行政院所屬各機關因公出國人員出國報告書

（出國類別：出席國際會議）

# 出席「第十二屆國際木材與造紙化學研討會」報告

服務機關：行政院農業委員會林業試驗所
出國人員　職　　稱：研究員兼組長
　　姓　　名：蘇裕昌
出國地區：美國
出國期間：九十二年六月七日至六月十八日
報告日期：九十二年七月八日

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# 公 務 出 國 報 告 提 要

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報告名稱:

出席「第十二屆國際木材與造紙化學研討會」報告

主辦機關:

行政院農業委員會林業試驗所

聯絡人／電話:

黃明仁／23039978#1215

出國人員:

蘇裕昌　行政院農業委員會林業試驗所　木材纖維組　研究員兼組長

出國類別: 其他

出國地區: 美國

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分類號/目: F8／林業　F8／林業

關鍵詞: 轉植基因赤桉(Eucalyptus camaldulensis)甜楓(Liqui dambar styraciflua)木材的木質素（Lignin）及精油（Essential oil）的變化

內容摘要: 國際木材及製漿化學會議爲世界上各主要國家：美、日、瑞典、芬蘭、加拿大、紐澳、俄羅斯、歐聯研究人員成立之研究會議，每二年舉辦一次，由上述諸國輪流主辦，本次已爲第12屆，由美國農部與威斯康辛大學主辦，各國的製漿造紙協會合辦統計演講口頭發表96件，壁報發表160件。分爲9個部門分組討論。（1） 製漿漂白之新技術（2） 木材、製漿漂白化學之新分析法（3） 纖維表面化學（4） 非木纖維之利用及化學（5） 木質材料的高附加價值產品（6） 纖維素及其衍生物化學（7） 纖維組合板（8） 木質成分的生成及化學構造（9） 木質材料基因工程 本人發表的論文爲基因轉植赤桉的木質素及精油的變異，開發利用熱解-氣層分析（Pyr-GC）分析方法用於分析區別木質素中的構造性變化同時分析轉植赤桉材中之精油成分。屬新分析方法之開發頗受肯定。

本文電子檔已上傳至出國報告資訊網

目　　次

一、緣起與目的

木材的化學利用中的最大宗是製版造紙利用，為了得到木材的最佳利用，對其化學的探討是十分必要的。國際木材及製漿化學研討會即為以此為目的創設，本年度針對基礎研究及應用研究，每二年集會一次，今年為第十二屆，由美國農業部林產研究部主辦，在威斯康新州立大學舉辦。

二、行程與任務

| 日期 | 星期 | 行程 | 任務 |
|---|---|---|---|
| 六月七日 | 六 | 台北-東京-芝加哥-麥迪遜 | 行程 |
| 六月八日 | 日 | 麥迪遜 | 報名及註冊 |
| 六月九日 | 一 | 麥迪遜 | 研討會報告、基調演講 |
| 六月十日 | 二 | 麥迪遜 | 論文宣讀 |
| 六月十一日 | 三 | 麥迪遜 | 論文宣讀及海報展示討論 |
| 六月十二日 | 四 | 麥迪遜-芝加哥-萊禮 | 論文宣讀及行程 |
| 六月十三日 | 五 | 萊禮 | 參觀北卡州立大學造紙科學系 |
| 六月十四日 | 六 | 萊禮 | 週末休息 |
| 六月十五日 | 日 | 萊禮 | 週末休息 |
| 六月十六日 | 一 | 萊禮 | 參觀北卡州立大學分子生物學中心 |
| 六月十七日 | 二 | 萊禮-芝加哥-東京-台北 | 行程 } 經換日線時差 |
| 六月十八日 | 三 | 台北 | 行程 延後一日到達 |

三、成果與心得

1、參加會議現況

本會議參加國有紐澳、巴西、加拿大、芬蘭、法國、德國、日本、挪威、俄羅斯、葡萄牙、瑞典、美國、韓國、菲律賓及我國，參加人數約有400人。統計演講口頭發表96件，壁報發表160件。分為9個部門分組討論。

（1）製漿漂白之新技術

（2）木材、製漿漂白化學之新分析法

（3）纖維表面化學

（4）非木纖維之利用及化學

（5）木質材料的高附加價值產品

（6）纖維素及其衍生物化學

（7）纖維組合板

（8）木質成分的生成及化學構造

（9）木質材料基因工程

2、有關製漿及漂白化學的進展

多數的研究仍為基礎研究，探討製漿及漂白時木質素分解之模式，反應性及所形成之木質素構造，或殘留木質素之漂白性等，其中尚有多篇論文探討各種無氯漂白流程時的各種漂白反應及利用尖端新技術的無公害漂白技術。

3、木材、製漿漂白化學的分析法

利用新的技術如拉曼光譜，近紅外光光譜或核磁共振質譜儀（NMR）、質譜儀（MS）分析進行木材或木材表面的木質素分析。藉以了解木材纖維或木材的性質或其組成含量，藉以了解製漿或漂白時材料與漂白藥劑之反應機制、效率等。

4、纖維與紙的表面性質

各種漂白處理對纖維表面性質之影響及纖維表面的構造性質。

四、檢討與建議

木材及製漿造紙化學會議集合各國林產化學與製漿造紙領域的學者進行學術研究及實際經驗的交流，由參與該會可獲知最新之研究趨勢及實際應用技術，獲益良多。第13屆會議將於2年後於紐西蘭舉行，希望屆時國內會有多人與會發表論文提升國內研究水準。

# Alterations of Essential Oil and Lignin in *Eucalyptus camaldulensis* and *Liquidambar styraciflua* through Genetic Manipulation

Yu-Chang Su[1], Chen-Lung Ho[1], Shu-Hwa Chang[1], Cheng-Kuen Ho[1], Yi-Chiann Chen[1], Jia-Bin Tsai[1], Vincent L. Chiang[2], and Zenn-Zong Chen[1]

[1] Taiwan Forestry Research Institute, Taipei 100, Taiwan

[2] North Carolina State University, Raleigh, NC 27695-8008, USA

## ABSTRACT

An efficient *Agrobacterium*-mediated transformation system, which is well coupled with superior clones of *Eucalyptus camaldulensis* selected from conventional tree improvement program, has been developed. Using this system, a secondary metabolism pathway gene encoding cinnamate 4-hydroxylase (C4H) isolated from aspen was successfully transferred into *E. camaldulensis* with constructs in sense or antisense orientation. Essential oil and lignin compositon were determined in the 2-year-old field-tested trees. Significant differences are found in essential oils among trees derived from the transgenic lines with varied transgene constructs or inserts and the non-transformed individuals. Alterations of lignin content and structures in the transgenic *E. camaldulensis* were found. Transgenic *Liquidambar styraciflua* (sweetgum) plants carrying a full length of the aspen cDNA gene encoding 5-hydroxy-coniferyl aldehyde O-methyltransferase (AldOMT) have been produced and out-planted to a test plantation for 6 yrs. This heterologous gene has caused the presence of red-brown wood in the transgenic trees. Cosuppression of the genes expression between the foreign recombinant DNA and the aldOMT endogene has also resulted in the incorporation of a higher amount of coniferyl aldehyde residues in the lignin of the transgenic sweetgum xylems.

## INTRODUCTION

Gene cloning and recombination coupled with transgenic plant technology allow the exchange of genetic materials among the widely dispersed genotypes, providing a revolutionary new approach for genetically manipulating plant growth characteristics. Lignin served as substrate glue in the linking the carbohydrate skeletons in wood and constituting the second most abundant organic material on earth. As about 20 to 35% of the drying weight in wood is composed of lignin (1), genetic manipulation of the biosynthesis process of lignification could represent a fast track to tree improvement.

Eucalypts are some of the most important plantation hardwoods in the world. *Eucalyptus camaldulensis* (river red gum) occupies a greater geographic range than any other eucalypt species in Australia and is now grown successfully in many countries over a wide range of habitats. The species has been provenance tested in Taiwan since 1987, and fast-growing phenotypes from the best provenances had been selected. We have also successfully developed vegetative methods of grafting, rooted cuttings and the *in vitro* micropropagation for the multiplication of selected individuals (2-3). An effective transformation system for genetic modification of elite tree of the species was also established (not yet published). Recently, Sewalt et al. (4) have shown lignin content reduction and structural alteration in transgenic tobacco with down-regulated gene expression on cinnamate 4-hydroxylase (C4H). There is no report we are aware of presenting similar results on tree species. We have successfully transferred a C4H gene cloned from *Populus tremuloides* into *E. camaldulensis* and duplicates of each transgenic line of the plants are field-tested.

Sweetgum, *Liquidambar styraciflua*, is a major economic hardwood in southern United States with rapid growth and wide geographical distributions. It is used for the cores of structural plywood or blended with pine pulp for the paper industry. A xylem specific gene encoding 5-hydroxyconiferyl aldehyde O-methyltransferase

(AldOMT) from quaking aspen has been reconstructed and transferred into the species (5). The transgenic plants have been out-planted in the field for up to 6 years.

We report the chemical analyses on the wood of different transgenic lines of *E. camaldulensis* and *L. styraciflua*. The effects of transgenes on wood characteristics such as lignin content, monolignol composition, cellulose content, essential oils etc. are described.

## METHODS AND MATERIALS

### Transgenic plants

The C4H gene from quaking aspen was reconstructed in a sense (pSC4H) or an antisense (pASC4H) orientation at the T-DNA position of plasmid pBI121. The plasmids were then moved into the strain C542 of *Agrobacterium tumefaciens*. Using an *Agrobacterium* mediated transformation, the gene was introduced into a fast-growing phenotype of *E. camaldulensis* and subsequent plantlet micropropagation *in vitro* produced the transgenic trees. Similar protocols were used in the production of transgenic sweetgum.

Polymerase chain reaction (PCR) and Southern hybridization were used to verify the integration of the transgenes into the target plant genomes (6). Transgenic plants were then vegetatively propagated to generate enough rooted propagules for out-planting to the test plantation (2-3).

### Wood analyses

Breast-height wood sections from the transgenic tree samples (2-yr-old *E. camaldulensis* and 3- and 6-yr-old *L. styraciflua*) were milled and their MWL prepared. In addition to the routine wood chemistry analyses, pyrolysis GC (Py-GC) analyses was undertaken in accordance with the method of Tanaka et al. (7) to determine the lignin composition. Seven each of the guiacyl-type (G) and syringyl-type (S) Py-GC main products were used for the determination of S/G ratios.

## RESULTS AND DISCUSSION

### Molecular verification of transgenic plants

In the stages of transgenic shoot and plant regeneration, total genomic DNA of *E. camaldulensis* was periodically extracted from regenerated shoots and/or leaves of *in vitro* plantlets and characterized by PCR and specific primers for the presence of the transgenes.(8) An expected 790-bp DNA fragment of the NPT II gene, which was the selectable marker conferring kanamycin resistance for transformants, was amplified from each of the total DNA from *in vitro* transgenic plants of 5 independent transformed lines. Also, a 1,800-bp DNA fragment of the C4H transgene, representing a correct restriction fragment, was amplified (data not shown). The genomic organizations of rooted cuttings derived from the 4 independent transformed lines were analyzed by the Southern hybridization. In molecular analyses of transgenic sweetgum, the aspen AldOMT gene incorporated with the chromosomal genome was shown in the Southern blot.

### C4H transgenic *E. camaldulensis*

Lignin and holocellulose content of the 2-yr-old C4H transgenic river red gum are shown in Table1. Although the sense transgenic S7-2 has 10.2% lower lignin content than the control, but the difference is not statistically significant. The antisense transgenic AS21-1, on the other hand, has 16.5% lower lignin than the control, and differs significantly from the control and other transgenic trees. As for the monolignol S/G ratio, all transgenic trees are not significantly different from the control, despite a 20% lowering of the ratio in the AS21-1 sample. The holocellulose content of all transgenic plants are slightly enriched than the control, but there is no significant difference among them.

The leaves of the sample trees were steam distillated and the essential oils collected. The oil yields are shown in Table2. The results show that the sample from AS3-6 has 13% more essential oil, while AS21-1 has 31% less

essential oil. As there is no report indicating that C4H gene modification will cause change in essential oil content, the causes of such changes await further investigation.

GC and GC-MS determinations on the essential oils composition of the river red gum suggested that they are composed of both oxygenated and non-oxygenated monoterpenes and sesquiterpenes. Table 3 shows the terpene and terpenol compositions of the control and transgenic *E. camaldulensis*. Identification of the individual components indicated 8 major components, viz., monoterpenoids: α-pinene, and ρ-cymene for terpenes and 1,8-cineole, and α-terpineol for terpenols; sesquisterpenoids: lendene and junipene for terpenes and α-eudesmol, and β-eudesmol for terpenols. Among the monoterpenoids, the content of 1,8-cineole shows the greatest variation. The transgenic AS21-1 has the least content of ρ-cymene. There are relatively little variations in sesquiterpenoid contents among the trees.

**Table 1.** Variations in lignin and cellulose content in the wood of 2-yr-old plantationgrown C4H transgenic *Eucalyputs camaldulensis*.

| | S/G ratio | Lignin (%) | Holocell-ulose (%) | Essential oil (%) |
|---|---|---|---|---|
| Control | 2.32 | 23.63 | 71.80 | 1.39 |
| AS3-6 | 2.23 | 23.29 | 73.65 | 1.58 |
| S7-2 | 1.90 | 21.22 | 72.69 | 1.26 |
| AS21-1 | 1.76 | 19.72 | 73.67 | 0.97 |

**Table 2.** Variations in essential oils from the leaves of 2-yr-old plantation grown transgenic *Eucalyptus camaldulensis*.

| Code | Monoterpenoid | | | Sesquiterpenoid | | |
|---|---|---|---|---|---|---|
| | Terpene | Terpenol | Total | Terpene | Terpenol | Total |
| Con-trol | 0.13 (100) | 1.01 (100) | 1.14 (100) | 0.11 (100) | 0.08 (100) | 0.18 (100) |
| S7-2 | 0.11 (86.53) | 0.91 (89.74) | 1.02 (86.56) | 0.08 (75.42) | 0.15 (141.41) | 0.23 (126.62) |
| AS3-6 | 0.15 (117.99) | 1.14 (112.42) | 1.29 (117.94) | 0.17 (160.26) | 0.11 (103.70) | 0.28 (154.14) |
| AS21-1 | 0.07 (55.06) | 0.74 (72.98) | 0.81 (55.24) | 0.08 (75.42) | 0.07 (65.99) | 0.15 (82.58) |

Note :(1) AS, S: transgenic shoots carrying the C4H gene in an antisense and sense orientation respectively
(2) Percentage base on o.d.. *Eucalyptus camaldulensis* leaves

**Table 3.** Variations in the major components of essential oils in the leaves of transgenic *Eucalyptus camaldulensis*.

| | Control | AS3-6 | AS21-1 | S7-2 |
|---|---|---|---|---|
| α-Pinene | 0.08 | 0.09 | 0.05 | 0.06 |
| ρ-Cymene | 0.02 | 0.02 | 0.004 | 0.01 |
| 1.8-Cineole | 1.08 | 1.12 | 0.72 | 0.91 |
| α-Terpineol | 0.04 | 0.06 | 0.02 | 0.03 |
| Junipene | 0.01 | 0.01 | 0.01 | 0.01 |
| Lendene | 0.01 | 0.01 | 0.02 | 0.01 |
| α-Eudesmol | 0.03 | 0.04 | 0.04 | 0.04 |
| β-Eudesmol | 0.10 | 0.08 | 0.04 | 0.07 |

Percent base on o.d. *Eucalyptus camaldulensis* leaves

The effects of C4H gene transfer on the S/G ratio of lignin and the changes in cellulose, lignin, and essential oil content suggested that along with diminishing S/G ratio in lignin, total lignin and essential oil content tended to increase, while holocellulose content showed little differences.

### AldOMT transgenic *L. styraciflua*

Some 3- and 6-yr-old transgenic sweetgum trees from an isolated plantation were collected and analyzed in a similar manner as the C4H transgenic river red gum. The S/G ratios of the lignin were established by Py-GC analyses. The results are shown in Fig. 1 and Table 4. There is a clear trend for the transgenic trees to have reduced S/G ratios, indicating a marked increase of the guaiacyl type structures. All transgenic trees exhibited a reddish-brown wood color and a positive Wiesner color reaction, suggesting a high coniferyl aldehyde content in wood, which is most likely derived from the introduced gene. The dbh and tree height comparisons among the trees indicate that gene transfer has no apparent effect on tree growth.

Izumi et al (9) used pyrolysis GC-MS to measure the S/G ratios of 13 Japanese woods. The results are in congruency with the S/V ratios of the nitrobenzene oxidation method. Our study provides similar results. Comparing the control and transgenic sweetgum wood meals, it appears that (1) there is no

apparent difference in lignin content of the 3-yr-old trees but there is a notable increase in that of the 6-yr-old trees, and (2) there is a noticeable decrease in S/G ratio for both 3-yr-old and 6-yr-old. Fiber morphology observations suggested that the 3-yr-old transgenic trees have slightly longer fiber while there is no apparent change in fiber width. Cell wall thickness tends to increase slightly as well (Table 4).

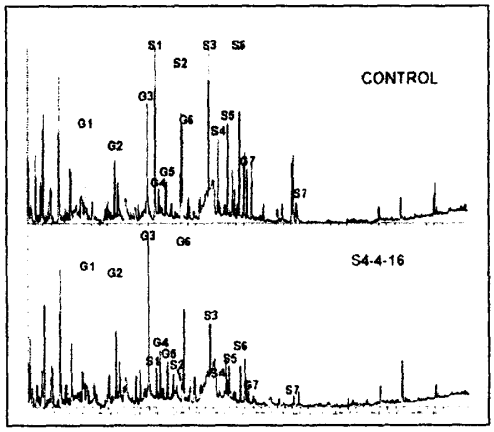


**Fig. 1.** Pyrolysis GC-MS chromatograms of the 6-yr-old control and an aldOMT transgenic *Liquidambar styraciflua.*

**Table4.** The lignin S/G ratio in relation to lignin content and fiber morphology of the 6-yr-old aldOMT transgenic *Liquidambar styraciflua.*

| | S/G ratio | | Lignin content (%) | | Avg. fiber length (mm) | Avg. fiber thickness x 2w (mm) |
|---|---|---|---|---|---|---|
| | 3 yr | 6 yr | 3 yr | 6 yr | 3 yr | 3 yr |
| Control | 2.13 | 1.80 | 18.75±0.20 | 17.09±0.11 | 0.99 | 0.18 |
| S4-2-11 | 0.33 | 0.61 | 18.61±0.08 | 18.58±0.06 | 1.04 | 0.21 |
| S4-2-13 | 0.58 | 0.76 | 18.16±0.10 | 19.91±0.02 | 1.30 | 0.17 |
| S4-4-10 | 0.59 | 0.54 | 18.75±0.09 | 19.97±0.04 | 1.11 | 0.23 |
| S4-4-16 | 0.72 | 0.96 | 18.34±0.09 | 20.06±0.2 | 1.02 | 0.19 |

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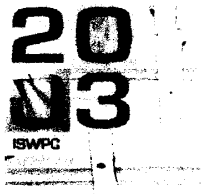


# 12th International Symposium on Wood and Pulping Chemistry

June 9–12, 2003
Monona Terrace Convention Center
Madison, Wisconsin USA

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**Technical Secretary**
Sally Ralph
USDA Forest Service, Forest Products Laboratory
One Gifford Pinchot Drive, Madison, WI 53726
saralph@wisc.edu Ph. 608-231-9449

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## Monday, June 9

8:30–9:00 **Opening Remarks**
Rajai H. Atalla, Kathleen M. Bennett, Christopher Risbrudt

9:00–9:40 **Condensation in Kraft Pulping. A Reality?**
Göran Gellerstedt, Department of Fiber and Polymer Technology, KTH, Royal Institute of Technology

9:40–10:10 Break

10:10–10:50 **Progress and Emerging Questions in Understanding Cellulose Biogenesis**
Candace H. Haigler, Department of Biological Sciences, Texas Tech University

10:50–11:30 **Recent Developments in Chemical Modification of Cellulose**
Akira Isogai, Graduate School of Agricultural and Life Sciences, The University of Tokyo

11:30–1:00 Lunch

| | Ballroom A | Ballroom B | Ballroom C |
|---|---|---|---|
| | ***Advances in pulping and bleaching chemistry***<br>**SESSION I**<br>Gordon Leary, APPITA, New Zealand | ***Analytical methods in wood, pulping and bleaching chemistry***<br>**SESSION I**<br>Dimitris Argyropoulos, North Carolina State Univ. | ***Surface chemistry of fibers and paper***<br>Gyosuke Meshitsuka, Univ. of Tokyo, Japan |
| 1:00 | **Trend in the Delignification of Lignin-Carbohydrate Complexes (LCC) during Kraft Cook and Oxygen Delignification of Softwood**<br>Martin Lawoko, Rickard Berggren, Fredrik Berthold, Gunnar Henriksson, Göran Gellerstedt | **Analysis of the Redistribution of Metal Ions in Softwood During Kraft Pulping by Synchrotron Radiation μ-XRF**<br>Harald Brelid, Anders Rindby, Laszlo Vincze | **Autoadhesive Bonding by Oxidative Treatment of Wood**<br>Ulla Westermark, Olov Karlsson |
| 1:30 | **Significance of β-aryl Ether Cleavage and Condensation Reaction during Alkaline Pulping**<br>Hiroyuki Nagatani, Yuji Matsumoto, Gyosuke Meshitsuka | **Characterization of Residual Lignin Structures by UV Resonance Raman Spectroscopy and the Possibilities of Raman Spectroscopy in the Visible Region with Kerr-Gated Fluorescence Rejection**<br>Anna-Stiina Jääskeläinen, Anna-Maija Saariaho, Pavel Matousek, Anthony W. Parker, Mike Towrie, Tapani Vuorinen | **Molecular Encapsulation of Optical Brighteners in Cyclodextrin-Modified Pulp Fibers**<br>Ezequiel Delgado-Fornué, Dante E. Giacomozzi-Vegas, Hector J. Contreras-Quiñones, J. Ángel Andrade-Ortega, L.R. Bravo-García |
| 2:00 | **An Overview of Side-Chain Oxidation on the Reactivity of Lignin Units**<br>Rallming Yang, Xianghui Wen, Yuan-Zong Lai | **Rapid Prediction of Solid Wood Lignin Content by Using Near Infrared Spectroscopy**<br>Ting-Feng Yeh, John F. Kadla, Hou-Min Chang | **Dielectric Discharge, a Concatenated Approach to Fiber Modification**<br>Lorraine C. Vander Wielen, Arthur Ragauskas |
| 2:30 | **Formation and Degradation of α-Carbonyl Structure in Lignin During Chlorine Free Bleaching of Kraft Pulp—Hidden Role of Hydrogen Peroxide**<br>Iori Tomoda, Yuji Matsumoto, Gyosuke Meshitsuka | **Determination of Carbonyl Group Profiles in Cellulosics by Fluorescence Labeling: Novel Applications of the "CCOA Method"**<br>Antje Potthast, Jürgen Röhrling, Thomas Rosenau, Paul Kosma, Herbert Sixta | **Anionic Groups in Papermaking Fibers: Origin, Depth Profile and Surface Distribution**<br>Pedro Fardim, Bjarne Holmbom |
| 3:00 | Break | | |

## Monday, June 9

| | Ballroom A | Ballroom B | Ballroom C |
|---|---|---|---|
| | ***Advances in pulping and bleaching chemistry***<br>**SESSION I**<br>Gordon Leary, APPITA, New Zealand | ***Analytical methods in wood, pulping and bleaching chemistry***<br>**SESSION I**<br>Dimitris Argyropoulos, North Carolina State Univ. | ***Surface chemistry of fibers and paper***<br>Gyosuke Meshitsuka, Univ. of Tokyo, Japan |
| 3:30 | **Selectivity Optimization of Extended Alkali Oxygen Delignification**<br>Steven Violette, Adriaan van Heiningen | **Mapping and Identifying Secondary Ions of Lignins Derived from the Surface of Woody Cell Walls by TOF-SIMS**<br>Kazuhiko Fukushima, Kazuchika Yamauchi, Yukiko Tsuji, Kaori Saito, Seiichi Yasuda, Motoki Takahashi, Takahiro Hoshi | **The Effect of Peroxide Bleaching on the Surface Chemical Composition of Mechanical Pulps**<br>Heli Kangas, Marjatta Kleen |
| 4:00 | **Effect on Reinforcement of Extraction Stages and a Philosophy for Controling Chlorine Dioxide Addition to the Final D-Stage**<br>Martin Ragnar | **AFM and DSC Studies on Water-Soluble Cellulose and Lignin Derivatives**<br>Tatsuko Hatakeyama, Hirotaka Sumino, Kazuhiro Zenjyo, Hyoe Hatakeyama | **The Effect of Enzymatic Treatments on the Surface Chemistry of Mechanical Pulp Fibers and Fines**<br>Marjatta Kleen, Heli Kangas |
| 4:30 | **Enhancing the Chemical Basis for Improved Kraft Pulping with PS, AQ, and PS/AQ**<br>T. Dyer, Z. Feng, A.J. Ragauskas, D. Vaaler, S.T. Moe | **Bringing the Wood Nanostructure to Light—Silica-Casts of the Fiber Cell Wall**<br>Per Valdemar Persson, Andrew Fogden, Jonas Hafrén, Geoffrey Daniel, Tommy Iversen | **A Model for the Relationship between Thermal Stability, Particle Size, Particle Tackiness and the Propensity to Deposit**<br>T.M. Garver, M.Y. Boluk |
| 5:00 | **The Method of Increasing of Pulp Yield with Kraft Cooking**<br>R. Belodubrovsky, T. Mironova, V. Ermolinsky, I. Zhukova, G. Shneerson, S. Krivosheev, A. Nenashev, Ju. Adamian, V. Vasilevsky, I. Jossel | **Application of Microwave Thermo-Desorption and GC/MS on Gas Analysis of Thermal Degradation Products of Wood**<br>Elisabeth Windeisen, Albert Lingens, Thomas Fröschl, Gerd Wegener | |

**Madison, Wisconsin**
*with Monona Terrace Convention Center in foreground*

## Tuesday, June 10

| | Ballroom A | Ballroom B | Ballroom C |
|---|---|---|---|
| | ***Advances in pulping and bleaching chemistry***<br>**SESSION II**<br>Kristiina Poppius-Levlin, KCL Science and Consulting, Finland | ***Analytical methods in wood, pulping and bleaching chemistry***<br>**SESSION II**<br>Danielle Robert, CERMAV/CNRS, France | ***Aging chemistry of pulp and paper***<br>Barbara Cole, Univ. of Maine |
| 8:30 | **New Insights into Lignin Modification during Chlorine Dioxide Bleaching Sequences (III): Modification in (EO) vs. E Stages**<br>Brian N. Brogdon, Douglas G. Mancosky, Lucian A. Lucia | **Quantitative $^{31}$P NMR Detection of Radical Species: A New Tool for the Lignin Chemist**<br>Dimitris S. Argyropoulos, Kamilah Smith | **Brightness Stability and Hexenuronic Acid Content of Totally Chlorine-Free Hardwood Bleached Pulp**<br>Tsutomu Ikeda, Hiroshi Ohi |
| 9:00 | **Dissolved Wood Components in the Kraft Pulping Liquor—Effect on the Rate of Delignification and Pulp Bleachability**<br>R. G. Sjödahl, A. Keyoumu, P. J. Axelsson, M. Ek, M. E. Lindström | **Effect of Oxygen on Thermo-Mechanical Pulp Lignin—Quantification of Quinone Groups Content using $^{19}$F NMR Spectroscopy**<br>M.-C. Brochier Salon, N. Marlin, D. Lachenal, G. Mortha | **Detection of *p*-Hydroquinone in Photo-Yellowing Paper from CTMP of *Eucalyptus globulus* by Pyrolysis-GC-MS**<br>T. Seino, A. Yoshioka, M. Takai, Y. Kojima, Y. Ishikura, T. Ona, Y. Ishida, H. Ohtani, S. Tsuge |
| 9:30 | **New Process of Highly Concentrated Polysulfide Liquor by Electrolysis of White Liquor (III). Optimizing Polysulfide Concentration with the Electrolytic Polysulfide Production System**<br>M. Shimizu, K. Watanabe, K. Kurosu, Y. Nanri, T. Andoh, J. Tanaka | **An improved $^{13}$C Tracer Method for the Study of Lignin Structure and Reactions**<br>Noritsugu Terashima, Dmitry Evtuguin, Carlos Pascoal Neto, Jim Parkås, Magnus Paulsson, Ulla Westermark, Sally Ralph, John Ralph | **The Interaction of Lignocellulosics with UV Absorbing Light Stabilizers: The Effect of Water on the Interaction of the Intramolecular Hydrogen Bond in UVA Paper Stabilisers with the Hydrogen Bonding Network of Paper**<br>C. Williams, P. F. McGarry, C. Heitner, S. Moroze, J. deGuzman, R. St. John Manley, Theodorus van de Ven |
| 10:00 | Break | | |
| 10:30 | **Residual Lignin in Hydrogen Peroxide-Bleached Softwood Pulps**<br>Tarja Tamminen, Taina Ohra-aho, Bo Hortling, Maija Tenkanen | **Use of Cryogenic NMR Probes in $^{13}$C and $^{1}$H-$^{13}$C 2D NMR Techniques for Structural Analysis of Lignin Preparations**<br>E.A. Capanema, M. Yu. Balakshin, C.-L. Chen, K.L. Colson, H.S. Gracz | **Fibre-Reactive Yellowing Inhibitors—A Path to the Future Use of Mechanical Pulps**<br>Thomas Q. Hu |
| 11:00 | **The Beatability of Norway Spruce and Scots Pine Kraft Pulps**<br>Kai Toven, David Vaaler | **Non-Degradative Dissolution and Acetylation of Plant Cell Walls; High-Resolution Solution-State NMR**<br>Fachuang Lu, John Ralph | **Heat-Treated Wood Exposed to Weathering**<br>M.Nuopponen, H. Wikberg, T. Vuorinen, S. L. Maunu, S. Jämsä, P. Viitaniemi<br><br>***Environmental chemistry in the wood and pulp industry***<br>Barb Cole |
| 11:30 | **The Immobilized Porphyrin-Mediator System (PMS): An Advanced Biomimetic Model for the Oxidation of Lignin**<br>Claudia Crestini, Pietro Tagliatesta | **Electrochemical Study of Isolated Lignins from Kraft and Oxygen Delignified Pulps: Assessment of the Method and Correlation with $^{13}$C NMR Spectroscopic Analysis** M. Allix, G. Mortha, D. Lachenal, O.Reynes, H. Ledon | **Effects of Loop Closure on the Fiber Line in ECF Bleaching**<br>Karin Lindgren, Agneta Fuhrmann, Kati Vuorenvirta |
| 12:00–1:00 | TAPPI Wood Chemistry Committee Meeting Ballroom C | | |

## *Advances in pulping and bleaching chemistry*

**P1 Effect of Pulp Leachable Lignin and Hexenuronic Acids Contents on O-Stage Performance**
Kátia M.M. Eiras, Ann H. Mounteer, Gustavo Venturim, Jorge L. Colodette

**P2 Swelling of Mechanical Pulp Fines After Chemical Treatment**
Størker T. Moe, John Mosbye

**P3 A New Approach for Better Ozonation Selectivity in ECF Kraft Pulp Bleaching**
Dinah Nyangiro, Christine Chirat, Dominique Lachenal

**P4 Brightness and HexA Content after Cooking and Oxygen Delignification— A Statistical Approach**
Catrin Gustavsson, Martin Ragnar

**P5 Estimation of Mill Cooking Yield**
Catrin Gustavsson, Mats Näsman, Elisabeth Brännvall, Mikael E. Lindström

**P6 Donnan Effect and Distribution of $[SiV^{V}W_{11}O_4 0]^{6-}$ Anion in Pulp Suspension**
Kyösti Ruuttunen, Tapani Vuorinen

**P7 A Study of Quality Loss due to Dehydration of Sulphate and Sulphite Pulps**
Kristin Syverud, Kai Toven

**P8 Lignin – Mixed Solvent Interaction** Tatyana Skrebets, Konstantin Bogolitsyn

**P9 Study About Stability of *Pinus radiata* Wood Carbohydrates in Kraft Pulping and Bleaching**
S. Vera, J. Anzaldo, R. Sanjúan, J. Rivera, J. Vargas, H.P. Contreras

**P10 On the Reactivity of Lignin Models with Oxygen-Centered Radicals (I). Computations of Proton and Electron Affinities and O-H Bond Dissociation Energies**
Lubo Jurasek, Dimitris S. Argyropoulos

**P11 Methyltrioxorhenium: a New Catalyst for the Activation of Hydrogen Peroxide to the Oxidation of Lignin and Lignin Model Compounds**
Claudia Crestini, Raffaele Saladino

**P12 Kinetic Analysis of Polyoxometalate (POM) Oxidation of Non-Phenolic Lignin Model Compound** Tomoya Yokoyama, Hou-min Chang, Ira A. Weinstock, Richard S. Reiner, John F. Kadla

**P13 The Catalytic Oxidation of the Lignin Model Compounds**
N. Popova, K. Bogolitsyn, A. Kosheleva, E. Shulgina

**P14 Organosolv Delignification of Hardwood**
Maria Gusakova, Galina Pazuhina, Nikolay Afanasjev

**P15 Effect of Residual Lignin on Carbohydrate Preservation during Pulp Bleaching and Delignification with Oxygen and Ozone**
E.I. Evstigneyev, V.G. Ermolinsky, S.M. Shevchenko

**P16 Oxygen Delignification of High Kappa Kraft Pulp Using a Novel Protector System**
Shiyu Fu, Wei Wang, Lucian Lucia

**P17 How do Phenoxyl Radicals Form during Oxygen Delignification?**
Margaret Hausman, Thomas Elder, Raymond Fort Jr.

**P18 Chlorine Dioxide Delignification in a Flow-Through Reactor: A Study on Fibre Bed Hydrodynamics and Delignification Performance**
Y. Hamzeh, G. Mortha

**P19 The Difference in Pulp Properties for Once Dried Kraft Pulps with Varying Pulp Yield**
David Vaaler, Øyvind Eriksen, Størker T. Moe

**P20 Acetylation of Methyl-β-Xyloside by an Acetylxylan Esterase**
Peter Biely, Ken K.Y. Wong, Ian Suckling, Silvia Spániková

**P21 Hydrolase and Oxidoreductase Activated Oxidation Systems: Use for Delignification/Bleaching, Removal of Hexenuronic Acids and Effective Treatment of High and Low Kappa Pulps** H.P. Call

**P22 Zeolite Modification for the Bleaching of Mechanical Pulp**
C. Daneault, F. Turcotte, F. Brouillette, B. Chabot, C. Leduc

**P23 Study on Lignin Reactions in Oxygen Delignification Catalyzed by Mn(II) Assisted Polyoxometalates**
A. Gaspar, D. V. Evtuguin, C. Pascoal Neto

**P24 Kraft Pulping Behavior of Xylans from *Eucalyptus globulus*, *Eucalyptus urograndis* and *Betula verrucosa***
P. Pinto, D.V. Evtuguin, C. Pascoal Neto

**P25 Extracellular Proteomic Analysis of *Phanerochaete chrysosporium***
Naoki Yuda, Motoyuki Shimizu, Hiroyuki Wariishi, Hiroo Tanaka

**P26 Lignin Peroxidase from White-Rot Basidiomycetes *Trametes cervina*** Yuta Miki, Hiroyuki Wariishi, Hiroo Tanaka

**P27 Molecular Analysis of Glyceraldehyde-3-Phosphate Dehydrogenase Gene from *Coprinus cinereus***
Tomotaka Ippongi, Hiroyuki Wariishi, Hiroo Tanaka

**P28 Effect of Manganese and its Oxidation State on Peroxide Bleaching of Mechanical Pulp**
Jari Käyhkö, Juha Tamper, Hannu Manner

**P29 Structural Changes in Lignin during High-Boiling Solvent Pulping**
Takao Kishimoto, Asuka Ueki, Yoshihiro Sano

**P30 Influence of Organosolv Pulping Process on TCF Bleachability of *Arundo donax* L. Pulps**
Anatoly A. Shatalov, Helena Pereira

**P31 Hexenuronic Acids in Ethanol-Alkalai Pulping**
Anatoly A. Shatalov, Helena Pereira

**P32 Understanding the Role of Alkaline Extraction in the Laccase-Assisted Delignification**
M. Kim, R. Yang, X. Wen, S. Omori, Y.-Z. Lai, J.P. Nakas, S.W. Tanenbaum

**P33 On the Role of $Na_2S$ in Alkaline Pulping**
M. Yu. Balakshin, E.A. Capanema, C.-L. Chen

**P34 Effect of Flocculated Whitewater on Handsheet Optical Properties** Mariefel B. Valenzuela, Ramon A. Razal, Rex B. Demafelis

**P35 Characteristics of change in Carbohydrates during the Green Liquor Pretreament**
W. Ban, J. Song, L. A. Lucia

**P36 Residual Lignin of Spruce Kraft and Kraft-Borate Pulps**
Biljana Bujanovic, Elke Schoffers, John Cameron

**P37 Birch Wood Delignification by $CH_3COOH/H_2O_2$ with $H_2SO_4$, $TiO_2$ Catalysts**
S.A. Kuznetsova, V.G. Danilov, N.B. Alexandrova, O.V. Yatsenkova, N.M. Ivanchenko, B.N. Kuznetsov

**P38 Abies Wood Delignification by $CH_3COOH/H_2O_2$ with $TiO_2$ Catalyst under UV Irradiation**
B.N. Kuznetsov, V.G. Danilov, S.A. Kuznetsova, O.V. Yatsenkova, N.B. Alexandrova

**P39 Reductive Bleaching of Mechanical Pulps by Amineboranes – Molecular Simulation and Reaction Mechanisms**
Nancy L'Ecuyer, Cyrielle Lobit, Audrey Geldes, Sylvain Robert

**P40 A Comparison between Alkali Methanol Anthraquinone Pulping and Kraft Pulping of Pine Wood**
Zensaku Abe

**P41 Metabolomic Differential Display Analysis of the White-Rot Basidiomycete *P. chrysosporium* Grown under 100% $O_2$**
Daisuke Miura, Hiroyuki Wariishi, Hiroo Tanaka

**P42 Chemical Investigation of Oxygen-Alkaline Delignification**
V. Soultanov, S.M. Krutov, M.Ja. Zarubin

**P43 Effect of Wood Pyrolytic Tar on Birch Kraft Pulping**
D.A. Ponomarev, N.G. Kostujkevich, A.B. Nikandrov

**P44 Novel β-Ether Cleavage of Non-phenolic β-O-4 Lignin Substructure Model by Laccase-Mediator System**
Shingo Kawai, Masato Iwatsuki, Makoto Nakagawa, Masumi Inagaki, Ayuka Hamabe, Hideo Ohashi

**P45 Stability and Creaming of Colloidal Extractives in Black Liquor**
Esa Pirttinen, Per Stenius, Ulla Vainio

**P46 Understanding Wood Chemistry Changes during Biopulping**
Chris Hunt, William Kenealy, Carl Houtman

**P47 Chemical Characterization of the Water Soluble Components from Radiata Pine MDF Fiber**
Armando G. McDonald, Andrew Clare, Roger Meder

**P48 Determination of Oxygen Penetration Rate in Medium-Consistency Kraft Pulps**
Jean Bouchard, Stephanie Beck, Chad Bennington, Richard Berry

**P49 Electrochemical Delignification of Wood Pulp Using Polyoxometalate Mediators**
R.S. Reiner, E.L. Springer, R.H. Atalla

**P50 Prehydrolysis of Selected Model Compounds and Milled Wood Lignin** Andrea Obermaier, Herbert Sixta, Hedda K. Weber, Walter Milacher, Norbert Müller

**P51 Complex of Ecologically Friendly Technologies of Deep Organosolvent Chemical Processing of Wood and Annual Plants into Pulps and Thermoplastic and Solvent-Soluble (among them water soluble) Polymer Materials**
A.I. Mikhailov, L.D. Kaplun, I.A. Shilova, V.A. Pahomova, A.N. Sherban, H.G. Bazarnova, V.I. Markin, E.A. Kuznetsov, A.A. Sazin, N.V. Rassadina

## *High-value products from lignocellulosic materials*

**P52 DSC Studies on Sodium Lignosulfate-Based PU Hydrogels**
Takashi Itoh, Hyoe Hatakeyama, Hirotaka Sumino, Tatsuko Hatakeyama

**P53 Mechanical Properties of Sodium Lignosulfate-Based Rigid Polyurethane Foams**
Yasuhiro Asano, Hyoe Hatakeyama, Tatsuko Hatakeyama

**P54 Thermal and Mechanical Properties of Plant Oil-Based Rigid PU Foams Containing Molasses**
Hyoe Hatakeyama, Hiroshi Matsumura,Yasuhiro Asano, Tatsuko Hatakeyama

**P55 Activation of Coconut Shell Carbon with $CO_2$ and Copper Chloride** G. Toriz, K.M.C. Dickow, E. Delgado, F. Ramírez

**P56 Carbon Fiber from Lignin-Recyclable Plastic Blends**
Satoshi Kubo, John F. Kadla

**P57 New Fiberboards Wet Processing Technique**
G.I. Tzarev, R.B. Belodubrovsky

**P58 Technology of Foliferous Wood Tall Oil Application**
G.I. Tsaryov, A.A. Bagayev, R.B. Belodubrovsky

**P59 Preparation of Fiberboards from Waste Papers and Isolated Lignins** Junji Nemoto, Yasumitsu Uraki, Yoshihiro Sano

**P60 Biomorphous Ceramics from Wood for Engineering Applications**
Cordt Zollfrank, Heino Sieber, Peter Greil

**P61 Effect of Ozone Pretreatment on Enzymatic Saccharification of Mushroom Grown Wood Meal**
Tomoko Sugimoto, Kengo Magara, Shuji Hosoya

**P62 Paperboard Performance after Treatment with Endoglucanase, Xylanase and their Combination**
Ken K.Y. Wong, Nathan T. Hamilton, Frances A. Signal

**P63 Acid Catalyzed Solvolysis of Lignocellulosic Waste for Preparing Useful Chemicals**
Tatsuhiko Yamada, Shuji Hosoya, Hirokuni Ono

**P64 Preparation of High Performance Paper Containing $TiO_2$ Photocatalyst Supported on Inorganic Fiber Matrix**
Yumi Iguchi, Hideaki Ichiura, Takuya Kitaoka, Hiroo Tanaka

**P65 Photocatalytic Decomposition of Bisphenol A in Water by Paper-Like $TiO_2$-Zeolite Composites**
Shuji Fukahori, Hideaki Ichiura, Takuya Kitaoka, Hiroo Tanaka

**P66 Adsorption/Ion Exchange Behavior between a Novel Amphoteric Granular Lignin Adsorbent and Reactive Red K-3B in Aqueous Solutions**
Huaiyu Zhan, Minghua Liu, Qianjun Liu, Baozhen Yue, Wei He

**P67 The Study of Low-Temperature Catalytic Conversion of Wood Carbohydrates into the Levulinic Acid and 5-Hydroxy-Methoxy-Furfural Derivatives**
V.E. Tarabanko, M.Yu. Chernyak, B.N. Kuznetsov

**P68 Enzyme Production by Two Aspergillus Strains using Spent Sulfite Liquor**
Z.A. Chipeta, J.C. du Preez, G. Szakacs, L. Christov

**P69 Enhancing High Humidity Compressive Performance of Linerboard with Covalent Crosslinkers. A Preliminary Evaluation** Ian D. Suckling, Maria F. Pasco, Dexter G. Morgan

**P70 Chemical Modification of Spruce Wood by Organosilicon Compounds**
G. Weichslberger, S. Knaus, H. Gruber

**P71 Can Water-Soluble O-Acetyl-Galactoglucomannans be Isolated in Large-Scale from TMP?**
Anna Sundberg, Stefan Willför, Patrik Rehn, Bjarne Holmbom

**P72 Investigating Biologically Active Compounds from Australian White Cypress Heartwood *(Callitris glaucophylla)***
Yasutaka Watanabe, Isao Murakumo, Tohru Mitsunaga

**P73 Deoderant Activity of Coniferous Barks and Proanthocyanidins on Ammonia and Methyl Mercaptan**
Tohru Mitsunaga, Yasuhide Saitoh, Sohta Abiko, Daisuke Mizuno

**P74 Investigating Glucosyltransferase Inhibitory Acitivity of Hydrolyzable Tannins from Tropical Woody Species**
Rie Mihara, Tohru Mitsunaga

### *Chemistry and utilization of non-woody materials*

**P75 Chemical Pulp Production from *Arundo donax* L. by Kraft-AQ Process and TCF Bleaching**
Sandra Abrantes, Emília Amaral, Ana Paula Costa, Anatoly Shatalov, Helena Pereira, Ana Paula Duarte

**P76 Bio-Chemical Pulping of Rice-Straw with *Pleurotus ostreatus* under Atmospheric Pressure**
Jin-Ha Kang, Heon-Do Park

**P77 Specificities of Bagasse and Wheat Sulphur-Free Lignins**
Stéphane Lepifre, Stéphanie Baumberger, Isabelle Mila, Brigitte Pollet, Catherine Lapierre

**P78 Preparation and Thermal Analysis of Palm Oil-Based Polyurethanes**
Ryohei Tanaka, Yasuhiro Asano, Shigeo Hirose, Hyoe Hatakeyama, Tatsuko Hatakeyama

**P79 Kinetic Study of the Acidic Oxidation of Sugarcane Bagasse Lignins Evaluated by UV, FTIR Spectroscopy**
Adilson R. Gonçalves, Lais P. Ferretti

**P80 Effect of Enzyme Treatment and Steam Explosion on Tensile Strength and Elongation of Elementary Hemp Fiber**
Frants Madsen, Ingo Burgert, Claus Felby, Karin Jungniki, Anne Thomsen

**P81 Delignification of Wheat Straw Soda-Pulp by Acidic Nitrate and Nitrite** Xuechen Shen, Huamin Zhai

### *Environmental chemistry in the wood and pulping industry*

**P82 Bioremediation of Lignocellulolytic Effluents by *Lentinus edodes* UEC 2019: Evaluation of Peroxidases Activity**
T.C.B. Paiva, E.S. Silva, J.V.B. Souza, F.T. Silva

**P83 Residual Lignin from Hardwood Oxygen-Bleached Kraft Pulp as Possible Precursor of 2,3,7,8-Tetrachlorodibenzofuran**
I. Nakayama, T. Yokoyama, T. Ikeda, H. Ohi, K. Nakamata

**P84 Mechanisms Involved in Fungal Degradation of Dioxins**
Y. Yamauchi, N. Hiratsuka, M. Oyadomari, H. Wariishi, H. Tanaka, K. Okada

**P85 Degradation of Nitroaromatic Compounds by Lignin-Degrading Basidiomycetes**
H. Teramoto, H. Wariishi, H.Tanaka

**P86 Activation of Aromatic Rings and Molecular Oxygen by Lignin-Degrading Basidomycetes as Key Steps for Metabolism of Diphenyl Compounds**
N. Hiratsuka, M. Oyadomari, H. Wariishi, H. Tanaka

### *Analytical methods in wood, pulping and bleaching chemistry*

**P87 Modelling Displacement Flow and Ionic Equilibria in Pulp Beds**
Erkki Räsänen, Risto Pajarre, Pertti Koukkari, Adriaan van Heiningen, Reijo Aksela

**P88 The Characteristic of Reactivity of Native Lignin's Preparations**
O.A. Samylova, A.M. Aizenshtadt, K.G. Bogolitsyn, M.V. Bogdanov

**P89 Characterization and Influence of Fungal Growth on Beech Wood used for the Production of Dissolving Pulp**
C. Gradinger, K. Messner, A. Promberger, H. Sixta

**P90 An Improved Method for Isolating Lignin in High Yield and Purity**
Shubin Wu, Dimitris S. Argyropoulos

**P91 The Characterisation of Archaeological Wood. A Case Study: The Conservation State of a Coffin**
Claudia Crestini, Nesrin El Hadidi, Guiseppe Palleschi

**P92 Metabolic Profiling—A New Tool in the Study of Wood Formation**
Cameron R. Morris, Jay T. Scott, Hou-Min Chang, Ronald Sederoff, David O'Malley, John F. Kadla

**P93 Characterization of Lignin Fragments in Alkaline-Oxygen Stage Waste Liquor as Soil Conditioning Agent**
Dongxiang Wang, Kyoko Katsumata, Gyosuke Meshitsuka

**P94 Determination of Carboxyl Groups in Wood Fibers by Headspace Gas Chromatography**
X.-S. Chai, Q.X. Hou, J.Y. Zhu, S-L. Chen, S.F. Wang, L. Lucia

**P95 Estimation of Extractives, Lignin and Natural Durability of Larch Heartwood (*Larix* spp.) by FT-NIR Spectroscopy**
N. Gierlinger, M. Schwanninger, R. Wimmer, B. Hinterstoisser, D. Jacques, L. E. Pâques

**P96 Characterization of Thermally Treated Beech Wood by UV-Microspectro-photometry, FT-MIR and FT-NIR Spectroscopy**
M. Schwanninger, N. Gierlinger, J. Hanger, C. Hansmann, B. Hinterstoisser, R. Wimmer

**P97 Multicomponent Chemical Process Model for Pulp Suspensions**
Pertti Koukkari, Risto Pajarre, Erkki Räsänen

**P98 On the Efficiency of Lignosulphonates Ultrafiltration**
Nikolay Afanasjev, Tatiana Lichutina, Larisa Parfenova, Olga Brovko

**P99 Fragmentation Kinetics of Beech Wood Derived Hemicelluloses**
Ursula Mais, Herbert Sixta

**P100 Structural Elucidation of Acacia Tannin by Pyrolysis-Gas Chrom-atography with On-Line Methylation**
Mirie Hasumi, Akiko Nakagawa-izumi, Hiroshi Ohi, Seiji Ohara

**P101 Prediction of Hard Wood Alkali Pulp Yield using Carbohydrates Analysis**
T. Koyasu, T. Yokoyama, T. Ikeda, H. Ohi, K. Nakamata

**P102 Developing Predictive Relation-ships Between $O_2$ Delignification and Physical Pulp Properties**
Rallming Yang, Yunqiao Pu, Lucian Lucia, Art Ragauskas, Hasan Jameel

**P103 Proteomic Differential Display Analysis of *Phanerochaete chrysosporium* Exposed to Aromatic Compounds**
Motoyuki Shimizu, Tomofumi Nakamura, Hiroyuki Wariishi, Hiroo Tanaka

**P104 A Rapid Quantitative Method to Assess Eucalyptus Wood Properties for Kraft Pulp Production by FT-Raman Spectroscopy**
Toshihiro Ona, Jyunichi Ohshima, Shinso Yokota, Nobuo Yoshizawa

**P105 Water in Paper Studied by NMR and FTIR**
Hanne Wikberg, Mari Nuopponen, Sirkka L. Maunu, Tapani Vuorinen, Juha Merta

**P106 Structural Changes of Lignin by Alkaline Oxygen Treatment-Quantitative Analysis by Liquid State FT-IR with ATR Method**
M. Yada, H. Shintani, G. Meshitsuka

**P107 AFM Observation of Kraft Pulp Fibers in Water: Preliminary Observation of Critical Point Dried Pulp Fibers in the Air**
Tomokazu Sasaki, Tetsuaki Okamoto, Gyosuke Meshitsuka

**P108 Proton and $^{13}C$ Transverse Relaxation of Lignin Macromolecules and the Influence of $T_2$ Values on Signal Quantification of the HSQC Spectrum of Lignin**
Liming Zhang, Göran Gellerstedt

**P109 Comparative Study on the Biodegradation of High-Molecular-Weight Components Produced by Chlorine-, Chlorine Dioxide-Ozone-based Bleaching Processes of Hardwood Kraft Pulp**
Keiichi Koda

**P110 Investigation of the Degree of Cellulose Crystallinity in TCF and ECF Bleached Pulps by Solid State NMR Spectroscopy**
Tiinia Liitiä, Sirkka Liisa Maunu, Bo Hortling

**P111 Sequencing Around 5-Hydroxyconiferyl Alcohol-Derived Units in COMT Deficient Lignins**
Fachuang Lu, John Ralph, Jane M. Marita, Catherine Lapierre, Lise Jouanin, Wout Boerjan

***P112 In situ* Quantitation of Ring-Conjugated Ethylenic Lignin-Units in Spruce Thermomechanical Pulps by FT-Raman Spectroscopy**
Umesh Agarwal, Sally Ralph

**P113 FT-Raman Study of Dehydrogenation Polymer (DHP) Lignins**
Umesh P. Agarwal, Noritsugu Terashima

**P114 FT-Raman Spectra of Cellulose and Lignocellulose Materials: "Self-Absorption" Phenomenon and its Implications for Quantitative Work**
Umesh Agarwal, Nancy Kawai

**P115 New Insights into Lignin Modification during Chlorine Dioxide Bleaching Sequences (I): Chlorine Dioxide Delignification**
Brian N. Brogdon, Douglas G. Mancosky, Lucian A. Lucia

**P116 Size-Exclusion Chromatographic Analysis of Celluloses using LiCl-DMI as an Eluent**
Masahiro Yanagisawa, Izumi Shibata, Akira Isogai

**P117 Raman Scattering and UV-Visible Spectroscopy Measurements of Dissolved Substances to Monitor Pulp Bleaching Reactions**
T.M. Garver, H. Yuan

**P118 A Model for Polyoxometalate Bleaching Reactor**
Ville Tarvo, Kyösti Ruuttunen, Juhani Aittamaa, Tapani Vuorinen

**P119 Near Infared Spectroscopy as a Tool for the Study of Genetic Determinism in Maritime Pine *(Pinus pinaster)***
Denilson da Silva Perez, Audrey Guillemain, Alain Bouvet, José Carlos Rodrigues, Guillaume Chantre

## *Fiber composites*

**P120 Effect of Aspect Ratio of Fillers on Mechanical Properties of Rigid Polyurethane Composities Using Oil Palm Empty Fruit Bunches**
Masahiro Funabashi, Shigeo Hirose, Ryohei Tanaka, Tatsuko Hatakeyama, Hyoe Hatakeyama

## *Genetic engineering on woody plants*

**P121 COMT Deficiency in an *Arabidopsis thaliana* Mutant Affects Both Lignification and the Biosynthesis of Sinapoyl Esters**
Catherine Lapierre, Brigitte Pollet, Isabelle Mila, Thomas Goujon, Richard Sibout, Dominique Buffard, Fachuang Lu, Paul Schatz, John Ralph, Yves Barrière, Lise Jouanin

**P122 Synthesis of Hydroxycinnamoyl-L-Malic Acids and Identification of 5-Hydroxyferuloyl-L-Malic Acid in COMT-Downregulated Arabidopsis**
Paul F. Schatz, Catherine Lapierre, John Ralph

## *Biosynthesis and chemical structure of wood components*

**P123 Oligolignans in Norway Spruce and Scots Pine Knots**
Stefan Willför, Markku Reunanen, Patrik Eklund, Lief Kronberg, Rainer Sjöholm, Suvi Pohjamo, Pedro Fardim, Bjarne Holmbom

**P124 Peroxidase-Catalyzed Polymerization of Monolignols: HPSEC Investigation of the Oligomerizaton Step**
Stéphanie Baumberger, David Fournand, Brigitte Pollet, Catherine Lapierre, Paul-Henri Ducrot

**P125 Characterization of Conventional Kraft and SuperBatch Pulp Residual Lignins Reacted with Peroxyformic Acid by $^{13}C$-NMR and FTIR Spectroscopy**
Petri Widsten, Bo Hortling, Kristiina Poppius-Levlin

**P126 Physical and Chemical Changes of Poplar Cell Walls during Tension Wood Formation**
A. Habrant, F. Laurans, A. Dejardin, J.C. Leple, G. Pilate, B. Cathala, B. Chabbert

**P127 New Complementary Information on the *E. globulus* Lignin Structure Obtained by $^{13}C$ NMR Selective Labelling and Advanced NMR Techniques**
D.V. Evtuguin, M. Yu. Balakshin, N. Terashima, C. Pascoal Neto, A.S.M. Silva

**P128 Stereo Preferential Degradation of β-O-4 Structure during the Process of MWL Isolation**
Aya Fujimoto, Yuji Matsumoto, Gyosuke Meshitsuka

**P129 Structure of Small Lignin Fragment Retained in Water Soluble Polysaccharide Extracted from MWL Isolation Residue**
Hikaru Aimi, Yuji Matsumoto, Gyosuke Meshitsuka

**P130 The Chemical Composition of Aspen Bark**
I.P. Deineko, N.M. Faustova

**P131 On the *cis-trans* Isomerism in Dibenzodioxocin-Type Lignin Structures**
Jussi Sipilä, Anssi Haikarainen, Pirkko Karhunen, Jorma Koskimies

**P132 Covalent Associations between Lignin and Polysachharides in Vascular Bundle, Fiber and Compound Middle Lammella of Plant**
Kyoko S. Katsumata, Tomoko Hirokawa, Kenji Iiyama

**P133 Characterization and Reactions of a *Salix* Extractive with a Unique Ring System**
Lawrence Landucci, Sally Ralph, Kolby Hirth

**P134 Variation in Chemical Composition of Earlywood and Latewood in Norway Spruce**
Andrey Pranovich, Jonas Konn, Bjarne Holmbom

**P135 Polymerization Rate and pH Effects on Lignin Formation and Lignin-Matrix Interactions in Maize Walls**
J. H. Grabber, Ronald D. Hatfield, John Ralph

### *Aging chemistry of pulp and paper*

**P136 Sulfonation of Lignin-Related Cinnamaldehydes and a Chalcone Derivative**
Knut Lundquist, Jim Parkås, Magnus Paulsson

**P137 Effects of Storage Conditions on Beech Wood Properties and on the Production of Mg-Sulfite Dissolving Pulp**
A. Promberger, C. Grandinger, K. Messner, H. Sixta

**P138 A Fluorescence Spectroscopic Study of the Long-Term Moderate Temperature Aging of ECF-Light Bleached Pine Kraft Pulps**
Henrik Tylli, Maija Tenkanen

**P139 Accelerated Aging of Wood-Containing Papers is a Poor Predictor of End-Use Aging**
Peter F. McGarry, John A. Schmidt, Cyril Heitner

**P140 Improvement of Brightness Stability of Peroxide-Bleached Mechanical Pulps by the Use of Tetraalkylammonium Salts**
Thomas Q. Hu

**P141 Aging of Printing and Writing Paper upon Exposure to Light. Part 2. Mechanical and Chemical Properties**
Chris Hunt, Xiaochun Yu, James Bond, Umesh Agarwal, Raj Atalla

### *Chemistry of cellulose and cellulose derivatives*

**P142 Degradation of Cellulose During Carboxymethylation**
Tove Schult, Bjørn E. Christensen, Størker T. Moe

**P143 Preparation and Liquid Crystalline Properties of Phenylacetoxycellulose Derivatives**
Qizhou Dai, Richard D. Gilbert, John F. Kadla

**P144 Thermal Treatment of Cellulose Pulps and its Influence to Cellulose Reactivity**
Thomas Röder, Herbert Sixta

**P145 Acylation of Cellulose in Carboxylic Acid-LiCl System**
Shigeo Hirose, Hyoe Hatakeyama

**P146 Studies into Chromophore Formation in NMMO Dopes**
Immanuel Adorjan, Thomas Rosenau, Antje Potthast, Herbert Sixta, Paul Kosma

**P147 Preparation and Alkaline Degradation of Model Compounds Related to Branched Xylan**
Jürgen Sartori, Antje Potthast, Herbert Sixta, Thomas Rosenau, Paul Kosma

**P148 The Chemistry of the Cellulose Solvent *N,N*-Dimethylacetamide/Lithium Chloride: Condensation Reactions, Reactive Intermediates and Cellulose Degradation**
Antje Potthast, Thomas Rosenau, Herbert Sixta, Paul Kosma

**P149 Raman Microprobe Analysis of Single Ramie Fiber during Mercerization**
A. Isogai, U. P. Agarwal, R. H. Atalla

**P150 TEMPO-Mediated Oxidation of Polysaccharides**
Yumiko Kato, Junichi Kaminaga, Ryukichi Matsuo, Akira Isogai

**P151 Degradation of Cellouronic Acid by Alkali or Cellulase to Prepare Hexenuronic Acid**
I. Shibata, K. Magara, K. Igarashi, A. Isogai

### *Surface chemistry of fibers and paper*

**P152 Effect of Physicochemical Conditions on the Properties of Zeolite Microparticles**
François Brouillette, Bruno Chabot, Daniel Morneau, Claude Daneault

**P153 Photocatalytic Oxidation of NOx by Paper-Like $TiO_2$ Composites Containing Zeolite and Metallic Oxides** H.Ichiura, T. Kitaoka, H. Tanaka

**P154 Preservative and Antibacterial Abilities of Wood to be fixed Hydroxyapatite which Part of Ca was Substituted for Antimicrobial Metals**
Hiroyuki Kagawa, Sumaru Itou, Haruhiko Yamaguchi

**P155 The Influence of Bleaching, Beating, and Drying in the Wet Fiber Flexibility of *Pinus pinaster* Kraft Pulp**
J.Curto, R. Simões, J.Silvy

**P156 Bio-Modification of Spruce Wood by *Ceriporiopsis subvermispora*: Comparison of the Effects of Three Different Strains**
Karin Fackler, Manfred Schwanninger, Barbara Hinterstoisser, Kurt Messner

**P157 Efficient Surface Modification of Pulp Fibers by Fluorine-Containing Reagents under Aqueous Conditions and its Application to Papermaking**
Satoru Fukuda, Shoichiro Yamashita, Akira Isogai, Hiroki Yamamoto, Takuya Kitaoka

**P158 A Comparison of Different Analyzing Techniques for Determination of the Chemical Surface Characteristics of Softwood Kraft Pulp Fibers**
Jeanette Risén, Anette Heijnesson Hultén, Magnus Paulsson

### *Chemistry and biotechnology in paper recycling*

**P159 Physical Characterization of Enzymatically Modified Fibers from Mixed Office Waste**
Qin Menghua, Shi Shulan, Li Zongquan, Gao Peiji, Qu Yinbo

**P160 Changes in Pulp Fibre Morphology Induced by Steam-Explosion Deinking**
Shuangfei Wang, Lucian A. Lucia, Chongxing Huang

## Wednesday, June 11

| | Ballroom A | Ballroom B | Ballroom C |
|---|---|---|---|
| | ***Advances in pulping and bleaching chemistry***<br>**SESSION III**<br>Carlos Pascoal Neto, Univ. of Aveiro, Portugal | ***Analytical methods in wood, pulping and bleaching chemistry***<br>**SESSION III**<br>Oskar Faix, Univ. of Hamburg, Germany | ***Chemistry and utilization of non-woody materials***<br>John Kadla, North Carolina State Univ. |
| 8:30 | **Mill-Scale Application of a Molybdate-Activated Peroxide Delignification Process in ECF and TCF Production of SW and HW Kraft Pulps**<br>Hannu Hämäläinen, Aarto Parén, Jukka Jäkärä, Thomas Fant | **Structure and Properties of Xylans Isolated from Kraft and Sulfite Pulps**<br>B. Saake, A. Rußler, S. Lebioda, J. Puls | **High Pressure Hydrogen Peroxide Bleaching of Kraft Bamboo Pulp**<br>Huang Ganqiang, Zhang Zeng, He Cuiping, Xie Yimin |
| 9:00 | **Reactivity of the Carbonate Radical Anion Towards Carbohydrate and Lignin Model Compounds**<br>David Stenman, Torbjörn Reitberger | **The Occurrence of Lignin-Carbohydrate Associations in Softwood Kraft Pulp Studied by Size Exclusion Chromatography**<br>Fredrik Berthold, Kristina Gustafsson, Mikael Lindström | **Highly Hydrophobic Surface on Sisal Chemithermo-Mechanical Paper by PFPDMS RF-Plasma Conditions**<br>Juan Ramos, Fernando Navarro, José Turrado, Florentina Dávalos, Ferencz Denes, Raymond Young |
| 9:30 | **Chromophore and Lignin Removal during ECF-Light Bleaching**<br>Kristiina Poppius-Levlin, Fredrik Lundqvist, Elisabeth Bergnor Gidnert, Tarja Tamminen, Maija Tenkanen | **Yield Prediction of Polysulfide and Polysulfide-AQ Cooks Based on the Mass Fraction and Degree of Polymerization of Cellulose in the Pulp**<br>Mehmet S. Tunc, Yang Gao, Adriaan R.P. van Heiningen | **Treatment of Wheat Straw by Potassium Carbonate and Sodium Hydroxyde: the Unmasking of a Hidden Side of Lignin**<br>Nathalie Durot, François Gaudard, Bernard Kurek |
| 10:00 | Break | | |
| | | | ***High value products from lignocellulosic materials***<br>**SESSION I**<br>John Kadla |
| 10:30 | **Adsorption of Colloidal Extractives to Different Types of Fines**<br>John Mosbye, Størker Moe | **Spectroscopic Determination of Anthraquinone in Kraft Pulping Liquors Using a Membrane Interface**<br>X.S. Chai, X.T. Yang, Q.X. Hou, J.Y. Zhu, L.-G. Danielsson | **Characterization of Amphiphilic Lignin Derivative – Formation of Langmuir Blodgett Film and Gel**<br>Yuriko Usukura, Yasumitsu Uraki, Takao Kishimoto, Yoshihiro Sano |
| 11:00 | **Importance of Hydroxyl Radicals during Hydrogen Peroxide Bleaching**<br>N.-O. Nilvebrant, David Stenman | **Studies on the Linkages between Dehydrogenation Polymer and Cell Wall Polysaccharide by Carbon-13 Isotopic Tracer Method**<br>Yimin Xie, Ruijun Gu, Takashi Watanabe, Shaoqiong Zeng, Hong Wu | **Thermal Modification of Almaciga (*Agathis philippinensis* Warb.) Resin and its Utilization for Paints**<br>Elvira C. Fernandez |
| 12:00–1:00 | TAPPI Wood Chemistry Committee Meeting Ballroom C | | |

## Wednesday, June 11

| | Ballroom A | Ballroom B | Ballroom C |
|---|---|---|---|
| | ***Advances in pulping and bleaching chemistry*** **SESSION IV** Størker Moe, Norwegian Univ. of Science and Technology, Norway | ***Analytical methods in wood, pulping and bleaching chemistry*** **SESSION IV** Ulla Westermark, Luleå Technical Univ., Sweden | ***High value products from lignocellulosic materials*** **SESSION II** Junyong Zhu, USDA, Forest Products Laboratory |
| 1:00 | **$CO_2$ Evolution during $H_2O_2$ Bleaching of Lignin-Containing Pulp** Craig Murphy, Theo G.M. van de Ven, Cyril Heitner | **Heat-Treated Wood Exposed to Different Fungi** H. Wikberg, M. Nuopponen, S. L. Maunu, F. Sundholm, T. Vuorinen | **Thermal Oxidation of Lignin: Effect of Heating Rate on Chemical Structure and $T_g$** Jennifer L. Braun, John F. Kadla |
| | | ***Biosynthesis and chemical structure of wood components*** **SESSION I** Ulla Westermark | |
| 1:30 | **Hardwood Soda-AQ Pulp Bleaching with Molybdovanadophosphoric Acids** Gottfried Kandioller, Lew Christov | **Lignin Stereochemistry and its Biosynthetic Implications** Knut Lundquist, Vratislav Langer, Shiming Li, Rolf Stomberg | **Phenolic Bioactive Substances in Wood and Knots of Different Spruce and Fir Species** B. Holmbom, J. Hemming, S. Willför, M. Reunanen, L. Nisula, C. Eckerman |
| 2:00 | **Details on Molecular Weight Distribution of Carbohydrates in Kraft Cooking using AQ, PS and $H_2S$ Gas Pretreatment** D. Vaaler, F. Berthold, S. Moe | **Ozone-Induced Lignification in Poplar** Catherine Lapierre, Brigitte Pollet, Jean-Claude Pireaux, Sylvain Ribert, Pierre Dizengremel, Mirelle Cabané | **Thermal Blending of Softwood and Hardwood Kraft Lignin with Poly(ethylene oxide): Effects of Lignin Structure on Blend Behavior** Satoshi Kubo, John F. Kadla |
| 2:30 | **Swelling Properties of Sulphite Pulps** Kristin Syverud, Kai Toven | **Impact of Pectin on the Reactivity of Coniferyl Alcohol: Model Investigations in Liquid and Solid State** B. Cathala, J. Touzel, B. Monties | **Thermal Degradation of Wood and Microstructure of Biocarbon** Cordt Zollfrank, Oskar Paris |
| 3:00 | Break | | |
| 3:30 | **How Lignin Oxidation is Related to the Delignification during Oxygen Bleaching** G. Tong, Y. Matsumoto, G. Meshitsuka, L. Zhongzheng | **Storage and Supply of Monolignol in Lignin Biosynthesis** Yukiko Tsuji, Seiichi Yasuda, Kazuhiko Fukushima | **Rigid Polyurethane Foams from Kraft Lignin and Sodium Lignosulfonate** Hyoe Hatakeyama, Yasuhiro Asano, Shigeo Hirose, Tatsuko Hatakeyama |
| 4:00 | **Supression of the Iron Redox Reactions by Ceriporic Acids Produced by a Selective Lignin-Degrading Fungus, *Ceriporiopsis subvermispora*** T. Watanabe, H. Teranishi, M. Enoki, N. Shirai, Y. Honda, M. Kuwahara | **Heterogeneity in Lignin Monomer Composition between Gymnosperms and Angiosperms is Satisfied by Means of a Multifunctional Basic Peroxidase Isoenzyme Responsible for the Polymerization Step** A. Ros Barceló, A. Paradiso, F. Pomar | **Plasticizer Efficacy in Alkylated Kraft Lignin-Based Polymeric Materials** Yan Li, Simo Sarkanen, Jyothi Varkey |
| 4:30 | **Structural Transformations of Lipophilic Extractives during *Eucalyptus globulus* Kraft Pulp Bleaching** Carmen S.R. Freire, Armando J.D. Silvestre, Carlos Pascoal Neto | **On the Reactivity of *p*-Quinone Methides in Lignin Biosynthesis and in Pulping** Jussi Sipilä | **Role and Reactivity of Low Molecular Weight Phenolics during the Processing of Starch Thermoplastics** St. Lepifre, S. Baumberger, C. Lapierre, P. Dole, D. Lourdin, F. Cazaux, X. Coqueret |

## Thursday, June 12

| | Ballroom A | Ballroom B | Ballroom C |
|---|---|---|---|
| | ***Advances in pulping and bleaching chemistry*** **SESSION V**<br>Tapani Vuorinen, Helsinki Univ. of Technology, Finland | ***Biosynthesis and chemical structure of wood components*** **SESSION II**<br>John Ralph, ARS-DFRC and UW Dept. of Forestry | ***Chemistry of cellulose and cellulose derivatives***<br>Akira Isogai, Univ. of Tokyo, Japan |
| 8:30 | **Gene Diversity of Cytochrome P450 Molecular Species in White-Rot Basidiomycete *Phanerochaete chrysosporium***<br>H. Wariishi, H. Ichinose, H. Kurihara, T. Ippongi, N. Hiratsuka, H. Tanaka | **Analysis of Structural Modification of Lignin during Mild Hydrochloric Acid Treatment in Aqueous Dioxane**<br>Tomokazu Sakaguchi, Yuji Matsumoto, Gyosuke Meshitsuka | **A Novel Method for Creating Cellulose Model Surfaces with Spin Coating**<br>Eero Konturri, Peter C. Thüne, J.W. (Hans) Niemantsverdriet |
| 9:00 | **Towards a Better Understanding of the Decreasing Effect of Oxygen Delignification**<br>Stefan Antonsson, Eva A. K. Pettersson, Martin Ragnar, Mikael E. Lindström | **Molecular Modeling Applied to Conformational Studies of Lignin β-O-4 Dimers and Lignin/Cellulose Interactions**<br>Stéphane Besombes, Danielle Robert, Jean-Pierre Utille, François Taravel, Karim Mazeau | **Reactions of Photochemically Generated Hydroxyl Radicals with Cellulose Models and Cellulose**<br>D.F. Guay, B.J.W. Cole, M.C. Hausman, R.C. Fort Jr., Ohkyu Lee |
| | ***Genetic engineering on woody plants***<br>Tapani Vuorinen, Helsinki Univ. of Technology, Finland | | |
| 9:30 | **Using Cell Cultures to Study Metabolite Changes Caused by a Lignin Mutation**<br>Claudio Stasolla, Jay T. Scott, Leonel van Zyl, Ronald R. Sederoff, John F. Kadla | **Characterization of Poplar Cell Wall Peroxidase Responsible for the Dehydrogenative Polymerization of Lignin**<br>Shinya Sasaki, Tomoaki Nishida, Yuji Tsutsumi, Ryuichro Kondo | **Recent Developments in Structural Studies using Oriented Highly Crystalline Cellulose Specimen**<br>Y. Nishiyama, M. Wada, P. Langan, H. Chanzy |
| 10:00 | Break | | |
| 10:30 | **Alterations of Essential Oil and Lignin in *Eucalyptus camaldulensis* and *Liquidamber styraciflua* through Genetic Manipulation**<br>Yu-Chang Su, Chen-Lung Ho, Shu-Hwa Chang, Cheng-Kuen Ho, Jia-Bin Tsai, Vincent L. Chiang, Zenn-Zong Chen | **Towards Better Understanding of Lignin Assembly: The Assessment of the Sequential Order of Building Blocks and Inter-Units Linkages Using Electrospray Ionisation Mass Spectrometry**<br>D.V. Evtuguin, F.M.L. Amado | **The Lyocell Process: Cellulose Solutions in *N*-Methylmorpholine-*N*-oxide (NMMO)- Degradation Processes and Stabilizers**<br>Thomas Rosenau, Tom Elder, Antje Potthast, Hebert Sixta, Paul Kosma |
| 11:00 | **Modifications in Lignin of Transgenic Alfalfa Down-Regulated in COMT and CCoAOMT**<br>J. Marita, J. Ralph, R. Hatfield, D. Guo, F. Chen, R. Dixon | **Ratio of *erythro* and *threo* Forms of β-O-4 Structures in Different Wood Species**<br>Takuya Akiyama, Deded S. Nawawi, Yuji Matsumoto, Gyosuke Meshitsuka | **Enzymatic Improvement of Cellulosic Fibres and Surface Characteristics**<br>Mónica López-Lorenzo, Vincent A. Nierstrasz, Marijn M.C.C. Warmoeskerken |
| | ***Fiber composites***<br>Tapani Vuorinen, Helsinki Univ. of Technology, Finland | | ***Chemistry and biotechnology in paper recycling***<br>Akira Isogai, Univ. of Tokyo, Japan |
| 11:30 | **Hot-Melt Composition for Fiber Composites that is Easy to Recycling**<br>E. Akim, L. Makhotina | **Modification in the Freudenberg Model for Lignin Biopolymerization**<br>Gunnar Henriksson | **An Auspicious Application of Laccase and Hydrogen Peroxidases for Biobleaching of Recalcitrant Paper Dyes**<br>Kristina Knutson, Arthur Ragauskas |
| 12:00–2:00 | Lunch | | |

## Thursday, June 12 *Closing Ceremony* Ballroom A

2:00 **Presentation of Notable Achievement Award to:**

**Gösta Brunow and Knut Lundquist**

Introductory Remarks – John Ralph and Ulla Westermark

Remarks by Co-Recipients

3:00 **Knut Kringstad Award, Committee Chair - Cyril Heitner**

3:15 **Announcement of the 14th ISWPC Host**

3:20 **Welcome to Auckland, New Zealand, for the 13th ISWPC**

3:35 **Closing Remarks**

### Knut Kringstad Award

The outstanding 12th ISWPC contribution (poster or oral) from a "young" researcher will be recognized with the Knut Kringstad Award. All participants who are Ph.D. candidates or have received their Ph.D. degrees within the past 3 years are eligible to participate. A volunteer subcommittee from the Scientific Committee will establish criteria and serve as judges.