutier[1], Vikram Yadama[3], Eini Lowell[4]

1. Université Laval, Québec, Qc, Canada, G1V 0A6
2. FPInnovations, Québec, Qc, Canada, G1P 4R4
3. Washington State University, Pullman, WA, 99164, USA
4. USDA Forest Service, Pacific Northwest Research Station, Portland, OR 97205, USA

The purpose of this study was to develop a special oriented strands board (OSB) formulation to be used as a substrate for engineered wood flooring (EWF).Three-layers oriented strands boards were manufactured from two types of strands: a mixture of 90% aspen (*Populus tremuloides*) and 10% paper birch (*Betula papyrifera*), and 100% of ponderosa pine (*Pinus ponderosa*). The parallel modulus of elasticity (MOE) for both types of specialty OSB was 8192 MPa (aspen/birch OSB) and 9049 MPa (pine ponderosa OSB), comparatively to the 11395 MPa minimum requirement of *Handbook of Finnish Plywood* for birch plywood, a product widely used in EWF. Prototypes of EWF were made using five types of substrates: Baltic plywood, sheathing OSB, web stock OSB and the two prototypes of specialty OSB panels. The tests in conditioning rooms showed that the Baltic birch plywood (BBP) core constructions present the lowest distortion between humid and dry conditions. There were no significant differences in the distortion measured for BBP and aspen/birch OSB substrates. The construction with OSB sheathing, OSB web stock and ponderosa pine OSB substrates showed the greatest distortion. The results of this study demonstrate the possibility to use the OSB panels as EWF substrate.

Fracture energy along the grain of teakwood under mode I loading after selected drying schedules

Hermann Pleschberger[1,], Christian Hansmann[1], Ulrich Müller[1], Jürgen Follrich[1], Stephan Frybort[1], Laura Oltean[2], Alfred Teischinger[1,2]*

[1]Wood K plus - Competence Centre for Wood Composites and Wood Chemistry, St. Peter Strasse 25, 4021-Linz, Austria

[2]Institute of Wood Science and Technology, Department of Material Science and Process Engineering, University of Natural Resources and Applied Life Science, Vienna, Peter Jordan Strasse 82, 1190 Vienna, Austria

** Corresponding author: h.pleschberger@kplus-wood.at*

Fracture energy characterization and measurements along the grain particularly in the crack propagation systems RL (radial/longitudinal) and TL (tangential/longitudinal) under mode I loading of plantation teakwood (*Tectona grandis* L.) from Costa Rica were investigated in this study. Furthermore two different drying schedules, a constant and an alternating climate and their effects on the mechanical behaviour of solid teakwood have been studied. The load-displacement curves of double cantilever beam (DCB) were obtained from the fracture energy tests in order to compare the corresponding values of each drying schedule. The results of the present research work show that a severe seasoning technique has a statistically significant influence on the mechanical properties of teakwood, especially the fracture energy (G_f) and the maximum breaking load (F_{max}) in both crack propagations.

SESSION 3

PROCESS OPTIMIZATION

Moderators: Pierre Blanchet and Maryse Bigot

New joining techniques for hardwood species

A.Pizzi

ENSTIB-LERMAB, Nancy Universités, Epinal, France

The joining techniques for hardwoods have progressed and continue to progress towards the increasing use of binders more friendly towards the environment, either less expensive or of improved performance up to the total elimination of gluing by the new technique of wood friction welding. After a brief overview of the resins used to-day for the structural gluing of timber, such as resorcinol resin of ever decreasing resoprcinol content, fast-setting separate application "honeymoon" adhesives based either on melamine or on resorcinol and one component polyurethanes, wood welding without adhesives will be the most important objective of the presentation. The two types of wood welding in operation, namely linear vibration welding and rotational dowel welding, will both be presented with the structural assemblies already achieved. These structures contain 100% wood , thus they are totally natural. The limitations, advantages and disadvantages of such a joining system will be discussed and compared to joining by gluing.

Working centres for the primary and secondary transformation of solid wood

Attilio Griner

ACIMALL (Italian woodworking machinery and tool association)

Just no more than twenty years have passed since the introduction of electronics in woodworking industry, with the first NC milling machines and point-to-point machines, but now working centres are dominating.

This applies not only to any piece of solid wood for furniture, chairs, doors and windows, construction elements and panels with any cutting, profiling, drilling pattern and maybe edgebanding and hardware inserting, but also starting from a large panel and using the nesting technique to all the elements of a piece of furniture made in one single cycle.

The templates, counter-templates and dusty warehouses of semi-finished products have been cast into oblivion: in the data storage devices of working centers maybe remote there are all machining programs that can be retrieved in any moment to produce a specific piece exactly as you need it and when you need it.

Surface process effect on PVAc glued joints

Marco Fellin[1], Roger E. Hernández[2], Martino Negri[3]

[1] Università degli Studi di Padova, Facoltà di Agraria, Padova (PD), Italy – marco.fellin@libero.it

[2] CRB Centre de Recherche sur le Bois, Université Laval, Québec, Canada - roger.hernandez@sbf.ulaval.ca

[3] IVALSA/CNR Trees and Timber Institute, San Michele all'Adige (TN), Italy – negri@ivalsa.cnr.it

The changes in glueline shear strength on sugar maple, American beech, paper birch wood bonded with polyvinyl acetate (PVAc) adhesive were evaluated. The wood species had different surface properties as the result of across and along to the grain helical planing and sanding with three grit size sandpapers (g.s.p.). The specimens prepared to determine the effect of the variables on bond performance were subjected to shear test in an universal test machine. Surface roughness and wetting properties of wood were measured; microscopic analysis allowed to reveal damages on wood surface. Sugar maple specimens were also subjected to an accelerated aging treatment. The most effective surfacing methods were the helical planing process along and across the grain and sanding process with 150 g.s.p., all able to obtain the best surface for gluing, reaching a peak stress of 22,5 N/mm^2.

Among the different species studied, sugar maple gave the best gluing performance, followed by American beech, and paper birch. Sanding with 60 and 100 g.s.p. produced the roughest surfaces, showing compressed parenchyma rays and torn fibres. Among the studied species paper birch showed the roughest surfaces followed by American beech and sugar maple. Sugar maple sanded with 100 g.s.p. had the highest contact and equilibrium angles, sugar maple sanded with 120 g.s.p. had the lowest.

Reducing shrinkage defaults and/or drying time thanks to oscillating drying conditions

Mariella De La Cruz – Lefevre[1,2,3], Daniel Aleon[1], Romain Rémond[2,3], Patrick Perré[2,3]

1 - Institut Technologique FCBA 10 Avenue de Saint Mandé 75012 Paris, France

2 - AgroParisTech, ENGREF, UMR 1092, LERFoB, Bois Biomatériau Biomasse Team 14 rue Girardet F-54052 Nancy Cedex, France

3 - INRA, UMR 1092, LERFoB, Bois Biomatériau Biomasse Team 14 rue Girardet F-54052 Nancy Cedex, France

Wood drying is an essential process in wood industry. During drying, the stress field developed in the boards can produce several defaults such as deformations and cracks. The main objective of this work is to assess the potential of oscillating drying conditions to reduce the stress level through the activation of mechanosorption. With the oscillation of the equilibrium moisture content in the peripheral part of the board, mechanosorptive creep is activated continously during the process. Beech wood, the second kiln dried hardwood after oak in France, has been chosen for this study. Beech wood has elevated shrinkage coefficients and thus an elevated risk of drying defaults. In this paper, we present some results concerning the use of oscillating drying conditions on the quality of the dried wood, specially its effect on case-hardening. Matched boards were kiln dried following a conventional schedule and two different oscillating schedules. The final moisture content, its distribution, the deformations and the residual stresses (casehardening) were measured. Our results prove that oscillating drying schedules are able to reduce significantly the internal stresses. Therefore, oscillating schedules seemed to be an interesting option to improve the quality of kiln dried wood. Notice that such schedules can be applied to conventional kilns with little modifications.

This research is developed in partnership between a fondamental public research laboratory, LERFoB – Bois Biomatériau Biomasse Team, and Institut Technologique FCBA. The association of fondamental and applied research allows both a better understanding of the wood mechanosorptive behaviour and the improvement of wood drying.

Keywords: wood kiln drying, oscillating conditions, drying stresses, slicing test, case - hardening

Hardwood Log CT Scanning - Proof of Concept

Sun Joseph Chang, Professor

School of Renewable Natural Resources

Louisiana State University Agricultural Center

Baton Rouge, LA 70803

and

Rado Gazo, Professor

Department of Forestry and Natural Resources

175 Marsteller Street

West Lafayette, IN 47907-2083

Tel: 765-494-3634

e-mail: gazo@purdue.edu

Sixty logs were specifically selected to include 12 logs per species of Black Cherry, Yellow Poplar, Red Oak, White Oak and Hard Maple. Groups of 12 included four logs per each of three log grades. The four logs per log grade per species were selected to make two pairs – pair being a close match in diameter, length, location within a tree and defects. Logs were 10’ to 16’ long and up to 16” in diameter.

All logs were scanned using a CT x-ray scanner. TOPSAW program was used to find sawing solutions for half of the logs (one of each matching pair). A sawing study was conducted where half the logs were processed into 4/4 lumber using the TOPSAW sawing solution and the other half was processed using normal mill practices. The scanning and sawing process as well as limited evaluation of collected data will be presented. To our knowledge, this is the largest study of full-size hardwood logs to date.

Water-based Nanocrystals Cellulose Coatings

Véronic Landry[1], Pierre Blanchet[1,2]

1. FPInnovations Forintek Division
2. Centre de recherche sur le bois, Université Laval

For the last few years, nanocrystal cellulose (NCC) has been one of the major research areas in the wood industry. NCC-based nanocomposites show a great potential for many industrial sectors such as coating. In this project, powder NCC was dispersed at four different loadings (1, 2.5 and 3.5%wt and 5 %wt) into two waterborne coatings: an acrylic lacquer and a UV waterborne varnish. Acrylic lacquers are used for kitchen cabinets, furniture, as well as for architectural coatings. UV waterborne coatings show good potential for the factory finished wood market. This project was launched to determine if NCC can improve the properties of these systems and how it can improve it.

Following the dispersion of NCC into the different coating systems, mechanical and optical testing was performed. Mechanical properties such as adhesion, hardness and abrasion, mar and impact resistance were studied. These experiments revealed that NCC can improve mechanical properties. Optimum NCC loading was determined for each property. Optical properties such as color, gloss and opacity were also assessed. This project revealed that NCC could be used as a matting agent. Gloss decrease of more than 50 %wt was obtained for a 5 %wt formulation. Opacity and color also change slightly with the addition of NCC. Contact angle measurements of the different nanocomposite formulations were also performed on yellow birch. These tests revealed that hydrophilic NCC could improve the wetting of the different coating systems.

As any other filler or reinforcing agents, NCC changes the curing efficiency of UV varnishes. Curing of UV waterbased nanocomposites was followed by photo-calorimetry. These experiments showed that a small amount of NCC can speed up the curing reaction. The extent of cure also increased slightly at low NCC loading.

Finally, microscopic experiments (optical and atomic force microscopy) were also performed in order to support mechanical, optical and wetting properties found for the different formulations.

Effect of High Temperature on Wood Properties of Canadian Boreal Hardwood Species: Case Study of Black Ash from northwestern Ontario

Mathew Leitch[a] and Chander Shahi[b]

[a] Associate Professor, [b] Assistant Professor

Faculty of Forestry and the Forest Environment, Lakehead University

955 Oliver Road, Thunder Bay, Ontario P7B 5E1

Thermally modifying wood originated in the early 1990's in Finland. The process involves cooking wood at high temperatures for relatively short durations. The end result is an aesthetically pleasing wood with much better properties. The objective of this paper is to present results on the effect of Thermowood treatment on physical, mechanical, and thermal properties of a Canadian Boreal hardwood species. Defect-free samples of Thermowood black ash (*Fraxinus nigra* Marsh.) were collected following runs in a new high temperature kiln system being developed in northwestern Ontario, Canada by Superior Thermowood®. As an under-valued and under-utilized tree in Canada, this species was selected as one, which could benefit from a new high temperature kiln process. During the high temperature runs (200°C wood temperature), the wood deepened in color from a light brown to a darker brown similar to that of walnut wood and displayed an increase in hardness compared to the controls as well as the published values for this species. Using the Janka Ball Hardness test, thermally modified black ash displayed average hardness values of 5670N at 8% moisture content (MC), which were 31% greater than the controls (3965N) and 33% greater than published values (3800N at 12% MC). When values were corrected to 12% MC, the thermally modified black ash displayed an average hardness value of 3968N while the controls were 2816N. Compared to the published values the thermally modified black ash corrected to 12% MC is still slightly higher in hardness than the published values for the species and well above the locally grown species values. Hardness values for control black ash samples from northern Ontario were around 6% greater than the average published values. Microscopy confirmed the modifications to the cell wall structure as being densified, which lead to a side study to test the British Thermal Unit (BTU) output of Thermowood waste on a bomb calorimeter. It was realized that the BTU output of controls materials was 4600 calories /gram while the high temperature Thermowood run (230°C) resulted in a BTU output of 5000 calories/gram. With an improvement in the woods aesthetic appearance combined with the slight increase in hardness and thermal output, this species is well suited to be utilized in high-value markets including flooring and fine furniture with the waste stream displaying opportunities in the pellet industry as an additive. A brief market study of the flooring industry was conducted to recognize the potential of products such as Superior Thermowood Black Ash flooring in the market place.

Keywords: thermally modified wood, Janka Ball Hardness Test, BTU, under-valued and -utilized species, value-adding, black ash, Boreal hardwoods.

SESSION 4

SUSTAINABLE DEVELOPMENT

Moderator: Gérard Deroubaix

Forest Certification in the Context of Sustainable Development

Ed Pepke[1], Tapani Pahkasalo[2] and Rune Juelsborg Karsten[3]

1. Dr. Ed Pepke, Forest Products Marketing Specialist, UNECE/FAO Timber Section, Geneva, Switzerland

2. Mr. Tapani Pahkasalo, Forest Economist, Indufor Oy, Helsinki, Finland

3. Mr. Rune J. Karsten, Masters Student, University of Bangor, Wales, UK

Sustainable development of the entire forest sector begins in the forest and continues until wood and paper products complete their life cycle. Sustainable forest management has been practiced for centuries in some countries, as it is essential to maintaining a constant stream of forest products, including non-wood forest products, to meet the ever-growing demands of society. On the other side of the sector, sustainable forest products markets are essential to maintain a demand and value for the forest's products and services. Certification of sustainable forest management is one means to assure that harvests are continually conducted in an environmentally, socially and economically sustainable manner. Sustainable development of the forest sector is not practiced globally, which leads to the necessity of having objective communication channels between producers and consumers about the source and production of their wood and paper products. Certification is a means to communicate to the markets about good harvesting, production and marketing practices which build consumer confidence in buying and using hardwoods and the many products derived from them.

Greenhouse gas dynamics of different forest management and wood use scenarios in Switzerland

Frank Werner[1], Ruedi Taverna[2], Peter Hofer[2], Edgar Kaufmann[3], Esther Thürig

1. Dr Werner Environment & Development, Waffenplatzstrasse 89, CH-8002 Zurich
2. GEO Partner AG, Baumackerstrasse 24, CH-8050 Zurich
3. Swiss Federal Research Institute WSL, Zürcherstrasse 111, CH-8903, Birmensdorf

An increased use of wood products and an adequate management of forests can help to mitigate climate change. However, planning horizons and response time to management actions in forestry are usually long and the respective GHG effects related to the use of wood depend on the availability of wood. Therefore, an integral long-term strategic approach is required to formulate the most effective forest and wood management strategies for the mitigation of climate change.

The greenhouse gas (GHG) dynamics related to the production, use and disposal of wood products are manifold and show a complex time pattern. On the one hand, wood products can be considered as a carbon pool, as is the forest itself. On the other hand, an increased use of wood – though related to fossil fuel emissions from the production of wood products – can lead to the substitution of usually more energy-intense materials and to the substitution of fossil fuels when the thermal energy of wood is recovered. Country-specific import/export flows of wood products and their alternative products as well as their processing stage have to be considered if substitution effects are accounted for on a national basis.

We will present an integral model-based approach to evaluate the GHG impacts of various forest management and wood use scenarios, with the following key characteristics: 1) combined consideration of climate relevant aspects of forestry and the use and disposal of wood; 2) consideration of pool effects in buildings and all possible energetic and material-related substitution effects related to the use of wood; 3) consideration of material substitution effects on a building products level based on a potential analysis; 4) use of scientifically based independently compiled life cycle assessment data for all products; 5) current practice assumptions on substituting products; 6) consideration of all carbon pools in the forest, including soil organic carbon; 7) spatial distinction of GHG effects occurring within the country and abroad, taking into account the foreign trade balance; 8) calibration of the model with data sets for the wood pool in buildings since 1900; 9) adaptability of the models and data to other countries.

Our approach allows us to understand the complex temporal and spatial GHG emission and removal patterns including trade-offs of different forest management and wood use strategies. The following recommendations have been developed on the basis of our models in order to optimize the contributions of the forestry and timber sector to mitigate climate change: (1) the maximum possible, sustainable increment should be generated in the forest; (2) this increment should be harvested continuously; (3) the harvested wood should be processed in accordance with the principle of cascade use, i.e. first be used as a material as long as possible (4) waste wood that is not suitable for further use should be used to generate energy.

Literature

Taverna, R., P. Hofer, F. Werner, E. Kaufmann and E. Thürig. 2007. CO_2 Effects of the Swiss Forestry and Timber Industry. Environmental Studies No 0739, Federal Office for the Environment (BAFU), Bern.

Werner, F., R. Taverna, P. Hofer, E. Kaufmann and E. Thürig. 2009. National and global greenhouse gas dynamics of different forest management and wood use scenarios: a model-based assessment. Environmental Science & Policy, submitted.

Promoting Sustainable Forest Industry Development - Forest Products Web Community

Eva Haviarova

Assistant Professor

FNR, Purdue University

West Lafayette, Indiana

ehaviar@purdue.edu

Currently, Indiana ranks first in the US in production of wood office furniture and manufactured homes, second in production of hardwood veneer and plywood, and third in production of wood kitchen cabinets. However, the US furniture industry is at a competitive disadvantage due to lower labor costs for manufacturing in other countries. To prosper, all domestic production segments from material through the manufacturing process to the finished product must be well organized and interconnected. To facilitate organization and connectivity, a networking tool for the forest products industry was created and an Indiana-wide network (web-based community) was formed for an industry that creates $17 billion in value-added for the state. The network provides Indiana industries with a competitive advantage over similar industries in other states and countries. This website facilitates forest sector economic development in the state of Indiana. The *Forest Products Web Community (FPWC)* (http://www.indianaforestproducts.com) includes a directory of Indiana companies that manufacture wood products, showroom, mapping capabilities, knowledge information, lings to associations and business development information. Wood products buyers anywhere in the world are able to search and interact online with Indiana manufacturers that meet their unique purchase needs. It allows small, rural companies to have the same exposure and marketing opportunities as large companies. Indiana manufacturers can also use the *FPWC* to search for nearby raw materials and equipment suppliers to support their companies. Links in each section lead *FPWC* members and visitors to additional information.

ISCHP 09
2nd International Scientific Conference on Hardwood processing

POSTERS

Small Diameter Hardwood – New potentials using hardwood with small diameters in forestry and timber industry

Christian Hansmann [1], Alfred Teischinger [1, 2]

[1] Wood K plus - Competence Centre for Wood Composites and Wood Chemistry, St. Peter Strasse 25, 4021 Linz, Austria

[2] Institute of Wood Science and Technology, Department of Material Sciences and Process Engineering, University of Natural Resources and Applied Life Sciences, Vienna, Peter Jordan Strasse 82, 1190 Vienna, Austria

Recently, the planting and the natural regeneration of hardwoods was forced by Austrian forestry. Consequently, the amount of accessible hardwoods has been growing in the concerned region. Despite the increasing availability of hardwoods, important thinning activities can not be done adequately due to missing utilisation concepts for hardwoods with low diameters. Therefore an interdisciplinary project along the whole forestry-wood chain was launched together with industrial partners. The potentials apart from energy production and industrial roundwood for pulp, paper and panel industry of hardwoods with low diameters shall be highlighted along the production chain from forest to wood processing industry. On the one hand side, this should lead to enhanced proceeds for the forest owners and consequently to improved forest cultivation. On the other hand side, innovation in product development and the guaranteed supply of sawn wood and other products from small diameter hardwood timber should be demonstrated and initiated for the wood processing industry. Finally, the project should lead to decision guidance for the forest owner and the wood processor in order to increase the added value of possible products made of small diameter hardwood.

Assessment of the willow (*Salix* sp.) clones with near infrared spectroscopy

Anna Sandak [1)], Włodzimierz Prądzyński [2)], Jakub Sandak [1)], Bogusława Waliszewska [2)], Magdalena Zborowska [2)] Bartosz Pałubicki [1)] Martino Negri [1)]

[1)] *IVALSA/CNR San Michele all Adige, Italy*
[2)] *Poznan University of Life Sciences, Poland*

Recent developments in the fields of optics and electronics opened new possibilities for measurements of various physical and chemical properties of materials. One of such techniques is near-infrared spectroscopy. The method allows rapid and low cost assessment of the chemical composition of the surface by measuring how the non-visible infrared light is absorbed by particular molecules.

The goal of this research was to exploit the potential of near infrared spectroscopy to measure and characterize three years old plantation of willow clones. Commercially available near infrared spectrometer (Bruker Vector 22N) has been used to scan the experimental samples. For spectra pre-processing and data mining both Bruker/Opus 6.5 and National Instruments LabView software packages were utilized. Two fractions of samples (chips and powders) were measured. Prediction models based on the partial least squares for quantifying chemical composition, such as lignin, cellulose, hemicelluloses, extractive components contents have been developed.

Near infrared technique is a useful tool for recognition of wood clones and it is capable for fast and not destructive quantification of the wood chemical composition.

Technological characteristics and attitude to plywood production of the wood of six new Poplar clones ('Brenta', 'Mella', 'Sesia', 'Soligo', 'Taro' and 'Timavo')

Gaetano CASTRO[1] - Riccardo ALGA[2] - Giuseppe FRAGNELLI[2] - Stefano VIGOLUNGO[3]

1: Researcher at C.R.A.-PLF - Research Unit for Intensive Wood Production, Casale Monferrato (AL) - Italy
2: Research grant at C.R.A.-PLF
3: Doctor in Wood Technology

In the present paper we analyze the dendrometric and physical characteristics, and the quality and suitability to rotary cutting of the wood of six new poplar clones ('Brenta', 'Mella', 'Sesia', 'Soligo', 'Taro' and 'Timavo'), comparing them with those of `I-214', the most widely spread clone in the Italian panorama.

In one polyclonal plantation 3 trees per clone were felled. After their dendrometric characteristics were assessed, from every plant we cut some logs for the rotary cutting test, carried out in a plywood industry, and two disks (5 cm thick) per plant, from which we obtained samples for the physical analyses (basic density, fresh weight and total shrinkage).

The basic density of the new poplar clones examined was definitely higher when compared to 'I-214' and so were the quantity and quality of the veneers obtained. In particular 'Taro' and 'Soligo' turned out extremely interesting: the first one for producing the highest number of sheets of excellent quality, the second for both the good quality of the veneer and a growth rate much higher than 'I-214'.

The mechanical characteristics of these clones, which have not yet been determined but which are likely to be superior at least by 15- 20 % to those of 'I-214', together with the higher amount of raw material obtainable, make the new clones particularly suitable for all those innovative uses beyond the production of packaging, (for instance in the building sector, with or without structural functions), in which the performance aspects are discriminating.

Use of HDF as Substrate in Floating Engineered Wood Parquet

Jean-François Bouffard[1], Pierre Blanchet[2]

1. Research Scientist, FPInnovations
2. Group Leader FPInnovations and Adjunct Professor, Wood and Forest Sciences Department, Wood Research Centre (CRB)

Because it offers good milling properties, especially for self-locking tongue and groove, high-density fibreboard (HDF) has gained acceptance as a substrate in the manufacture of engineered wood flooring (EWF). Depending on the component selected, delamination in the HDF or severe cupping deformation have, however, been observed. The aim of this study was to identify key design parameters in EWF made with an HDF substrate, taking into account the density of the HDF, the characteristics of the face layer and the type of backing process selected to meet quality requirements. A sliced face layer led to lower at least twice the cupping deformation than a sawn face layer. With a sawn face layer, denser HDF provided a better substrate for EWF. The use of melamine-impregnated paper as a backing layer significantly contributed to reduced cupping deformation in all cases.

Influence of spreading rate and gluing pressure on PVAc glue joints effectiveness

Marco Fellin[1], Martino Negri[2], Raffaele Cavalli[1]

1 Università degli Studi di Padova, Padova (PD), Italy - marco.fellin@libero.it - raffaele.cavalli@unipd.it
2 IVALSA/CNR Trees and Timber Institute, San Michele all'Adige (TN), Italy – negri@ivalsa.cnr.it

The changes in glueline shear strength on European beech bonded with five polyvinyl acetate (PVAc) and one polyurethane (PU) adhesives at pressure levels of 0,15 N/mm2, 0,3 N/mm2, 0,5 N/mm2 and at three spread rates were evaluated. Spread rates were either the suitable one, either lower and higher than the suggested value; similarly, the press was set up to reach either the suitable gluing pressure, either lower and higher than the suggested value. All the possible "spread rate *vs* gluing pressure" combinations were tested. The specimens prepared to determine the effect of the variables on bond performance were subjected to shear test in an universal testing machine.

Increasing of spread rate created stronger glue lines, and the magnitude was more evident comparing low spread rates with suggested. Best gluing results were obtained increasing spread rate. Gluing pressure had a lower influence than spread rate in glue lines strength, and results revealed values suggested by technical sheets and higher values were most of the time the best ones.

Mid-term colour change of finished and non-finished temperate hardwood due to natural and artificial ageing

Ignazia Cuccui[1], *Martino Negri*[1], *Barbara Tessadri*[1]

[1] *IVALSA/CNR Trees and Timber Institute*
San Michele a/A (TN), Italy
Tel.+39.0461.660201 fax +39.0461650045 negri@ivalsa.cnr.it

We report the changes of temperate hardwoods in outdoor conditions. In a large project on wooden buildings , IVALSA is studying the evolution of colour changes on different wood species either without any surface treatment, either with various finishing and/or protecting products or processes, included hygro-thermic modifications of wood. The protective finishing cycles are either water either organic solvent based; the resins are the followings: alkyd, alkyd/acrylic, oil and natural resins. Also the properties of the layers are different, from transparent to thick brown. The main goal is to provide the behaviour of the different wood species, according to the protecting methodology adopted, due to the ageing effect deriving from the outdoor environmental conditions and from the artificial ageing; the changes are recorded as pictures (digital colour calibrated), as CIE-Lab coordinates, as gloss values. The contribution of visible and UV-A spectra, such as RH and temperatures are logged in field experimental set up.
The tests here reported have been carried out along two years of natural ageing outdoor and twelve weeks of EN 927/6 QUV Panel artificial ageing.

Dust exposures in the wood processing industry in Northeast Italy

Andrea R. Proto[1], Martino Negri[1], Mario Marra[1]

1 IVALSA/CNR Trees and Timber Institute, San Michele all'Adige (TN), Italia
<negri@ivalsa.cnr.it> <proto@ivalsa.cnr.it> marra@ivalsa.cnr.it

Over the last decade workers' health and safety have been given a growing attention and the laws issued in Italy to protect and improve both workers' health and work standards are intended to avoid, or at least contain, occupational hazards and diseases. In Northeast, the productive compartment of the secondary wood working presents many issues in term of occupational safety and health. The exposure to wood dust is one of the principal risks for workers.

The timber processing sector relies on a variety of processing plants and production lines which are characterized by a high level of process automation. In spite of this, many businesses, also due to the low added value of their finished products, still make use of obsolete machines and processing lines which, while still assuring a good operation and production efficiency, are by now inadequate to comply with the new requirements in terms of workers' health and safety. The exposition of wood dust, object of this research, would contribute to the realization of a preventional model for the limitation of occupational exposure to carcinogenic agents.

Young plantation teak from Costa Rica – Material assessment of young teak grown on reforested fallow pastures

Christian Hansmann[1], Robert Stingl[2], Alfred Teischinger[1, 2]

[1] Wood K plus - Competence Centre for Wood Composites and Wood Chemistry, St. Peter Strasse 25, 4021 Linz, Austria

[2] Institute of Wood Science and Technology, Department of Material Sciences and Process Engineering, University of Natural Resources and Applied Life Sciences, Vienna, Peter Jordan Strasse 82, 1190 Vienna, Austria

Young plantation teak (*Tectona grandis* L.) with an age of 18 and 7 years from a mountained region in Costa Rica was analysed. The plantation is established on fallow pastures and makes therefore a contribution to a sustainable development in that region. While teak wood from plantations in Middle America is normally converted to sawn timber with a minimum age of approximately of 25-30 years, the question arose if material from different thinning stages can also be used for sawn timber and therefore be converted to products with higher value added. Several round wood characteristics were recorded and the logs showed sufficient diameters to produce sawn timber. A detailed mechanical and chemical analysis was performed and the results were compared to literature values. While the investigated young teak wood consisted of 100 % juvenile wood the results showed surprisingly high values, for both mechanical and chemical characteristics. The natural durability is one of the most important features of teak wood and based on specific extractive contents. While the analysed extractive content could not reach the values of Burma teak (as it is common for plantation teak wood) it could reach values comparable to other plantation teak with significant higher tree age. The revealed mechanical characteristics such as bending, impact bending and compression strength showed very high values and exceeded those of Burma teak as known by literature.