2012 IUFRO CONFERENCE DIVISION 5 FOREST PRODUCTS

INTERNATIONAL UNION OF FOREST RESEARCH ORGANIZATIONS

8 › 13 JULY'12 - ESTORIL CONGRESS CENTRE, LISBON, PORTUGAL

FINAL PROGRAM, PROCEEDINGS AND ABSTRACTS BOOK

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Universidade Técnica de Lisboa

Centro de Estudos Florestais (CEF)

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Dave Cown, New Zealand
Pekka Saranpää, Finland

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DIVISION 5
FOREST PRODUCTS

PRODUITS FORESTIERS - PRODUCTOS FORESTALES - HOLZ UND ANDERE FORSTPRODUKTE

Coordinator: Andrew Wong, Malaysia
Deputies: Jamie Barbour, United States; Dave Cown, New Zealand; Pekka Saranpää, Finland

5.01.00 Wood quality
Qualité du bois
Calidad de la madera
Holzqualität
C Pekka Saranpää, Finland
D Pauline Fernández, Chile
D Jianxiong Lu, China
D Elspeth MacDonald, United Kingdom
D Katsuhiko Takata, Japan

5.01.04 Wood quality modelling
Modélisation de la qualité du bois
Modelación de la calidad de madera
Modellierung der Holzqualität
C Jean-Michel Leban, France
D Joseph Gril, France
D Heli Peltola, Finland
D Christine Todoroki, New Zealand

5.01.07 Tree ring analysis
Analyse des cernes
Análisis de anillos de crecimiento
Jahrringanalyse
C Margaret Devall, United States
D Paolo Cherubini, Switzerland

5.01.08 Understanding wood variability
Comprendre la variabilité du bois
Entender la variabilidad de la madera
Holzvariabilität verstehen
C Barbara Lachenbruch, United States
D Paul McLean, United Kingdom
D John Moore, New Zealand

5.02.00 Physiomechanical properties of wood and wood based materials
Propriétés physiomécaniques et utilisations du bois et des matériaux dérivés du bois
Propiedades fisiomecánicas y aplicaciones de la madera y de materiales compuestos en base a madera
Physiomechanische Eigenschaften und Anwendungen von Holz und Holzwerkstoffen
C Xiping Wang, United States
D John Moore, New Zealand
D Lihai Wang, China

5.02.01 Non-destructive evaluation on wood and wood-based materials
Evaluation non déstructive du bois et des matériaux dérivés du bois
Evaluación no destructiva de madera y materiales compuestos en base a madera
Nicht zerstörende Evaluierung von Holz und Holzwerkstoffen
C Xiping Wang, United States
D Roger Meder, Australia
D Houjiang Zhang, China

5.02.02 Fundamental properties of wood and wood-based materials
Propriétés fondamentales du bois et des matériaux dérivés du bois
Propiedades fundamentales de madera y materiales compuestos en base a madera
Grundlegende Eigenschaften von Holz und Holzwerkstoffen
C Hongmei Gu, United States
D Raquel Goncalves, Brazil

5.03.00 Wood protection
Protection du bois
Protección de la madera
Holzschutz
C Donatien Pascal Kamdem, United States
D Gyu-Hyeok Kim, Korea (Rep)
D Adya P. Singh, New Zealand
D Andrew Wong, Malaysia

5.03.05 Biological resistance of wood
Résistance biologique du bois
Resistencia biológica de la madera
Biologische Beständigkeit von Holz
C Nasko Terziev, Sweden
D Jinzhen Cao, China
D Sung-Mo Kang, Korea (Rep)

5.03.06 Wood protection for quarantine, food packing and trade in wood
Protection du bois dans la quarantaine, l'emballage et le commerce du bois
Protección de la madera para cuarentena, embalaje de alimentos y comercio de maderas
Holzschutz zur Erfüllung von Quarantäne-, Lebensmittelverpackungs- und Holzhandelsvorschriften
C Magdalena Kutnik, France
D Hugh Bigsby, New Zealand
D Donatien Pascal Kamdem, United States

5.03.07 Wood protection under tropical environments
Protection du bois sous les tropiques
Protección de la madera bajo condiciones tropicales
Holzschutz in den Tropen
C Marie-France Thevénon, France
D Osvaldo Encinas, Venezuela
D Andrew Wong, Malaysia

5.03.10 Protection of cultural artefacts
Protection des artefacts culturels
Protección de objetos culturales
Schutz von Kulturgegenständen
C Wibke Unger, Germany
D Geoffrey F. Daniel, Sweden
D Donatien Pascal Kamdem, United States
D Marie-France Thevénon, France

5.03.11 Protection by surfacing and finishing
Protection du bois par le revêtement et la finition
Proteger la madera con recubrimientos y acabados
Holzschutz durch Beschichtung und Finish
C Philippe Gerardin, France
D Andre Merlin, France
D Martino Negri, Italy

5.04.00 Wood processing
Transformation du bois
Transformación de la madera
Holzbearbeitung
C Marius Barbu, Romania
D Mihaela Campean, Romania
D Jegatheswaran Ratnasingam, Malaysia

5.04.06 Wood drying
Séchage des bois
Secado de la madera
Holztrocknung
C Diego Elustondo, Canada
D Agron Bajraktari, Republic of Kosovo
D Süleyman Korkut, Turkey
D Gan Kee Seng, Malaysia

5.04.07 Adhesives and gluing
Collage des bois
Adhesivos y encolado
Holzverleimung
C Hui Pan, United States
D Warren Grigsby, New Zealand
D Shujun Li, China
D Tohmura Shin-ichiro, Japan

5.04.08 Sawing, milling and machining
Sciage et usinage
Aserrado y maquinado
Sägen und Holzbearbeitung
C Roger Hernandez, Canada
D Pierre-Jean Meausoone, France
D Takeshi Ohuchi, Japan

5.04.13 Industrial engineering, operations analysis and logistics
Ingénierie industrielle, analyse des opérations, et logistique
Ingeniería industrial, análisis de operaciones y logística
Industrielle Verarbeitung, Verfahrenstechnik und Logistik
C Henry Quesada-Pineda, United States
D Omar Espinoza, United States
D Roger Moya Roque, Costa Rica

5.05.00 Composite and reconstituted products
Composites et produits reconstitués
Materiales compuestos y productos reconstituidos
Verbundwerkstoffe und Leimholzprodukte
C S. Salim Hiziroglu, United States
D Marius Barbu, Romania
D Zhiyong Cai, United States
D Tatsuya Shibusawa, Japan

5.06.00 Properties and utilization of plantation wood
Propriétés et utilisation du bois provenant des plantations
Propiedades y utilización de madera proveniente de plantaciones
Eigenschaften und Verwendung von Plantagenholz
C Roger Meder, Australia
D Yafang Yin, China

5.06.01 Utilization of dry area timber
Utilisation du bois provenant des terres sèches
Utilización de madera proveniente de zonas áridas
Verwendung von Holz aus Trockengebieten
C Nick Pasiecznik, France
D George Muthike, Kenya

5.06.02 Utilization of planted teak
Utilisation du teck provenant des plantations
Utilización de madera de teca proveniente de plantaciones
Verwendung von Teakholz aus Plantagen
C P.K. Thulasidas, India
D vacant

5.06.03 Utilization of planted eucalypts
Utilisation de l'eucalyptus provenant des plantations
Utilización de madera de eucaliptus proveniente de plantaciones
Verwendung von Eukalyptusholz aus Plantagen
C Jose Nivaldo Garcia, Brazil
D Roger Meder, Australia
D Yongdong Zhou, China

5.07.00 Energy and chemicals from forest biomass
Energie et produits chimiques de la biomasse forestière
Energía y productos químicos de la biomasa forestal
Energie und chemische Produkte aus forstlicher Biomasse
C vacant
D Hyeun-Jong Bae, Korea (Rep)
D Fuxiang Chu, China
D Alan Rudie, United States

5.10.00 Forest products marketing and business management
Commercialisation des produits forestiers et développement de l'entreprise
Comercialización de productos forestales y gestión de empresas
Vermarktung von Forstprodukten und Betriebsführung
C Eric Hansen, United States
D Paul Dargusch, Australia
D Rob Kozak, Canada
D Toshiaki Owari, Japan
D Anne Toppinen, Finland
D Richard Vlosky, United States

5.10.01 Wood culture
Culture du bois
Cultura de la madera
Holzkultur
C Howard N. Rosen, United States
D Victoria Asensi Amoros, France
D Monlin Kuo, United States
D Yang Ping, Japan
D Jinling Su, China
D Mario Tomazello Filho, Brazil

5.11.00 Non-wood forest products
Produits forestiers non-ligneux
Productos forestales no leñosos
Nichtholz-Forstprodukte
C A.L. "Tom" Hammett, United States
D James Chamberlain, United States
D Madhav Karki, Nepal
D Pawel Staniszewski, Poland
D Paul Vantomme, Italy

5.11.02 Medicinal forest products
Produits forestiers médicinaux
Productos forestales medicinales
Waldprodukte in der Medizin
C Carsten Smith Olsen, Denmark
D Giridhar A. Kinhal, Nepal

5.11.03 Edible forest products
Produits forestiers comestibles
Productos forestales comestibles
Nahrungsmittel aus dem Wald
C Susan J. Alexander, United States
D Sarah W. Workman, United States

5.11.05 Bamboo and rattan
Bambou et rotin
Bambú y ratán
Bambus und Rattan
C Jinhe Fu, China
D Johan Gielis, Belgium
D Lay Thong Hong, Malaysia

5.12.00 Sustainable utilization of forest products
Utilisation durable des produits forestiers
Utilización sostenible de productos forestales
Nachhaltige Verwendung von Walderzeugnissen
C Robert Deal, United States
D Ying Hei Chui, Canada
D Choi Don Ha, Korea (Rep)

5.14.00 Forest products education
Formation en matière de produits forestiers
Educación en productos forestales
Ausbildung im Bereich der Walderzeugnisse
C Rupert Wimmer, Germany
D Aldo Ballerini, Chile
D Jamie Barbour, United States
D Sudipta Dasmohapatra, United States

CONFERENCE VENUE

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N 38º42'25.00
W 9º23'46.0

REGISTRATION DESK

DAY	TIME
Sunday, July 8	14h-18h00
Monday, July 9	08h-18h00
Tuesday, July 10	08h-18h00
Wednesday, July 11	08h-13h00
Thursday, July 12	08h-18h00
Friday, July 13	08h-16h00

TECHNICAL VISITS JULY 11

Departure time: 12h15

Technical Visit 1 - Corticeira Amorim

Technical visit 2 - Espirra Estate (Portucel Soporcel Group)

Technical visit 3 - Industrial Plant "About the future" (Portucel Soporcel Group)

Technical visit 4 - Companhia das Lezírias

Technical visit 5 - Pinhal de Leiria

PROGRAM AT A GLANCE

Time	SUNDAY 8	MONDAY 9	TUESDAY 10	WEDNESDAY 11	THURSDAY 12	FRIDAY 13
0800-0830		Registration, welcome coffee	Registration			
0830-0900			Jack Saddler Keynote 2	Klaus Richter Keynote 3	Madhav Karki Keynote 4	Rich Vlosky Keynote 5
0900-0930						
0930-1000		**OPENING CEREMONY**	BREAK			
1000-1030			5 Technical session rooms	IAWS Academy lecture	7 Technical session rooms	7 Technical session rooms
1030-1100						
1100-1130		Eduardo Rojas-Briales Keynote 1		Sub plenary Biorefinery		
1130-1200						
1200-1300		LUNCH				
1300-1330		7 Technical session rooms	6 Technical session rooms	In-congress tour / technical visits	6 Technical session rooms	6 Technical session rooms
1330-1400						
1400-1430	Registration and Poster Fixing					
1430-1500						
1500-1530		BREAK			BREAK	
1530-1600		6 Technical session rooms	5 Technical session rooms		RG Business meeting	Technical Group Reporting
1600-1630						
1630-1700					Poster Session 2	
1700-1730						
1730-1800		**Wine and Cheese Cocktail** Poster Session 1	RG Business meeting			Resolutions / Closing
1800-1830						
1830-1900						
1900-1930						
1930-2000		**IAWA SOCIAL HOUR**	**IAWS DINNER**		**CONFERENCE DINNER**	
2000-2030						

PROGRAM DAY BY DAY

JULY 9

TIME	SESSION NAME			ROOM	RG
08h00-09h30	Registration & welcome coffee				
09h30-11h00	**OPENING CEREMONY**			Auditorium	
TIME	**SESSION NAME**	**MODERATOR**	**ABSTRACT REF.**	**ROOM**	**RG**
11h00-12h00	Eduardo Rojas-Briales - Global and European Challenges of Forests Moving towards Green Economies	Pekka Saranpaa	KN01	Auditorium	Plenary 1
LUNCH					
13h00-15h00	Wood Quality	Pekka Saranpaa	OP001, OP002, OP003, OP004, OP005, OP006	Auditorium	5.01.00
	Properties and utilisation of plantation wood – Wood Quality and Utilisation	José Nivaldo Garcia	OP007, OP008, OP009, OP010, OP011, OP012	E	5.06.00
	CT and X-ray Applications to Wood Processing	Franka Bruechert	OP013, OP014, OP015, OP016, OP017, OP018, OP019	F1-F3	5.02.00
	Natural durability	Nasko Terziev & MF Thevenon	OP020, OP021, OP022, OP023, OP024	F7	5.03.00 / IRGWP
	Wood processing – Adhesives & Surface	Marius Barbu	OP025, OP026, OP027, OP028, OP029, OP030	C1-C3	5.04.00
	Non-wood Forest Products	Tom Hammett	OP031, OP032, OP033, OP034, OP035, OP036	F4-F6	5.11.00
	Cork	Miguel Cabral	OP037, OP038, OP039, OP040, OP041	CA-C6	Cork 1
COFFEE BREAK					
15h30-17h30	Composite and Reconstituted Products	Salim Hiziroglu & Marius Barbu	OP042, OP043, OP044, OP045, OP046	Auditorium	5.05.00
	Physiological and adaptive changes in wood	Barry Gardiner	OP047, OP048, OP049, OP050, OP051	E	5.01IAWA
	Energy and Chemicals from Forest Biomass	Hyeun-Jong Bae & Jamie Barbour	OP052, OP053, OP054, OP055, OP056	F1-F3	5.07.00
	CT and X-ray Applications to Wood Processing	Udo Sauter	OP057, OP058, OP059, OP060, OP061, OP062, OP063	F4-F6	5.02.00
	Pulp & Paper-Biorefinery and Wood Chemistry	Dominique Lachenal	OP064, OP065, OP066, OP067, OP068	F7	5.15.00
	Wood processing – Drying	Marius Barbu	OP069, OP070, OP071, OP072, OP073, OP074	C4-C6	5.04.00
17h30-19h30	**WINE AND CHEESE COCKTAIL** / Poster Session 1				
19h30-20h30	**IAWA SOCIAL HOUR**				

JULY 10

TIME	SESSION NAME	MODERATOR	ABSTRACT REF.	ROOM	RG/WP
08h30-09h30	Jack Saddler – The Biorefining Story: Progress in the commercialization of biomass-to-fuels and chemicals (The influence of the biomass fedstock on the process and products)	Jamie Barbour	KN02	Auditorium	Plenary 2
COFFEE BREAK					
10h00-12h00	Environmental and developmental controls on wood quality	Barb Lachenbruch	OP075, OP077, OP078	Auditorium	5.01.08
	Wood processing – Sustainability	Marius Barbu & Henry Quesada Pineda	OP079, OP080, OP081, OP082, OP083, OP084	E	5.04.00
	Sustainable utilization of forest products	Bob Deal & Jamie Barbour	OP085, OP086, OP087, OP088, OP089, OP090	F1-F3	5.12.00
	Non-destructive Evaluation Techniques	Xiping Wang	OP091, OP092, OP093, OP094, OP095, OP096	F4-F6	5.02.00
	Forest Products Marketing and Business Management	Rich Vlosky	OP307, OP097, OP098, OP099, OP100, OP101	F7	5.10.00
LUNCH					
13h00-15h00	Emerging wood preservatives	Philippe Gerardin & Joran Jermer	OP102, OP103, OP104, OP105, OP106	Auditorium	5.03.00/ IRGWP
	Genetic options for altering wood quality	Hisahi Abe	OP107, OP108, OP109, OP110, OP111	E	5.01.08
	Composite and Reconstituted Products	Salim Hiziroglu & Marius Barbu	OP112, OP113, OP114, OP115, OP116	F1-F3	5.05.00
	Properties and utilisation of plantation wood – New Materials from Plantation Wood	Yin Yafang	OP117, OP118, OP119, OP120, OP121, OP122	F4-F6	5.06.00
	Non-destructive Evaluation Techniques	Roger Meder	OP124, OP125, OP126, OP127, OP128, OP129	F7	5.02.00
	Turning by products in Biomaterials	Marie-Pierre Laborie	OP130, OP131, OP132, OP133, OP134, OP135	C1-C3	5.07.00
COFFEE BREAK					
15h30-17h30	Forest Products Marketing and Business Management	Eric Hansen	OP136, OP137, OP138, OP139, OP140, OP141	Auditorium	5.10.00
	Non-wood Forest Products	Tom Hammett & Madhav Karki	OP142, OP143, OP144, OP145	E	5.11.00
	Within-tree variability in wood quality and anatomy	Sabine Rosner	OP146, OP147, OP148, OP149, OP150	F1-F3	5.01.IAWA
	Integrating forest products with ecological services	Jamie Barbour	OP151, OP152, OP153, OP154, OP155, OP156	F4-F6	5.12.00
	Pulp & Paper-Nanocrystalline Cellulose	Raymond C. Francis	OP157, OP158, OP159	F7	5.15.00
17h30-18h30	RG Business Meeting - Wood Quality			E	5.01.00
	RG Business Meeting - Physiomechanical properties of wood and wood-based materials			F1-F3	5.02.00
	RG Business Meeting - Wood Protection			F4-F6	5.03.00
	RG Business Meeting - Wood Processing			F7	5.04.00
	RG Business Meeting - Composite and Reconstituted Products			C1-C3	5.05.00
	RG Business Meeting - Properties and utilisation of plantation wood			C4-C6	5.06.00
19h30 - 22h00	**IAWS DINNER**				

JULY 11

TIME	SESSION NAME	MODERATOR	ABSTRACT REF.	ROOM	RG
8h30-9h30	Klaus Richter - Wood in Construction – Including Multi-Storey Building	Dave Cown	KN03	Auditorium	Plenary 3
10h00-11h00	Lennart Salmén - The wood fibre structure – how to be utilized?	Rupert Wimmer	SP01	Auditorium	5.01/IAWS Academy Lecture
COFFEE BREAK					
11h00-12h00	Jorge Colodette – The Brazilian Forestry Industry Focusing on Eucalypt	Tarja Tamminen	SP02	Auditorium	Subplenary 1
	Helena Pereira – The importance of biomass structure and chemical composition for biorefineries	Tarja Tamminen	SP03	Auditorium	Suplenary 2
12h15-19h00	**TECHNICAL VISITS**				

JULY 12

TIME	SESSION NAME	MODERATOR	ABSTRACT REF.	ROOM	RG
08h30-09h30	Madhav B. Karki – Enhancing the contribution of non-timber forest products in supporting green economy and sustainable development in mountain countries	Andrew Wong	KN05	Auditorium	Plenary 4
COFFEE BREAK – **Sponsored by Forest Stewardship Council (FSC) www.fsc.org**					
10h00-12h00	Flexwood	Luc LeBel	OP160, OP161, OP162, OP163, OP164, OP165	Auditorium	5.01.01
	Wood quality modeling	Geoff Downes	OP166, OP167, OP168, OP169, OP170	E	5.01.04
	Properties and utilisation of plantation wood – Teak	Henri Bailleres	OP171, OP172, OP173, OP174, OP175	F1-F3	5.06.00
	Recent development in wood protection	Cao Jinzhen & DP Kamdem	OP176, OP177, OP178, OP179, OP180, OP181	F4-F6	5.03.00 / IRGWP
	Energy from the forest, IUFRO's Biomass Task Force	Jamie Barbour & Hyeun-Jong Bae	OP182, OP183, OP184, OP185, OP186, OP187	F7	5.07.00
	Emerging wood preservatives (2)	Magdelena Kutnik & Andew Wong	OP188, OP189, OP190, OP191, OP192, OP193	C1-C3	5.03.00 / IRGWP
	Sawing, milling and machining – Tools	Jega Ratnasingam & Roger Hernandez Pena	OP194, OP195, OP196, OP197, OP198, OP199	C4-C6	5.04.08
LUNCH					
13h00-15h00	Composite and Reconstituted Products	Salim Hiziroglu & Marius Barbu	OP200, OP201, OP202	Auditorium	5.05.00
	Properties and utilisation of plantation wood – Lesser known species (particularly those from Africa)	P.K.Thulasidas	OP204, OP205, OP207, OP209, OP211	E	5.06.00
	Wood variation: utilization and identification	Paul McLean	OP212, OP213, OP214, OP215	F1-F3	5.01.08
	Fractionation of raw wood material for biobased products	Tarja Tamminen	OP216, OP217, OP218, OP219, OP220	F4-F6	5.07.00
	Protection of wood packaging	D Pascal Kamdem & Nasko Terziev	OP221, OP222, OP223, OP224, OP225, OP226	C1-C3	5.03.00 / IRGWP
	Wood Culture 1	Mario Tomazello	OP227, OP228, OP229, OP230, OP231, OP232, OP233	C4-C6	5.10.01
COFFEE BREAK – **Sponsored by Forest Stewardship Council (FSC) www.fsc.org**					
15h30-16h30	RG Business Meeting - Energy and Chemicals from Forest Biomass			E	5.07.00
	RG Business Meeting - Forest Products Marketing and Business Management			F1-F3	5.10.00
	RG Business Meeting - Non-wood Forest Products			F4-F6	5.11.00
	RG Business Meeting - Sustainable utilization of forest products			F7	5.12.00
	RG Business Meeting - Forest Products Education			C1-C3	5.14.00
	RG Business Meeting - Pulp & Paper			C4-C6	5.15.00
16h30-18h00	Poster Session 2				
19h30-22h30	**CONFERENCE DINNER**				

JULY 13

TIME	TITLE	MODERATOR	ABSTRACT REF.	ROOM	RG/WP
8h30-9h30	Rich Vlosky – Creating Competitive Advantage in a Global Recession	Helena Pereira	KN06	Auditorium	Plenary 5
COFFEE BREAK					
10h00-12h00	Wood quality	Pekka Saranpää	OP234, OP235, OP236, OP237	Auditorium	5.01.00
	Biodiversity and wood products paths to compatibility	Bob Deal & Jamie Barbour	OP238, OP239, OP240, OP241, OP242, OP243	E	5.12.00
	Tree ring analysis	Margaret Devall	OP244, OP245, OP246, OP247, OP248, OP249	F1-F3	5.01.07 / IAWA
	Field Performance of treated wood	MF Thevenon & Aree Abdluquader	OP250, OP251, OP252, OP253, OP254, OP255	F4-F6	5.03.00 / IRGWP
	Pulp & Paper-Pulp Bleaching	Ken Kaw	OP256, OP257, OP258, OP259	F7	5.15.00
	Properties and utilisation of plantation wood – Biomass Characterisation	José Nivaldo Garcia	OP260, OP261, OP262, OP263, OP264	C1-C3	5.06.00
	Wood Culture 2	Howard Rosen	OP266, OP267, OP268, OP269, OP270, OP271	C4-C6	5.10.01
LUNCH					
13h00-15h00	Protection of Cultural Artifacts	Wibke Unger	OP272, OP273, OP274, OP275, OP276, OP277	Auditorium	5.10.01 / 5.03.00 / IRGWP Special Session
	Wood quality from complex stand structures	Elspeth McDonald	OP278, OP279, OP280, OP281, OP282, OP283	E	5.01.00 Special Session
	Forest Products Education	Rupert Wimmer	OP284, OP285, OP287, OP288, OP289, OP290	F1-F3	5.14.00
	Pulp & Paper – Pulping	Eugene I-Chen Wang	OP291, OP292, OP293, OP294, OP295, OP296	F4-F6	5.15.00
	Processing of plantation wood and innovative technologies	Jega Ratnasingam & Marius Barbu	OP297, OP298, OP299, OP300, OP301, OP302	F7	5.04.08
	Cork	Helena Pereira	OP303, OP304, OP305, OP306	C1-C3	Cork 2
COFFEE BREAK					
15h30-17h30	**TECHNICAL GROUP REPORTING**			E	
17h30-18h00	**RESOLUTIONS / CLOSING**			Auditorium	

ABSTRACTS

tifolia species for 72hrs using dipping method. The samples were divided into two equal halves which are true representatives of all the wooden samples used. One part were incubated at the timber graveyard to expose them to termites attacks while the second part was plated on sterile potato dextrose agar (PDA) and attacked with a wood desroying fungus (Rhizoctonia solani) while the deterioration rate was observe for a period of 1month for fungi growth and six months for termites attacks respectively. Data collected include phytochemical concentration of the plant extracts, retention rate (%), visual durability ratings, and mass and hardness losses of the wood samples due to fungi and termites attacks.

The analysis of variance showed that there was significant difference ($P<0.05$) in the type of extracts used wood species and concentration of the plant extracts. There was significant difference in the visibility test conducted for the wood species attacked by termite. C. odorata was found more effective because it contained more phytochemicals than other extracts used. All the extracts were found to be effective even at low concentration. The weight loss exhibited by tested sample were found to be significantly low.These extracts are potential alternatives for inorganic preservations in that they were found to be effective in suppressing both fungi and termite attacks.

Keywords: Preservatives, extracts, fungi and termites.

OP025

Study of the cure of melamine-urea-formaldehyde resins with very low formaldehyde emissions

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Urea-formaldehyde (UF) resins are the most widely used adhesives for wood-based panels (WBP). Worldwide, these resins represent 80 % of the total production in the aminoresins class. These are thermosetting polymers that, before cure, consist of an aqueous solution/dispersion of unreacted monomers, linear or branched oligomeric and polymeric molecules. They are obtained by condensation of aldehydes with compounds containing amino groups and their commercial success is mostly due to high reactivity, good performance and low cost. However, hydrolytic degradation of covalent bonds in the cured resin causes a significant weakening of mechanical strength and is a source of formaldehyde emissions.

The incorporation of a small percentage of melamine on UF resins improves the moisture/water resistance and therefore decreases formaldehyde emission. This occurs because more stable bonds are formed when a methylene carbon is linked to an amide group from a melamine ring, instead of nitrogen from urea. However, this results in a resin with lower reactivity and, consequently, higher pressing times.

In industry, the methods used for determining resin gel time are not representative of reality and the results are inaccurate and operator-sensitive. Other advanced characterization equipment, such as Differential Scanning Calorimetry (DSC) allows the identification of the onset temperature, cure rate, heat of reaction and kinetic parameters. However, it does not assess the strength of bonds formed within the resin, neither its interaction with wood. While DSC monitors the "chemical cure", ABES (Automatic Bonding Evaluation System), TMA (Thermo Mechanical Analysis) and DMTA (dynamic mechanical thermal analysis) allow for the evaluation of the bonding strength development.

This paper presents the results of curing studies of melamine-urea-formaldehyde (MUF) resins with low formaldehyde emissions performed with ABES technique. This equipment represents an expeditious and quick way to assess the strength of bonds formed during adhesive curing. Simple analytical models allowed for the quantification of resin gel time, cure rate and strength of adhesive joint. A comparison between the results for the resins gel time obtained using ABES and conventional methods is also presented.

Keywords: urea-formaldehyde resin, melamine, Automatic Bonding Evaluation System, gel time, resin cure

OP026

Characterization of Tunisian Aleppo pine Tannin Extract For a Potential Use in Adhesives Formulation

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At present, the production of wood adhesives mainly relies on the petrochemical-based resins, which are non-renewable and therefore ultimately limited in supply. The aim of this work is to get a better knowledge of Mediterranean wood plantations and forests and to valorize them as a potential source of tannins for adhesives formulation; we selected a local Tunisian vegetable material for the study which is Aleppo pine bark.

Tannins are important secondary metabolites and are very diffuse in the whole plant kingdom; they play a principal role in plant defense, for example against herbivores. They are divided in two broad classes, namely condensed tannins and hydrolysable tannins. Vegetable tannins have been used traditionally to tan leather. On the twenty-first century, they found a new application as phenol substitutes in the adhesives formulation.

Tannins can be found in the bark, stem, phloem, seeds, fruits, fruits pods, wood leaves and needles of dicotyledonous plants. The most common commercial tannins are coming from mimosa bark, quebracho wood, pine bark and oak bark.

Aleppo pine (Pinus halepensis Mill) is a conifer tree belongs to Pinaceae family. It is one of the most common pines throughout the Mediterranean on the plains and low mountains. In Tunisia Aleppo pine barks are used traditionally for leather tanning and its local name is "Sellekh".

The intending use of Aleppo pine barks as phenol substitutes in the formulation of adhesives was studied. Thus, total phenols, condensed tannins and hydrolysable tannins were estimated by colorimetric essays, characterized using NMR, DSC and TGA and compared to those of common tannins to evaluate their use as a source characterization of the visco-elastic behaviour in terms of stress for 33 % strain (S33, MPa), Young modulus (E), resilience index (I), density (D, g·l-1) and dimensional recovery at 15 s, 15 min and 1 week (R15s, R15m, R1w, %).

Results show the effect (p<0,01%) of the commercial classification on the stress (S33), resilience (I) and intermediate recovery (R15m). The effect of the origin is appraised specially in the variables that define the initial zone of the stress-strain curve: instantaneous recovery (R15s, p<0,01%) and Young Modulus (E, p<0,05%), being also detected for R15m and R1w. Interaction between both factors has not been detected. Correlations are low excepting that between D and S33 (R2 = 0.725). Finally, the analysis of anomalous cases highlights the relationship between mechanical behaviour and the presence of some defects (ligneous inclusions, stains) hardly detectable by image analysis and, therefore, causes of possible classification errors.

It can be concluded that mechanical tests can be of great help in the definition of more objective and homogenous quality grades as well as in the improvement of the final products traceability.

Keywords: Quercus suber; cork properties; cork grading; traceability; quality control

OP038

The surface porosity of natural cork stoppers and quality classes produced from cork boards of different calliper

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The natural cork stoppers are the premium product of the cork industry and the commercial value of cork is determined by its suitability for the production of stoppers. Cork is a biological material with cellular structure, chemical inertia and specific mechanical behaviour that provide an unmatched closure for bottles with worldwide recognition of quality and performance as wine sealant. The aim of this study was to characterize the variability and quantify the surface porosity of wine cork stoppers that were produced from cork boards of different callipers and are of different commercial quality classes.

The porosity of 600 cork stoppers, 300 punched out from cork strips of calliper 27-32 mm and 300 from calliper 45-54 mm was characterized by image analysis on the total lateral surface and tops. Porosity coefficient was 2.5%, 4.0% and 5.8%, respectively for premium, good and standard stoppers from 27-32 mm cork boards, and 2.4%, 4.0% and 5.5% for the premium, good and standard quality class from 45-54 mm. In average, stoppers produced from the thinner cork boards (calliper 27-32 mm) present less pores but with higher average area and maximum pore area than the stoppers produced from 45-54 mm.

The commercial quality classes of cork stoppers can be differentiated by the mean values of the main porosity features of their surface namely dimension and concentration variables, considering either the lateral surface or tops. These features showed an increasing trend from the best to standard quality class independently of the corkboard calliper from which they were produced.

Due to the large sampling and the detailed observation the results may be used for reinforcing quality requirements for the cork stoppers commerce i.e. definition of standards.

Keywords: natural cork stoppers, quality classes, corkboard calliper, porosity, image analysis

OP039

Study of the bonding of cork using ABES technique

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Portugal is the largest worldwide producer of cork and the cork industry plays an important role in Portuguese economy. Cork is a renewable and recyclable raw material and presents unique characteristics as lightness, elasticity, fire resistance, impermeability, and sound and thermal insulation. It is used in several products as stoppers, flooring, footwear components, sound control underlayment, etc. In 2006 the Portuguese cork oak forest represented a carbon sink of around 4.8 million tons.

Cork agglomerate composites use residues from cork stopper production and it is a material of excellence in the field of Sustainable Construction, mostly in flooring and wall applications. Cork agglomerate panels are a cork based sheet material manufactured from cork particles bonded together with a synthetic resin adhesive under a hot-pressing process. This process is quite complex as involves simultaneous and coupled heat and mass transfer, polymerization of the adhesive and forming. Therefore, mechanical, physical and chemical interactions as compression, stress relaxation, softening and distortion of cell wall structure, heat and mass transfer, phase changes of water, as well as adhesive curing and adhesion takes place within a pressing cycle. The dynamics of the strength development influences production speed, energy consumption and product quality. So, a better understanding of the cork particle – adhesive interactions within cork composite mat is important for the optimization and control of this operation.

This paper presents a new application for ABES (Automated Bonding Evaluation System), a technique developed for determining the rate of strength development of adhesives as they cure, in wood lap shear joints. This equipment provides a quantitative means of understanding the dynamics of bond strength development under highly controlled conditions. It allows for accurate control of bonding pressure, platen temperature, and bonding dwell time and good alignment of the lap shear samples. To explore the reactivity of adhesive-cork combination during hot-pressing, a new sample configuration was proposed. Isothermal bond strength development was plotted as a function of time for several platen temperatures and kinetic parameters were computed from these plot families, for each type of adhesive. This technique seems to be appropriate to assess the sensitivity of an adhesive/cork system to different process variables, enabling a quantitative screening of adhesives and operating conditions in industrial context.

Keywords: cork composites, thermosetting resins, Automated Bonding Evaluation System, resin cure

OP202

Scavengers to reduce formaldehyde emission from wood-based panels

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Wood is a privileged way to stock CO2 in nature. During growth, carbon dioxide (CO2) is removed from the environment and incorporated in wood structure. The use of wood as biofuel would release carbon stoked during years. Stimulating the recycling of wood for the production of wood-based panels, will prevent this carbon of being released contributing for the carbon sequestration. Nowadays, particleboard industry uses 50 to 100 % of recycled wood; using wood-based products contributes to the global goal of greenhouse gases emission reduction.

Urea-formaldehyde resins are still the most commonly used adhesive to produce wood-based panels due to their high reactivity, low cost and excellent adhesion to wood. Nevertheless, their main disadvantage is the low resistance towards water and moisture, especially at high temperature, thus promoting hydrolysis of aminomethylene links and causing continuous formaldehyde released from the panel. Due to the recent classification of formaldehyde by the International Agency for research on Cancer (IARC) as "carcinogenic to humans (Group 1)", companies are compelled to produce low formaldehyde emission panels. Up to the present the reduction of formaldehyde to urea molar ratio was the common approach used but the minimum usable limit has been already reached. Other approaches were also applied with success as incorporating melamine in resin polymeric structure. Another approach to reduce formaldehyde emissions is using scavengers, but normally this approach is normally linked with the reduction of the physical properties of the panels. However, old panels presents itself formaldehyde from adhesive used that will contribute to formaldehyde emission of the new panels, reinforcing the used of formaldehyde scavengers.

The selection of chemical scavengers and process application are variables with critical impact in the reduction of formaldehyde emissions. The application of scavenger mixed with adhesive is the simplest approach, but the premature reaction of scavenger with formaldehyde penalises the cure reaction and therefore the physico-mechanical properties. Is this work, different procedures for the application of chemical scavengers are studied in order to understand the relevant reactions and mechanisms that occur during the hot-pressing. The main goal of this work is to find suitable systems for producing wood-based panels using formaldehyde based resins, with formaldehyde emissions at the same level as natural wood.

Keywords: Wood-based panels, formaldehyde emissions, formaldehyde scavengers, formaldehyde based resins

OP204

Eucalypt coppice management for multiple-use in South Africa

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Eucalypts were introduced into South Africa late in the 19th century, initially as a source of timber for the mining industry, but by the late 1980's they were most commonly planted for pulp. Due to the types of buds found in eucalypts (epicormic buds and/or lignotubers), most have the ability to regenerate coppice shoots after felling. Dependent on a number of criteria, the stepwise and selective thinning of these coppice shoots can be used for the re-establishment of commercial plantations. As such, all the past coppice management research in South Africa was exclusively focused on maximizing timber volume production alone.

To supplement the quantity of timber required by the larger companies for their pulp mills and/or chipping plants, additional timber supplies have been obtained from rurally based, small-scale timber growers that belong to various timber growing schemes. Although the average size of each of their planted areas is small (1.5 ha), collectively the large number of growers participating in these schemes provides an important source of timber to the commercial companies. Besides supplying timber to the commercial companies, the eucalypt coppice shoots/stems are also used by these small-scale timber growers for fencing (droppers and poles), building (laths or poles), or as a source of firewood. Thus, the management of these stands is varied, with no consensus amongst the different growers as to the best management practices for any specific product. It is therefore critical to determine the most effective manner in which coppice regrowth can be managed for multiple-use (fuel wood, droppers, building material, wood for pulp, etc.) rather than focusing on maximizing volume production alone.

In 2005, a trial was initiated in the sub-tropical region of Zululand, South Africa, on a recently felled Eucalyptus grandis x E. camaldulensis stand. Twelve different multiple-use management scenarios were tested against a commercial control over the subsequent 6 years. The most appropriate coppice systems are highlighted that include product-specific, as well as multiple-product options.

Keywords: building material; coppice; Eucalyptus; fencing material; rural communities

OP205

The Recovery Rate and Lumber Quality of Two Lesser Utilized Species (LUS) in Ghana: Essential Technical Measures to promote LUS

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With the dwindling volumes of the primary species and the 'acceptable' lesser used timber species due to overexploitation, there is scarcity of timber supply for both domestic in Ghana and international