

COST

Domain Committee "Forests, their Products and Services"

COST Action E50

Start Date 07/07/2005

End Date 09/06/2009

Cell Wall Macromolecules and reaction Wood (CEMARE)

FINAL EVALUATION REPORT

This Report stems from the relevant Domain Committee.
It contains four parts:

- I. Management Report** prepared by the COST Office/Grant Holder
- II. Scientific Report** prepared by the Chair of the Management Committee of the Action.
- III. Evaluation Report** prepared by the "ad hoc" Evaluation Panel, established by the Domain Committee, and edited by the COST Office.
- IV. DC General Assessment** prepared by the Domain Committee

Appendices:

- Appendix 1: Previous Annual Monitoring Progress Report Scientific Reports
- Appendix 2: Programmes of Action Meetings
- Appendix 3: Scientific and Technical Cooperation
- Appendix 4: STSMs
- Appendix 5: Publications and Reports

Confidentiality: the documents will be made available to the public via the COST Action web page except for chapter *II.D. Self evaluation* and *IV. DC General Assessment*.

Executive summary of the Scientific Report (max.250 words):

The Action brought together scientists from a broad range of disciplines to investigate cell-wall structure and formation and its effects on wood properties, particularly those of reaction wood. Working groups centred on cellulose and other cell wall polysaccharides, lignin, formation and structure of reaction wood, and the relationship between cell wall structure and timber properties. The Action organised six workshops, two of them jointly with other organisations (COST Action E41 in Turku, Finland, the International Lignin Institute in Dubendorf, Switzerland). There were also six working group meetings held at various times during the course of the Action. The success of the Action may be measured by its growth during the four years from an original 12 signatories to seventeen and by the fact that the number of participants rose from 75 in 2006 to 200 by 2009. Of these about 40% were early stage researchers, of whom 24 were enabled to undertake short term scientific missions. During the course of the Action there were significant developments in understanding of many aspects of the science, and the application of new techniques, which are listed in more detail in the report. The development of new techniques provided the motivation for many of the early stage researchers to undertake STSMs to learn these techniques and apply them to their own research. Some members of the Action will be continuing as participants in FP802 which is closely related in theme to E50.

I. Management Report

I.A. COST Action Fact Sheet

Title

Cell Wall Macromolecules and reaction Wood (CEMARE)

Contacts

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Details

Draft Mou:		Mou:	281/05
Start of Action:	07/07/2005	Entry into force:	09/06/2005
End of Action:	09/06/2009	CSO approval date:	15/06/2005

Objectives

The main objective of the Action is to achieve a better understanding of the structure and biosynthesis of wood macromolecules like lignin, hemicelluloses and cellulose and their impact on wall assembly and wood properties, including reaction wood, for the development of new products based on wood.

Parties

Country	Date	Country	Date	Country	Date
Austria	09/06/2005	Belgium	05/01/2006	Denmark	10/08/2007
Finland	09/06/2005	France	19/07/2005	Germany	09/06/2005
Italy	10/08/2007	Latvia	30/06/2005	Luxembourg	20/07/2005
Netherlands	09/06/2005	Norway	03/11/2008	Poland	09/06/2005
Slovenia	30/08/2005	Sweden	06/09/2005	Switzerland	29/06/2005
Turkey	27/06/2008	United Kingdom	21/06/2005		

Total: 17

Participating Institutions from non-COST countries

Queensland Department of Primary Industries and Fisheries (Horticulture and Forestry Science), Australia	University of Auckland New Zealand
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Website

<http://www.forestresearch.gov.uk/cemare>

Working Groups

WG 1: Process optimisation and process innovation
WG 2: Fundamentals and modelling
WG 3: Performance in use and new products

Management Committee

Chair	Vice Chair	DC Rapporteur
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I.B. Overview activities and expenditure

Action E50 - budget from 01-Jan-2005 to 31-Dec-2005						
Meetings						
Meeting Type	Date	Place	Paid part	Cost	Status	Total
Kick-off	19-Apr-2005	Brussels (BE)	12	7978.62	Paid	
Management Committee	07-Jul-2005	Brussels (BE)	11	7068.42	Paid	
Joint Management Comr	03-Nov-2005	Montpellier (FR)	33	29656.89	Paid	
						44703.93
STSM						
Beneficiary	Date	From	To	Cost	Status	Total
						0
Workshops						
Title	Date	Place		Cost	Status	Total
Workshop: 'Cell wall ma	03-Nov-2005	Montpellier (FR)		3,000	Paid	
						3,000
General Support Grants						
Title	Date			Cost	Status	Total
						0
Schools						
Type	Date	Place	title	Cost	Status	Total
						0
Honoraria						
Title	Date	Expert		Cost	Status	Total
						0
Grant						
Grant Holder	Date			Cost	Status	Total
						0
Dissemination						
Title	Date			Cost	Status	Total
						0
					Action Total	47703.93

Action E50 - budget from 01-Jan-2006 to 31-Dec-2006
BUDGET YEAR 2006
Meetings

Meeting Type	Date	Place	Paid part	Cost	Status	Total
Others	16-May-2006	Florence/Sesto Fiorentino	8	7373.61	Paid	
Others	17-Jul-2006	Brussels (BE)	6	3251.01	Paid	
Working Group	28-Aug-2006	Stockholm (SE)	16	14434.24	Paid	
Joint Management Comr	19-Oct-2006	Warsaw (PL)	49	41648.86	Paid	
Working Group	18-Dec-2006	Wageningen (NL)	14	9242.33	Paid	
						75950.05

STSM

Beneficiary	Date	From	To	Cost	Status	Total
Dr Riikka Piispanen	04-Sep-2006	Vantaa (FI)	1Potsdam (DE)	1468	Paid	
Ms Claudia Carolina Cifu	04-Sep-2006	Wageningen (NL)	Stockholm (SE)	2500	Paid	
Ms Valerie Billosta	18-Sep-2006	Grenoble (FR)	Helsinki (FR)	2500	Paid	
Ms Pia Stieger	19-Nov-2006	Neuchâtel (CH)	Thiverval-Grignon (FR)	1880	Paid	
Dr Carole ASSOR	11-Dec-2006	Nancy (FR)	Stockholm (SE)	1200	Paid	
						9,548

Workshops

Title	Date	Place		Cost	Status	Total
						0

General Support Grants

Title	Date			Cost	Status	Total
						0

Schools

Type	Date	Place	title	Cost	Status	Total
						0

Honoraria

Title	Date	Expert		Cost	Status	Total
						0

Grant

Grant Holder	Date			Cost	Status	Total
						0

Dissemination

Title	Date			Cost	Status	Total
						0

Action Total 85498.05

Action E50 - budget from 01-Jan-2007 to 01-Jun-2007					BUDGET YEAR 2007	
Meetings						
Meeting Type	Date	Place	Paid part	Cost	Status	Total
Joint Management Comr	26-Mar-2007	Montpellier (FR)	18	17464.61	Paid	
Others	12-Apr-2007	Potsdam (DE)	5	3716.75	Paid	
Working Group	19-Apr-2007	Edinburgh (uk)	9	8374	Paid	
						29555.36
STSM						
Beneficiary	Date	From	To	Cost	Status	Total
Mr Jimmy Berrio-Sierra	17-Feb-2007	Grenoble (FR)	Potsdam (DE)	860	Paid	
Mr Bertrand MARCON	08-Apr-2007	Montpellier (FR)	Liege (BE)	1250	Paid	
Ms Tuula Jaakkola	22-Apr-2007	Vantaa (FI)	Ljubljana (SI)	830	Paid	
Ms Nele Schmitz	16-Apr-2007	Brussels (BE)	Hamburg (DE)	2500	Paid	
						5,440
Workshops						
Title	Date	Place		Cost	Status	Total
						0
General Support Grants						
Title	Date			Cost	Status	Total
						0
Schools						
Type	Date	Place	title	Cost	Status	Total
						0
Honoraria						
Title	Date	Expert		Cost	Status	Total
						0
Grant						
Grant Holder	Date			Cost	Status	Total
						0
Dissemination						
Title	Date			Cost	Status	Total
						0
					Action Total	34995.36

Action E50 - budget from 02-Jun-2007 to 01-Jun-2008					BUDGET YEAR 2008	
Meetings						
Meeting Type	Date	Place	Paid part	Cost	Status	Total
Joint Management Comr	26-Sep-2007	Potsdam (DE)	50	46726.91	Paid	
Others	14-Feb-2008	Espoo (FI)	6	6043.32	Paid	
Others	11-Apr-2008	Ljubljana (SI)	16	13774.68	Paid	
Working Group	19-May-2008	Turku (FI)	12	12774.76	Paid	
						79319.67
STSM						
Beneficiary	Date	From	To	Cost	Status	Total
Mr Johnny Mukoko Bopg	22-May-2007	Gosselies (BE)	Reims (FR)	1885	Paid	
Dr Clemens Altaner	11-Nov-2007	Glasgow (uk)	Stockholm (SE)	1665	Paid	
Dr Alicja Banasiak	01-Oct-2007	Wroclaw (PL)	Umea (SE)	2500	Paid	
Dr Magdalena Krzeslows	12-Oct-2007	Poznan (PL)	Umea (SE)	2500	Paid	
						8,550
Workshops						
Title	Date	Place		Cost	Status	Total
MC5 + WGs	26-Sep-2007	Potsdam (DE)		538	Paid	
						538
General Support Grants						
Title	Date			Cost	Status	Total
						0
Schools						
Type	Date	Place	title	Cost	Status	Total
						0
Honoraria						
Title	Date	Expert		Cost	Status	Total
						0
Grant						
Grant Holder	Date			Cost	Status	Total
						0
Dissemination						
Title	Date			Cost	Status	Total
						0
					Action Total	88407.27

Action E50 - budget from 02-Jun-2008 to 01-Jun-2009					BUDGET YEAR 2009	
Meetings						
Meeting Type	Date	Place	Paid part	Cost	Status	Total
Others	07-Aug-2008	Dübendorf (CH)	8	5583.36	Paid	
In conjunction with Work	27-Oct-2008	Dübendorf (CH)	40	32048.92	Paid	
Working Group	16-Mar-2009	Nancy (FR)	7	5994.72	Paid	
						43627
STSM						
Beneficiary	Date	From	To	Cost	Status	Total
Mr Ville Veikko Tapani K	30-May-2008	Helsinki (FI)	Vancouver (CA)	2500	Paid	
Mr Cedric Montero	18-Aug-2008	Montpellier (FR)	Vienna (AT)	1150	Paid	
Ms Frederique NOLIN	25-Aug-2008	Reims (FR)	Helsinki University (FI)	2500	Paid	
Mr Karl Bytebier	30-Nov-2008	Montpellier (FR)	Vienna (AT)	1000	Paid	
Ms Leena Vihermaa	04-Feb-2009	Glasgow (UK)	Nancy (FR)	585	Paid	
Mr David Auty	22-Mar-2009	Aberdeen (UK)	Stockholm (SE)	1660	Paid	
Ms Edita Jasiukaityte	15-Jan-2009	Ljubljana (SI)	Rome (IT)	2500	Paid	
Ms Marta Hrabalova	15-Apr-2009	Tulln (AT)	Dübendorf (CH)	2020	Paid	
Ms Cindy Mettraux	27-Apr-2009	Neuchâtel (CH)	Lyon Cedex 07 (FR)	1400	Paid	
Dr Adriana Gregorova	20-Apr-2009	Wien (AT)	Stockholm (SE)	2445	Paid	
Ms Leena Vihermaa	28-Apr-2009	Glasgow (UK)	Auckland (NZ)	2770	Paid	
						20,530
Workshops						
Title	Date	Place		Cost	Status	Total
Workshop	27-Oct-2008	Dübendorf (CH)		3,000	Paid	
						3,000
General Support Grants						
Title	Date			Cost	Status	Total
						0
Schools						
Type	Date	Place	title	Cost	Status	Total
						0
Honoraria						
Title	Date	Expert		Cost	Status	Total
						0
Grant						
Grant Holder	Date			Cost	Status	Total
						0
Dissemination						
Title	Date			Cost	Status	Total
						0
					Action Total	67157

II. Scientific Report prepared by the Chair of the Management Committee of the Action

II.A. Innovative Networking:

The Action has brought together scientists from a broad background of research on cell-wall macromolecules, wood formation, wood and fibre properties, and reaction wood, to exchange their knowledge, techniques and methodologies in a synergistic way. During 2006 this was achieved through two major workshops, one in Florence (programme attached in Annex 1) and one in Warsaw (programme attached in Annex 2). There were also two working group meetings; one for members of Working Groups 3 and 4 in Stockholm (report in Annex 3) and one for Working Group 1 in Wageningen (report in Annex 4). These meetings focused on issues identified during working group discussion in Florence and Warsaw. A major issue for working groups 3 and 4 was to revisit ideas on the size of cellulose microfibrils and the effect of this on wood mechanical properties. This issue has become important following the discovery that the crystallite size in tension wood appears to be larger than that in normal wood. The consequences of this for wood properties will be a major subject for investigation. Another important result has been the discovery of inhomogeneity of lignin in different wall layers, and the effect that linkage between lignin and cellulose has on mechanical properties of wood and hence its utilisation. Also of importance in this respect is the problem created for industry by the unpredictable behaviour of mixtures of normal and reaction wood. Compiling and analysing data on the properties of abnormal and normal wood tissues and wood fibres, as well as of related problems at the processing and utilization stages was a major theme of the Working Group 3 and 4 meeting in Stockholm.

In 2007 two working group meetings were held. The first was in Edinburgh on the theme “Modelling from Plant Cell Wall to Plank” studying the relationship between the structure of the cell wall and wood properties (Annex 5). Participants described models they are developing for predicting wood properties and highlighted the key issues on which future research should focus. The second was in Montpellier on “Regulation of lignin biosynthesis and reaction wood induction” (Annex 6). The major workshop was held in Potsdam on the theme “Structure and Function of the Primary and Secondary Cell Wall” (Annex 7). Of particular importance was the information supplied about demonstrations of the activity of the cellulose synthesizing system which can now be visualized actively producing microfibrils, and its association with the microtubules of the cytoskeleton. The application of antibody techniques and spinning disc confocal microscopy has been particularly fruitful. As far as understanding and possibly controlling the assembly of fibre walls and studying the regulation of RW formation by identifying genetic traits involved in the biogenesis pathways is concerned, there is much activity in the field of using *Arabidopsis* and *Populus* as model species. Emphasis is on the need to translate the results on models to commercial tree species. This had also been a major point of discussion in the Working Group 1 meeting in Wageningen in 2006. Another key issue addressed was that of defining reaction wood, with the growing awareness that while industry regards this as abnormal wood, it is in fact, from the point of view of the tree just another form of normal wood produced to deal with variations in growing conditions.

In 2008 two workshops were held. The first was jointly held with the final workshop of Action E41 in Turku, Finland (Annex 8). This was brought about because of a mutual interest in the way fibre cell wall components are put together to form the wall structure. This was very productive in providing new perspectives on the problem for participants of both Actions. The second was a joint workshop with the International Lignin Institute in Dubendorf, Switzerland (Annex 9) and thus involved many

non-COST participants and industry representatives. Again, the participation of scientists from outside the Action brought a new stimulus to the members of the Action.

A very successful working group meeting was held in Ljubljana (Annex 10) dealing with wound reactions in trees. This provided a different approach to the way trees deal with stresses. Abstracts of this meeting are on the Action website. Techniques are needed for the location of reaction wood in standing trees and work at the University of Ljubljana is pioneering the use of magnetic resonance imaging (MRI) for this purpose.

In the final six months of the Action in 2009 a working group meeting was held in Nancy (report Annex 11) on the causes and measurement of reaction wood. The final workshop was held in Wageningen from 8-12 July 2009. The programme is appended as Annex 12. This will take a systems approach to plant design, particularly with respect to cell walls.

The potential for the application of new techniques to the study of cellulose has been recognised. Potential candidates include liquid crystal polarization microscopy and x-ray microtomography. New information on the relationship between lignin, hemicelluloses and cellulose continues to emerge at an encouraging rate. Thus the Action is doing well in meeting its objective to find better methods and tools for the analysis and characterization of wood fibre cell walls, their native structure, and in developing new techniques for changing the structure using chemical, mechanical and enzymatic treatments.

Among the important results obtained during 2008, work on structure-function relationships in plant cell walls has provided new and fundamental information about the mechanical role of xyloglucan (published in *Plant Cell*) and new results on cellulose fibril aggregation in spruce cell walls (published in *Cellulose*). Significantly, multiple functions have been described (published in *Nature*) for the microtubule cortical array on organising cellulose synthase complexes. A special focus was on stress generation in tension wood of poplar. The findings (published in *The Plant Journal*) may help to better understand the underlying mechanism. A timely research project at VANTAA in Helsinki has also shown the important result that climate change is unlikely to affect cell wall structure in northern coniferous trees. Work at STFI, Stockholm has established that it is possible to detect molecular deformation of cellulose in wood using FTIR together with mechanical straining. Work in Ljubljana has developed a new method for moisture content determination by NMR. The method is described in the paper "A method for instantaneously determining the moisture content of wood samples using NMR" published in *Holzforschung*.

A European network on the topics of the Action has been established and is very active. A "chat room" has been set up on the Action website for the benefit of partners in the Action, and active collaboration between laboratories in different EC member states is evidenced elsewhere in this report. The ENP policy has been useful for this Action with experts from Russia, Romania and Serbia attending our workshops, while twenty one experts from ten non COST countries have also attended. Links have been established under the new policy with institutions in Australia and New Zealand, while one STSM was undertaken to Canada and one to New Zealand.

II.B. Interdisciplinary Networking:

Synergic activities in 2008 have involved a joint workshop with COST Action E41, and with the International Lignin Institute as detailed above. The joint meeting with E41 has contributed to a new COST Action proposal “Analytical Techniques for biorefineries”.

An application in the EU framework 7 was prepared for the EU call KBBE-2009-3-1-01 with the title: ‘Spruce as a green factory for valuable bioactive compounds’ and with the acronym BIOSPRUCE. This is a collaborative project with researchers from Finland, Sweden, Germany, France and Romania.

Members of E50 participated as both teachers and trainees for the training course in Spring 2009 held in Vienna by FP0802 looking at methods for studying wood structure and properties.

Full details of interactions between Action members and others are given in Annex 13.

II.C. New Networking:

Additional new members joining the Action during its life were five: Belgium, Denmark, Italy, Norway and Turkey.

The number of individual participants rose from 75 in the first year to 180 by year 4. 46% were early stage researchers and 33% were female.

Many of the participants at workshops and working group meetings have been young scientists carrying out postdoctoral research in laboratories of partners in the Action. These have both made oral and poster presentations, and been encouraged by being invited to present their posters for extended and directed discussion in Working Group meetings. The presence of eminent invited non-EC speakers as well as established European scientists in these sessions gives them a feeling that their work is recognised as being of value and provides encouragement for them to continue in science. The Action also provides opportunities for these young scientists to network and become aware of employment opportunities in Europe, and brings them to the attention of potential employers in the group. There have been several instances of postdoctoral workers moving between laboratories, in addition to the movements involved in STSMs. Early stage researchers took advantage of 24 STSMs. This would have been more, but money was not made available for these in the first year of the action under instructions from the COST Office. Details of STSMs are presented in Annex 14.

Researchers from outside of COST countries attending workshops as invited speakers have come from Australia (1), Canada (2), Japan (2), New Zealand (1), USA (7).

Promotion of scientific knowledge through publication has taken the form of papers in refereed journals (Annex 15)

III. Evaluation Report prepared by the “ad hoc” Evaluation Panel established by the Domain Committee and edited by the COST Office (approximately 2 pages)

1. Evaluation panel and evaluation procedures

The evaluation panel consisted of:

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The evaluation panel participated in the Actions’ Final Conference in Wageningen in July 9th -11th, 2009 and the final MC meeting on 11th of July, where discussions and interviews with a number of participants were carried out. The evaluation is based also on the following documents:

- Memorandum of Understanding
- Working Plan
- Monitoring Reports from Action Chair
- Monitoring Reports by Rapporteur 2007 and 2008
- Final scientific Reports by the Action Chair
- Minutes of the MC meetings
- Workshop programmes
- Questionnaires filled in by the MC members and participants at the final conference

Around 25 questionnaires were distributed during the final conference. In total 19 questionnaires were collected and a summary of written comments has been compiled in appendix 1 to this report.

2. Results versus objectives

There were four working groups:

- 1: Biosynthesis and structure of cellulose and polysaccharides;
- 2: Biosynthesis and modification of lignin;
- 3: Formation and induction of reaction wood;
- 4: Relating wood and fibre properties to structure and formation.

The WGs are merely a result of the original pre-proposal phase, when two pre-proposals were asked to merge into a one full proposal for a new action to be adopted. WG 1 and 2 “represented” one and WGs 3 and 4 the other original pre-proposals. Meetings carried out in the on-going action seemed to focus either to themes of WG 1 and 2 or those of WG 3 and 4. It might have been useful to look for the existing synergies during the first year to build up a common vision in the merged action.

The objectives mentioned in the work plan were all – more or less – achieved. Regarding the benefits, it is more difficult to say. Many of the benefits have also been achieved, such as STSMs, which as an activity has been very successful (24 missions in total, meaning 6 missions in a year).

For the economical and technological benefits, the work plan was very broad and ambitious, looking for specific technological solutions. The real impact of the action (as a form of technological applications) will be seen later and, most probably, also in other related areas. Positively is the fact that some of the workshops were attended by representatives from industries. For example, the final conference was attended by 8 representatives from 4 different industries.

The industrial involvement for the action was though not as high as planned in MoU. The most activities in this respect were within WG4’s group. The topic for the action, “Cell walls”, seems (and perhaps was at the time of the launching the action) to be far from the industrial needs. Today, however, the ability to “manage” the cell walls is a very hot topic when speaking about producing biofuels or other biomaterials or products from fibres.

The scientific outcome of the action has in several aspects been really interesting and in some cases really break-throughs. For example:

- * Identification of genes (related to fibre and plant genomics)
- * Understanding of wood formation and cellulose synthases
- * Huge increase in knowledge of cell wall ultra-structure
- * Advanced understanding of tension wood

Another outcome of the action will be the compilation of the state of the art of knowledge in the cell wall formation field. The book “The Biology of Reaction Wood” is to be published in 2010. The theme has been interesting enough to be published by a commercial actor, Springer. This shows the relevance and the interest in the topic at the scientific community.

All in all, the evaluation team rates the achievement of the action objectives as very good to excellent.

Other special remarks

The website to the action, hosted by Forestry Commission, is well managed and has been updated regularly.

The annual monitoring reports presented to the COST Office, are “cumulative reports” what has been done during the past period. Even at the mid-term, the report starts to be too massive to follow. Perhaps a summary report would help the case.

The list of publications is impressive. However, it would be useful/interesting to elaborate the list a bit; for example to make separate categories such as “joint publications by the COST action participants as a result of COST networking”; or as a result of STSM; and the “others” (the result of individual groups).

3. *Innovative networking*

Many scientists had the networks since earlier, but the action has created new networks, and has especially – also by having a look around at the audience of the final conference – contributed to bringing together and involving lots of young scientists.

The research – and the talents involved – at this COST action has attracted scientists and research groups from non-COST countries also. Researchers from Australia, Canada, and US have been involved in the research. Some researchers arrived from non-COST countries due to attractive topic of the meetings (like Japan).

The feeling about the final conference is challenging; it is not only looking back what has been done for the ending action, but it is presenting new ideas for the audience in a very positive spirit. Scientifically the researchers see the future in this area.

New data on cellulose synthesis are significant. Generally speaking, the knowledge in the area of plant cell wall formation and components biosynthesis is increasing considerably during the last decade and also during the life-span of action E50. Innovative and new networking promoted the innovativeness breakthroughs significantly. The areas as bio-refinery, new business from wood fibres etc, will have a great use in the near future.

During the COST action, the co-operation in several networks has been established. So even, when the Action now is ended, the co-operation will continue as the good partners have been identified during the action. As high relevance and improved interest for the topic in the near future, there will probably be funding available in these areas on an international level.

4. *Inter-disciplinary networking*

Synergic activities have been involved as a joint workshop was carried out with E41, and also that with the International Lignin Institute. A new Action, FP0802 has emerged partly from this Action, the proposal involving several members of E50. Also members of the Action are, in one way or another, involved in at least 5 ongoing consortia or projects in the ERANET WoodWisdom-Net Research Programme.

An application in the EU framework 7 was prepared for the EU call KBBE-2009-3-1-01 with the title: 'Spruce as a green factory for valuable bioactive compounds' and with the acronym BIOSPRUCE. The result is not yet available.

The level of interdisciplinary is very high; the action involves experts from molecular biology, simulation and modelling, and plant mechanics.

5. *New networking*

The Action had 12 signatory countries with lots of participating institutions including research institutes and organisations as well as universities. New members joining the Action during its life were five. The ground for a sufficient network providing fairly good European added-value thus existed.

It seems that the Action utilized the COST Framework quite well to achieve its objectives. Examples of this are the workshops and symposia arranged and also the STSMs, which were 24 in total. These activities enhanced the dissemination of new knowledge and helped to raise the level of knowledge throughout Europe. This is a clear European added-value aspect.

The number of individual participants rose from 75 in the first year to 210 by year 4. Of the participants, 46% were early stage researchers and 33% were female. Researchers from outside of COST countries attending workshops as invited speakers have come from Australia (5), Canada (2), Japan (3), New Zealand (1), USA (8), Brazil (1), China (2) and Russia (1).

The core of the Action is not large, but it is stable. The workshops are focused on selected topics and new participants are joining these specific events. So the active network is constantly increasing.

As the research performed in the Action gives a crucial input/information for the field of bio-fuels, biorefinery and new renewable materials, funding opportunities seems to be really fair for these research topics in the future.

6. *Coordination and management*

According to the interviews, the management of the Action has been excellent and efficient. The management has succeeded to keep the working atmosphere fruitful – despite the reservations in the beginning.

The documents available from the Action as well as the opinion of the participants obtained via the discussions and the questionnaires at the final meeting and workshop seem to indicate that the coordination and management of the Action has been very good to excellent.

The overall evaluation of the panel rates the Coordination and management to have been excellent.

7. Strengths and weaknesses

The evaluation panel has identified the following strengths:

- A result of the networking, and in particular STSMs, is a good transfer of knowledge between different countries also outside Europe. The E50 has managed “to open up” – not to stay a closed club”. 2/3 of the STSMs were female.
- Action seems to have a good attraction of young scientists active in the field.
- The management of this Action has been excellent.

The evaluation panel has identified the following weaknesses:

- The interaction links between WGs 1-2 and 3-4 are not really visible as the idea was in the beginning when merging the two proposals.

8. Some advice for future actions by the evaluation panel

The evaluation panel would raise following thoughts or ideas about action activities to the Cost Office:

- There is a rather large work with administrating a successful action and the success is depending on people who have possibility to spend time for this. In a few cases, newly adopted new actions fail to start smoothly due to lack of persons in charge. When submitting full proposals (invited pre-proposals) there ought to be a pool of researchers already signed for MC and WG members and grant holder.
- COST Office should prepare some practical guide-lines or organise an information day for chair persons and grant holders in the beginning phase of the action.
- To maintain the excellent quality of the COST actions in the future, it will need some improvement in the compensation system not only for action chair but for other key persons involved in the management of the action.

APPENDIX 1 Previous (Annual Monitoring Progress Report) Scientific Reports

2005-6

At the time of writing the Action is only four months old and it is too early to comment on scientific results arising from the Action. However, the first major activity of the Action took place in Montpellier from 3-5 November 2005. This took the form of a Workshop/Working Group meeting which was well attended considering the very short lead time for preparation following the kick-off meeting in July. Fifty four delegates attended representing all the signatory countries and two that had expressed interest in signing up to the Action.

An important part of the meeting was the presentation of four keynote papers by the chairs of the four working groups on the state of the art. These papers provided the foundation for the Action and for the working group discussions that followed. The working group discussions were lively with each group reporting back to the assembled delegates on the main discussion and the appropriate course to be followed by their working group in relation to the others.

For Working Group 1, the main issues were as set out in the MOU and relate to acquisition of a better understanding of the control of cellulose microfibril angle in the cell wall, and a need to look more closely at the chemistry and structure of hemicelluloses, which are increasingly being seen to have an important structural role. Variation in the chemistry, structure and composition of these wall components in reaction wood cells needs to be characterized. The way in which the various wall components are bonded together was also identified as a key issue to be addressed.

Working Group 2 emphasised the need for better ways of identifying and locating lignin in the wall, and for determining its location and linkages to other wall components (a theme common to WG1. The process of lignification needs to be investigated further in order to understand how and when precursors are moved into the cell wall and how polymerization is achieved. Variation in the lignin component of the cell wall in reaction wood in terms of chemistry, composition, structure and location in the wall needs to be determined.

Working Group 3 highlighted a range of problems, beginning with the classification and detection of different types of reaction wood and how they affected timber properties (in common with Working Group 4). There is a need to discover how the environmental signals that trigger reaction wood formation are perceived by the tree and how these are converted to signals to control gene expression in the differentiating cambial cells. The genes involved in reaction wood formation need to be identified. The maturation processes in reaction wood formation need to be further investigated and more needs to be known about so-called opposite wood and how it interacts with reaction wood.

Working Group 4 will work towards a better understanding of the relationship between fibre wall chemistry and structure and wood properties. It will investigate types of reaction wood which differ from the conventional definitions of tension wood and compression wood, and to understand how these act in the tree, and their effect on timber and pulp properties. The group will be concerned with the practical aspects of cell wall structure from the point of view of industry and so will focus on those issues of major concern.

Proceedings of the Workshop have been prepared and submitted to Brussels. They are attached to this document.

2005-2007

Results achieved during the period July 2005 – December 2007

Comparing the results obtained with the objectives of the Action:

The Action is succeeding well in bringing together scientists from a broad background of research on cell-wall macromolecules, wood formation, wood and fibre properties, and reaction wood to exchange their knowledge, techniques and methodologies in a synergistic way. During 2006 this was achieved through two major workshops, one in Florence (programme attached in Annex 2) and one in Warsaw (programme attached in Annex 3). There were also two working group meetings; one for members of Working Groups 3 and 4 in Stockholm (report in Annex 4) and one for Working Group 1 in Wageningen (report in Annex 5). These meetings focused on issues identified during working group discussion in Florence and Warsaw. A major issue for working groups 3 and 4 was to revisit ideas on the size of cellulose microfibrils and the effect of this on wood mechanical properties. This issue has become important following the discovery that the crystallite size in tension wood appears to be larger than that in normal wood. The consequences of this for wood properties will be a major subject for investigation. Another important result has been the discovery of inhomogeneity of lignin in different wall layers, and the effect that linkage between lignin and cellulose has on mechanical properties of wood and hence its utilisation. Also of importance in this respect is the problem created for industry by the unpredictable behaviour of mixtures of normal and reaction wood.

In 2007 the major workshop was held in Potsdam on the theme “Structure and Function of the Primary and Secondary Cell Wall” (Abstracts attached as PDF file). Of particular importance was the information supplied about demonstrations of the activity of the cellulose synthesizing system which can now be visualized actively producing microfibrils, and its association with the microtubules of the cytoskeleton. The application of antibody techniques and spinning disc confocal microscopy has been particularly fruitful. This seems to have settled the question as to whether cellulose orientation is under biological control or whether it is determined purely by physical factors in favour of the former idea. This was also a major point of discussion in the Working Group 1 meeting in Wageningen (see report attached as Annex 5). Another key issue addressed was that of defining reaction wood, with the growing awareness that while industry regards this as abnormal wood, it is in fact, from the point of view of the tree just another form of normal wood produced to deal with variations in growing conditions. The relationship between the structure of the cell wall and wood properties was the subject of a meeting of Working Groups 3 and 4 in Edinburgh in the theme “modelling from plant cell wall to plank” (report in Annex 6). Participants described models they are developing for predicting wood properties and highlighted the key issues on which future research should focus.

The potential for the application of new techniques to the study of cellulose has been recognised. Potential candidates include liquid crystal polarization microscopy and electron tomography microscopy. New information on the relationship between lignin, hemicelluloses and cellulose continues to emerge at an encouraging rate. Thus the Action is doing well in meeting its objective to find better methods and tools for the analysis and characterization of wood fibre cell walls, their native structure, and in developing new techniques for changing the structure using chemical, mechanical and enzymatic treatments.

Techniques are needed for the location of reaction wood in standing trees and work at the University of Ljubljana is pioneering the use of magnetic resonance imaging (MRI) for this purpose. Use of 3D MRI has revealed the location of tension wood in branches of beech. This has shown that the properties of reaction wood in magnetic fields is worthy of further investigation.

As far as understanding and possibly controlling the assembly of fibre walls and studying the regulation of RW formation by identifying genetic traits involved in the biogenesis pathways is concerned, there is much activity in the field of using *Arabidopsis* and *Populus* as model species. Emphasis is on the need to translate the results on models to commercial tree species. This issue

was particularly addressed during the Working Group 1 workshop, where the latest results for the model species were described.

Compiling and analysing data on the properties of abnormal and normal wood tissues and wood fibres, as well as of related problems at the processing and utilization stages was a major theme of the Working Group 3 and 4 meeting in Stockholm (Report Annex 4), while development of basic science on fibre structure, formation and properties, continues to be actively pursued by Working Groups 1, 2 and 3.

An European network on the topics of the Action has been established and is very active. A “chat room” has been set up on the Action website for the benefit of partners in the Action, and active collaboration between laboratories in different EC member states is evidenced elsewhere in this report.

The workshops and working group meetings have been lively and well-attended. The presence of eminent invited speakers has stimulated discussion and ideas, and these visitors have been impressed with the activities and research carried out by partners in the Action. Many of the participants at workshops and working group meetings have been young scientists carrying out postdoctoral research in laboratories of partners in the Action. These have both made oral and poster presentations, and been encouraged by being invited to present their posters for extended and directed discussion in Working Group meetings. The presence of eminent invited non-EC speakers as well as established European scientists in these sessions gives them a feeling that their work is recognised as being of value and provides encouragement for them to continue in science. The Action also provides opportunities for these young scientists to network and become aware of employment opportunities in Europe, and brings them to the attention of potential employers in the group. There have been several instances of postdoctoral workers moving between laboratories, in addition to the movements involved in STSMs.

2005-2008

Results achieved during the period July 2005 – December 2008

The Action has succeeded well in bringing together scientists from a broad background of research on cell-wall macromolecules, wood formation, wood and fibre properties, and reaction wood to exchange their knowledge, techniques and methodologies in a synergistic way. During 2006 this was achieved through two major workshops, one in Florence (programme attached in Annex 1) and one in Warsaw (programme attached in Annex 2). There were also two working group meetings; one for members of Working Groups 3 and 4 in Stockholm (report in Annex 3) and one for Working Group 1 in Wageningen (report in Annex 4). These meetings focused on issues identified during working group discussion in Florence and Warsaw. A major issue for working groups 3 and 4 was to revisit ideas on the size of cellulose microfibrils and the effect of this on wood mechanical properties. This issue has become important following the discovery that the crystallite size in tension wood appears to be larger than that in normal wood. The consequences of this for wood properties will be a major subject for investigation. Another important result has been the discovery of inhomogeneity of lignin in different wall layers, and the effect that linkage between lignin and cellulose has on mechanical properties of wood and hence its utilisation. Also of importance in this respect is the problem created for industry by the unpredictable behaviour of mixtures of normal and reaction wood. Compiling and analysing data on the properties of abnormal and normal wood tissues and wood fibres, as well as of related problems at the processing and utilization stages was a major theme of the Working Group 3 and 4 meeting in Stockholm.

In 2007 two working group meetings were held; one in Edinburgh on the theme “Modelling from Plant Cell Wall to Plank” (Annex 5) and one in Montpellier on “Regulation of lignin biosynthesis and reaction wood induction” (Annex 6). The major workshop was held in Potsdam on the theme

“Structure and Function of the Primary and Secondary Cell Wall” (Annex 7). Of particular importance was the information supplied about demonstrations of the activity of the cellulose synthesizing system which can now be visualized actively producing microfibrils, and its association with the microtubules of the cytoskeleton. The application of antibody techniques and spinning disc confocal microscopy has been particularly fruitful. As far as understanding and possibly controlling the assembly of fibre walls and studying the regulation of RW formation by identifying genetic traits involved in the biogenesis pathways is concerned, there is much activity in the field of using *Arabidopsis* and *Populus* as model species. Emphasis is on the need to translate the results on models to commercial tree species. This had also been a major point of discussion in the Working Group 1 meeting in Wageningen in 2006. Another key issue addressed was that of defining reaction wood, with the growing awareness that while industry regards this as abnormal wood, it is in fact, from the point of view of the tree just another form of normal wood produced to deal with variations in growing conditions. The relationship between the structure of the cell wall and wood properties was the subject of a meeting of Working Groups 3 and 4 in Edinburgh in the theme “modelling from plant cell wall to plank” (report in Annex 6). Participants described models they are developing for predicting wood properties and highlighted the key issues on which future research should focus.

In 2008 two workshops were held. The first was jointly held with the final workshop of Action E41 in Turku, Finland (Annex 8). This was brought about because of a mutual interest in the way fibre cell wall components are put together to form the wall structure. This was very productive in providing new perspectives on the problem for participants of both Actions. The second was a joint workshop with the International Lignin Institute in Dubendorf, Switzerland (Annex 10) and thus involved many non-COST participants and industry representatives. Again, the participation of scientists from outside the Action brought a new stimulus to the members of the Action. The abstracts of these two workshops are attached as a PDF file.

A very successful working group meeting was held in Ljubljana (Annex 9) dealing with wound reactions in trees. This provided a different approach to the way trees deal with stresses. Abstracts of this meeting are on the Action website. Techniques are needed for the location of reaction wood in standing trees and work at the University of Ljubljana is pioneering the use of magnetic resonance imaging (MRI) for this purpose.

The potential for the application of new techniques to the study of cellulose has been recognised. Potential candidates include liquid crystal polarization microscopy and x-ray microtomography. New information on the relationship between lignin, hemicelluloses and cellulose continues to emerge at an encouraging rate. Thus the Action is doing well in meeting its objective to find better methods and tools for the analysis and characterization of wood fibre cell walls, their native structure, and in developing new techniques for changing the structure using chemical, mechanical and enzymatic treatments.

Among the important results obtained during the 2008 year, work on structure-function relationships in plant cell walls has provided new and fundamental information about the mechanical role of xyloglucan (published in *Plant Cell*) and new results on cellulose fibril aggregation in spruce cell walls (published in *Cellulose*). A special focus was on stress generation in tension wood of poplar. The findings (published in *Plant J*) may help to better understand the underlying mechanism. A timely research project at VANTAA in Helsinki has also shown the important result that climate change is unlikely to affect cell wall structure in northern coniferous trees. Work at STFI, Stockholm has established that it is possible to detect molecular deformation of cellulose in wood using FTIR together with mechanical straining. Work in Ljubljana has developed a new method for moisture content determination by NMR. The method is described in the paper “A method for instantaneously determining the moisture content of wood samples using NMR” to be published shortly in *Holzforschung*.

A European network on the topics of the Action has been established and is very active. A “chat room” has been set up on the Action website for the benefit of partners in the Action, and active collaboration between laboratories in different EC member states is evidenced elsewhere in this

report. The ENP policy has been useful for this Action with experts from Russia, Romania and Serbia attending our workshops, while twenty one experts from ten non EC countries have also attended. Links have been established under the new policy with institutions in Australia and new Zealand, while one STSM was undertaken to Canada.

Many of the participants at workshops and working group meetings have been young scientists carrying out postdoctoral research in laboratories of partners in the Action. These have both made oral and poster presentations, and been encouraged by being invited to present their posters for extended and directed discussion in Working Group meetings. The presence of eminent invited non-EC speakers as well as established European scientists in these sessions gives them a feeling that their work is recognised as being of value and provides encouragement for them to continue in science. The Action also provides opportunities for these young scientists to network and become aware of employment opportunities in Europe, and brings them to the attention of potential employers in the group. There have been several instances of postdoctoral workers moving between laboratories, in addition to the movements involved in STSMs. These have been actively encouraged by the Management Committee and four took place in 2008.

APPENDIX 2: PROGRAMMES OF ACTION WORKSHOPS

Programme for CEMARE workshop in Florence

Monday, May 15 2006

8,30-09,00 Registration

9,00 -9,15 Conference opening

COST E35 - WG1 Microstructure and Micro-mechanics

Sub-Session - Understanding wood variability (Chairman P. Saranpää)

9,15 -10,0 **Invited lecture: AM Emons Cellulose: Synthesis, Texture, and Microfibril Angle**

10,00- **Key note lecture: JR Barnett** "Variation in anatomy and microfibril angle in wood of silver birch
10,20 (Betula pendula Roth.)."

10,20- Badel E, P Perré Morphology-Based Numerical Modelling: Prediction of the
10,40 Transverse Shrinkage Coefficients for Oak

10,40- Coffee break
11,00

Sub-Session - Stress Analysis and Anisotropy (Chairman L. Berglund)

11,00- Astrup T, L Damkilde, Analysis of Glulam Subjected to Compression Perpendicular to
11,20 Hergenroder, Grain
L Berglund

11,20- Brémaud I, N Amusant, J GriThe Effects of Sequential Removal of Extractives on the Vibrational
11,40 B Thibaut Properties of Two Tropical Woods With Interlocked Grain

11,40- Fang C, B Clair, J Gril, S Liu Contribution of the Gelatinous Layer to the Growth Stresses
12,00 Generation in Tension Wood

12,00- Xavier j, S Avril, F Pierron, Application of the Virtual Fields Method for the Characterization of
12,20 Morais the LR Anisotropic Stiffness of Wood Pinus Pinaster

12,30- Short communications aided by poster (Chairman I. Burgert)
13,00

Esteban LG, P de Palacios dComparison of Hydroxyl Groups and Crystallinity in the Cell Wall of
Palaciosa New and Old Juvenile Wood of Pinus Sylvestris L.
FG Fernández, AG Casasúsa

Hemmasi A Physical Characteristics of Aspen Wood Fibers

Shipsha A Analysis of Annual Ring Structure Effects on Strain Fields in Wood

Saranpaa P. Ultrasonic Testing of Norway Spruce

13,00- Lunch - (14,00- 15,00 M of COST Action E35)
15,00 Meeting

15,00- Short communications aided by poster (Chairman I. Burgert)
15,30

Johnson JJ, J Hermanson, A Model for Excessive Bending of Wood or Wood/Fiber Composite
Peyer Beams

Jullien D, M. Yoshida, fMeasurement of Residual Strains At Stem Periphery Using the Two-
Cabrolier, Grooves Method
J. Gril

Muszyński L, HL Frandsen Experimental Characterization of the Variability of Poisson Effect in
Wood and Wood-Based Composites

Simon P, H Maigre, J-F JullierFull Field Image Correlation At Macro-Scale to Investigate
D Eyheramendy, B Callet Transverse Meso-Scale Mechanical Behaviour of Softwood.

Sub - Session - Micromechanics (Chairman L. Salmen)

- 15,30 **Invited lecture: W Glasser** **About Bonding to Cellulose-Abiomimetic First Step**
16,15
- 16,15- Salmen L, AM Olsson, M Ede *Mechano-Sorptive Creep of Single Wood and Pulp Fibres*
16,35 Burget I
- 16,35 Navi P, B Meylan, CJG Plumme *Role of Hydrogen Bonding and Hemicelluloses in Wood Stress*
16,55 M Spycher, F Heger *Relaxation*
- 16,55- Gierlinger N, I Burgert *Molecular Deformation Mechanism in Wood Studied by Raman*
17,15 *Microscopy*
- 17,15- Hofstetter K, Ch Hellmich, *Estimation of Anisotropic Macroscopic Wood Strength from Local*
17,35 J Eberhardsteiner *Faliure of Lignin and Microstructural Characteristics*

Evening session - WG1-WG2 joint section: Wood Mechanics Applied to Conservation of Wooden Cultural Heritag (Place - Tribunetta del David - Galleria Accademia Museum) (Chairman H Yamamoto)

- 19,00- **Invited lecture: L Uzielli** **Wood Science and Technology for the Conservation of Wooden**
19,45 **Cultural Heritage: Experiences At DISTAF**
- 19,45- Gril j, E Ravaud, L Uzielli, JMona *Mona Lisa Saved by Griffith Theory: Assessing the Crack Propagation*
20,05 Dupré, *Risk in the Wooden Support of a Panel Painting*
P Perre, D Dureisseix, O Arnouk
P Dionisi Vici, D Jaunard,
Mandron
- 20,05- Vaiedelich S *Conservation of Musical Instruments*
20,25
- 20,25- Ljungdahl J *Degradation of Radial Compression Properties in Waterlogged*
20,45 *Archaeological Oak From the Vasa Ship*

Tuesday, May 16 2006

- 09,00- *Short communications aided by poster (Chairman E. Landis)*
09,30
- Blumer, PJ Gustafsson, E *Moisture Induced Deformation, Stress and Fracture in Parquet Floors*
Serrano,
P Niemz
- Serrano E, S Blumer, PJ *Moisture Induced Stresses and Deformations in Parquet Floors*
Gustafsson,
P Niemz
- Yamamoto H, T Alméras, J Gril *Reinforced-Matrix Hypothesis As A Theoretical Basis for Analyzing*
Mechanical and Physical Properties of Wood Cell Wall
- Modén CS, LA Berglund *Radial Modulus of Softwood – Is Cell Wall Stretching Important?*
- Martikka H, E Taitokari, S Platt, *Testing and Simulation of Behaviour of Thermally Treated Wood Fibre*
Kärki *Reinforced Plastic Components*

COST E35 - WG2 Fracture and Surface Characterisation

Sub-Session - Time dependent behaviour (Chairman J. Gril)

- 09,30 **Invited lecture: H Yamamoto** **Growth Stress, Time-Dependent Biomechanics, and Okuyama's**
10,15 **Dream**
- 10,15- Frandsen HL, L Muszyński *Significance of the Time and Strain Dependent Poisson Effect in*
10,35 *Wood and Wood-Based Composites*
- 10,35- Dikrallah A, A Hakam, L *Experimental Analysis of Acoustic Anisotropy of Wood By Using*
10,55 Brancheriau, *Guided Waves*
A Famiri, H Bailleres, B

- Kabouchi,
M Ziani
- 11,00-
11,30** **Coffee break**
- 11,30- Vincent, S Bardet, P Tordjema *Analysis of Viscoelastic Properties of Green Poplar in Torsion*
11,50 J Gril
- 11,50- Merakeb S, F Dubois, N Sauvat, *Hydro-Mechanic Coupling in the Mass Transfer Process in Timber*
12,10 C Petit *Elements*
- 12,10- Hunt D, J Gril *Anomalies of Shrinkage and Swelling As Related to Cell-Wall*
12,30 *Anatomy*
- 12,30- *Short communications aided by poster (Chairman E Landis)*
13,00
- Ziegler S, P Haller *Stress Strain Relationships of Wood and Compressed Wood in Hydro-
Thermal Regime*
- Dlouha, B Clair, T Laurent *Measurement of viscoelastic properties of Green Wood in view of
Biomechanical Applications*
- Cancellato
- Mazzanti P, L Uzielli *Laboratory Tests to Characterize the "Compression Set" in Transverse
Direction in Poplar Wood*
- Sodini N., M Fioravanti, P Navì *Investigation of the Influence of Hemicelluloses on Time Dependent
Behaviour of Wood.*
- Frandsen HL, S Svensson, *A New Model for Hysteresis Applicable for Finite Element Simulations
Damkilde of Moisture Transport in Wood*
- 13,00-
14,30** **Lunch**
- 14,30- *Short communications aided by poster (Chairman E. Landis)*
15,00
- Le Conte S, S Vaiedelich, *Non Destructive Wood Mechanical Properties Evaluation Under
Francois Hygrometric Variations: Application to Conservation of Musical
Instruments.*
- Nkolo Meze'e YN, J Noa *Effect of Enthalpy-Entropy Compensation During Sorption of Water
Ngamveng, Vapour in Tropical Woods: the Case of Bubinga (Guibourtia
S Bardet Tessmanii J. Léonard ; G. Pellegriniana J.L.)*
- Srpčič S, J Srpčič, N Krauberger, *Determination of MC By Nondestructive Gravimetric Method
Turk*
- P Chassagne, P Dionisi-Vici, *Mechanical Consequences of Hygroscopic Variations on Wooden
E Vidal-Sallé, L Uzielli, J-F Jullien Panel Paintings: Development of A Predictive Model*
- Roohnia M, I Brémaud, D Guiba *NDT_Lab; Software to Evaluate the Mechanical Properties of
N Manouchehri Wood*
- Sub session - Fracture Mechanics (Chairman S. Tschegg)*
- 15,00 **Invited lecture: Chaplain Myriam Non Linear Fracture Mechanics in Wood**
15,45
- 15,45- Fournier CR, E Nagy, W Davids, E *Meso Mechanical Simulations and Measurements of Damage and
16,05 Landis Failure*
- 16,05- Dourado N., S Morel, MFSF *Effect of the Specimen Size on the R-Curve in Spruce*
16,25 Moura,
G Valentin, J Morais
- 16,25-
17,00** **Coffee break**
- 17,00- Müllner HW, M Fleischmann, *Experimental Validation of An Orthotropic Single-Surface Plasticity*

- 17,20 J Eberhardsteiner *Model for Spruce Wood*
- 17,20-17,40 Nielsen LF *On the Influence of Load Variations on Lifetime and Strength of Wood*
- 17,40-18,00 Vasic S, S. Stanzl-Tschegg *Change in the Fracture Mode and Fracture Properties of Wood With Moisture Content*
- 20,30 **Conference Dinner**

Wednesday, May 17 2006

- 09,00-10,00 *Short communications aided t (Chairman P.Navi) poster*
- Chaplain M, D Thibaut, G Valentin *Crack Propagation in Wood in Opening Mode Under Various Climatic Condition*
- Coureau JL, C Lespine, S Morel *Estimation of Cohesive Crack Model Parameters From Experimental Data: Application to Mode I.*
- Loidl D, EK Tschegg, SE Stanz *Mixed Mode Fracture of Wood*
Tschegg
- Moutou-pitti R, F Dubois, C Petit, | *Long Term Fracture of Wood Under Mixed Mode Loading: Numerical Approach By the MO-V-Integral*
Sauvat
- Oliveiraa J.M.Q., M.F.S.F. de Mourab, M.A.L. Silvac, J.J.L. Moraisc *Numerical Analysis of the MMB Test for Mixed-Mode I-II Wood Fracture*
- Nafa Z., M Chaplain, P Morlier, | *Damage of Glued-Laminated Beams Under Cyclic Torsion*
Guenfoud
- Franke St, B. Franke, | *Determination of Strain-Dependent Strength Behaviour of Wood Under Compression Stress*
Rautenstrauch
- Heräjärvi H, R Junkkonen *Bending Strength and Fracture of Finger-Joints of Modified and Unmodified Populus Sp. Components: Comparison of Air-Dry and Wet Wood Jointed With Six Different Glues*

COST E35 - WG3 Wood Machining

(Chairman G. Jeromidis)

- 10,00 **Invited lecture: F Scholz -** **Developments in the industrial wood processing and challenges**
10,45 **for research**
- 10,45-11,05 Goli G, M. Fioravanti, *Cutting Forces and Fracture Propagation Processing With Different Grain Orientation in Elastoplastic Orthogonal Wood Cutting*
- 11,05-11,30 Coffee break**
- 11,30-11,50 Sinn G, P Beer, S Stanz *Analysis of Cutting Forces in Circumferential Flat Milling of Particleboard*
Tschegg
- 11,50-12,10 Wyeth D, T Atkins *Force-Depth of Cut Relationships in Wood Cutting*
- 12,10-12,30 Garrido N, J Martins, L Carvalho *A Novel Method for Evaluating the Influence of Wood Machining Conditions on the Quality of Particleboards Edges*
- 12,30-12,50 *Short communications aided by poster (Chairman T. Atkins)*
- Palubicki B, G Kowaluk, W *Evaluation of Visual Method for Laminated Particleboard Edge Quality*
Szymanski, Determining
P Beer
- Ramananantoandro T, P Larricq, *The Use of Colour Image Analysis to Characterize Surface Quality of*
O Eterradosi, D Lafon *Machined Wood*

Outahyon A, R Marchal, P
Larricq,
P-J Meausoone

*Engineering of Wood Surfaces – Influence of Cutting Parameters on
Wood Surfaces Micro Damages and Reactivity*

Kowaluk G, W Szymanski, B
Palubicki,
P Beer

*Quality of Milling Correlated to Cutting Parameters of Laminated
Particleboard*

**13,00-
14,30**

Lunch

14.30

***MC Meeting of COST Actio
E35***

CEMARE PROGRAMME WARSAW

Thursday 19th October 2006

8.00-9.00 Registration

9.00-9.10 Welcome

9.10-10.00 Keynote: Physical factors vs. physiological reaction on formation of reaction wood by **Stefan Zajaczkowski**

10.00-11.00 Presentations WG3

- Thoughts about the role of galactan in the mechanism of compression wood (CW) action by **Clemens Altaner and Mike Jarvis**
- **Mechanical stimuli and vascular tissue differentiation** by Pia A Stieger

11.00-11.30 Coffee

11.30-12.30 Presentations WG3

- **Formation of juvenile wood and related wood properties** by Oliver Dünisch, Gerald Koch, Hans-Georg Richter, Uwe Schmitt, Robert Evans
- **Factors Affecting Compression Wood Formation in Sitka Spruce and Scots Pine** by Alexis Achim, Elspeth Macdonald, Barry Gardiner and Tom Connolly

12.30-14.00 Lunch

14.00-14.30 WG1 Keynote: **Evolution of the CESA gene superfamily: lessons from a moss genome** by Alison W. Roberts,

14.30-16.00 WG1 Presentations

- **Evidence for the contribution of glucomannans in the architecture of highly cellulosic secondary cell-walls** by Chabbert, B.; Crônier, D.; Habrant H.
- **Dimensions of primary-wall cellulose microfibrils isolated from celery collenchyma strands** by Craig J. Kennedy, Graeme J. Cameron, Adriana Šturcová, David C. Apperley, Clemens Altaner, Timothy J. Wess and Michael C. Jarvis
- **Update on cellulose synthase localization and movement** by Anne Mie Emons, Miriam Akkerman, Bela Mulder

16.00-17.00 Posters and coffee

17.00-18.30 WG1 Presentations

- **Correlative EM and LM microscopy for designing a method to determine amount and increase of cellulose microfibrils in Zinnia xylem suspension cells, and produced in vitro** by Carolina Cifuentes Espitia and Anne Mie Emons
- **Describing the initial stages of xylogenesis with the geometrical model for cell wall deposition** by Adkham Paiziev and Bela Mulder
- **Functional characterization of aspen genes coding for regulatory proteins potentially involved in wood formation** by Marc Schottey, Mondher El Jaziri and Marie Baucher

19.30 Dinner

20th October Friday

9.00-10.30 WG2 Keynote: **Down-regulation of cinnamoyl-coa-reductase in poplar: from the lab to the field** by Wout Boerjan

9.30-10.30 WG2 Presentations

- **Xylans deposition in the macromolecular assembly of the plant cell wall** by Jean-Paul Joseleau
- **Characterization And Localization Of Class Iii Peroxidases In Lignifying Xylem Of Norway Spruce** by Kaisa Marjamaa, Kristiina Hildén, Mikko Lehtonen, Taina Lundell and Kurt Fagerstedt

10.30-11.00 Coffee

11.00-12.00 WG2 Presentations

- **A few approaches for tissue-selective characterization of wood cell walls** by Katia Ruel
- Response of differentiating fibres to wounding: a structural and topochemical study by **Uwe Schmitt, Claus Frankenstein and Gerald Koch**

12.00-12.30 WG4 Keynote: **George Jeronimidis**

12.30-13.00 WG4 Presentations

- **Assessing the structural variability of woody tissues via thermal analysis: a comparative study** by Dries Vansteenkiste and Joris Van Acker
- **Hygroelastic behaviour of compression wood tracheids based on analytical composite micromechanics** by E.K. Gamstedt, S.L. Bardage and R.C. Neagu

13.00-14.30 Lunch

14.30-16.00 WG4 Presentations

- **Observation of tension wood shrinkage at cell wall level** by Changhua Fang, Bruno Clair, Joseph Gril, Shengquan Liu

- **Structure Of Wood In Scots Pine Trees After Irradiation From The Chernobyl Accident** by Mirela Tulik

16.00-16.30 Coffee

16.30-18.00 WG meetings

18.00-18.30 WG Reports

21st Saturday

9-00 Management Committee Meeting

12-00 End of meeting

Joint WG3/WG4 meeting of COST Action E50 "Cell-wall macromolecules & Reaction wood" 28th - 29th August 2006, Stockholm, Sweden
REPORT BY GEOFFREY DANIEL AND BARRY GARDINER

Location of WG3/WG4 meetings

The meetings were held at the Royal College of Technology (KTH), and STFI-Packforsk, Stockholm.

Monday 28th August

The meeting was opened by the deputy leader of Working Group 3, Geoff Daniel from the Swedish Wood Ultrastructure Research Centre (WURC). This was followed by a specially invited lecture entitled "*Structural aspects of cellulose microfibrils in wood –links to biomechanics*" which was given by Prof. Jungi Sugiyama from the Research Institute for Sustainable Humanosphere, Kyoto University, Kyoto, Japan. Professor Sugiyama was sponsored by WURC. The lecture was followed by a long discussion session. Matters of particular importance arising concerned the size of cellulose microfibrils and techniques for their measurement. In accordance with the themes of the two working groups, the role of the mechanical state of cellulose in reaction wood was discussed based on research carried out in tension wood in poplar. Of great interest and value to delegates was a new technique described by Prof. Sugiyama for the measurement of cellulose crystallites in wood. This provided evidence that crystallites in tension wood were larger than those in normal wood. Possible reasons for the differences and the consequences were discussed.

Tuesday 29th August

The meeting on Tuesday 29th August was attended by scientists from the host institution, encouraging more extensive discussions. The morning and afternoon sessions were occupied by scientific presentations (titles and authors below):

- *WURCs impact on our understanding of wood fibre nanostructure*; G. Daniel, (Sweden);
- *Influence of ultrastructure on pulp fibres mechanical properties*; K. Ruel et al., (France);
- *Inhomogeneity in lignin structure between different cell wall layers in conifers and hardwood*; G. Henriksson et al., (Sweden);
- *Interactions of the components within the outer fibre wall layers*; J.-S. Srdovic et al., (Sweden);
- *Dislocations counting and comparison of pulp fibre properties after HCL- treatment and fibre length determination*; P. Ander, (Sweden);
- *Effects of relative humidity on load redistribution in cyclic loading of wood-fibre composites analysed by dynamic Fourier transform infrared spectroscopy*; K. Bogren et al., (Sweden);
- *Finite element modelling of mechanical properties of geometrically characterized wood fibres*; D. Wilhelmsson et al., (Sweden);
- *Load-carrying characteristics of moist cellulose studied by FT-IR in combination with Deuterium exchange*, K. Hofstetter et al. (Austria);
- *Modelling the effects of ultrastructural morphology on the elastic properties of wood fibres*; C. Neagu et al., (Sweden);
- *Ultrastructure arrangement and rearrangement of the cellulose aggregates within the secondary wall*; L. Salmén (Sweden);
- *In-situ ESEM deformation studies of single wood cells*; M. Eder et al., (Austria/Germany);
- *Spectroscopic molecular deformation studies on wood cell walls*; B. Gierlinger (Germany);
- *Monitoring dislocations in single hemp fibres during tensile testing*; L. Thygesen et al., (Denmark/Germany).

The evening session was chaired by Working Group 4 leader, Barry Gardiner and began with another invited lecture entitled "*Genetic variability of compression wood traits in Pinus pinaster*". This was given by Dr. Rosario de Grado from Spain, who was also sponsored by WURC. Following the lecture, Barry Gardiner led discussions concerning the importance of genetic versus of environmental effects for the induction of compression wood. Aspects of the potential industrial uses of reaction wood and problems caused by *reaction wood-normal wood* mixtures for industry were also discussed.

Finally, a short plenary discussion led by the CEMARE Deputy Chairman J. Gril was held and the main conclusions from the meeting discussed. Thereafter the upcoming EU50 CEMARE meeting in Warsaw, Poland was discussed and the criteria for papers and presentations outlined. Future activities of WG3 and WG4, STSMs, possibilities for collaborative projects and grant applications, and finally any other matters were briefly discussed.

LIST OF PARTICIPANTS

Finland (2):

Kurt Fagerstedt

Eija Kukkola

France (9):

Thierry Constant
Joseph Gril
Gaëlle Jaouen
Meriem Fournier
Tancredè Alméras
Sandrine Bardet
Julien Ruelle
Eric Badel

Germany (5):

Michaela Eder
Burgi Gierlinger
Uwe Schmitt
Christian Lehringer
Ingo Burgert

SLOVENIA (1)

Primoz Oven

Sweden (5)

Lennart Salmen
Geoffrey Daniel
Stig Bardage
Paul Ander

Switzerland (1):

Pia Stieger

United Kingdom

Clements Altaner
Alexis Achim
Barry Gardiner
Georges Jeronimidis
Monica De Ioanni

Invited speakers

Rosario de Grado, Spain: Specialist on gravitropic reactions and compression wood in *Pinus pinaster*.

Junji Sugiyama, Japan: Specialist on the formation of cellulose and especially the formation of the G-layer in tension wood.

WORKING GROUP 1 MEETING ON CELLULOSE, 18, 19, 20 DECEMBER, 2006 WAGENINGEN

18 December

The meeting was opened at 15 h by the chair of the workshop, Anne Mie Emons, Wageningen University. She presented 'The cell biology behind the geometrical model', discussing work done in her laboratory with immunolabeling of cellulose synthases (CESA) to show their localization in Arabidopsis root cells. This work had been provided by Chris Somerville, Stanford University. Work using spinning disk confocal microscopy from the Stanford laboratory was discussed as being an important contribution to the cellulose field. It reveals that CESA complexes in the plasma membrane of living cells of Arabidopsis etiolated hypocotyls move at constant rates in linear tracks, aligned with cortical microtubules, but that, in the absence of microtubules, synthases still move in ordered patterns (Paredes et al. 2006). This shows that microtubules may be needed for guiding microfibrils in elongating cells, but that there should be a different default mechanism for cellulose microfibril orientation.

The next speaker was Bela Mulder from the FOM Institute for Atomic and Molecular Physics, Amsterdam on 'The mathematics of the geometrical model for cell wall texture formation', taking up on the message of the first speaker that cellulose synthase complexes move in ordered arrays, also in the absence of cortical microtubules. This makes the geometrical model for cellulose texture formation only more relevant as a theory for cellulose ordering in cells, in which the two polymers are not aligned. New information is available showing that the model can also readily explain cellulose band formation in xylem cells. These first two presentations were about general topics concerning cellulose organization during its production.

In the second two presentations the use of Arabidopsis as model system for cellulose production research was the issue. Herman Höfte, INRA Versailles discussed how the model plant Arabidopsis can be used for such research questions, for instance by altering cell wall texture', and the use and analysis of mutants and transgenics. In his laboratory they have several mutants/transgenics available now to be used in studies deciphering the mechanism of cellulose architecture formation in plant cells. Data from Arabidopsis can be used to understand also more complex systems like the tree poplar. In the discussion it appeared that especially pectin mutants would be useful.

Ingo Burgert, from the Max Planck Institute in Golm reported on their advances especially in technologies on the study of 'The mechanics of Arabidopsis and poplar cells and seedlings with altered wall texture. They are devising techniques in which mechanical properties of smaller tissues can be measured, up to hypocotyls of Arabidopsis. A new development is the scanning acoustic microscope.

After that, the discussion redirected from the model system Arabidopsis to the tree poplar. Bjorn Sundberg, Umea, gave an 'Update on cellulose and wall texture in poplar', after which not only primary wood production was discussed but also reaction wood and the differences with normal wood, for instance the G-layer, which for almost 100% consists of cellulose.

The last presenter before the general discussion was Magnus Hertzberg, from SWETREE Technologies in Umea, who collaborates with Bjorn Sundberg of the University in Umea. This last presentation was the start of a general discussion on 'The industrial perspective for use of poplar trees with altered cell wall texture'.

19 December

This day was devoted to cellulose properties, and how they can be studied with a variety of techniques.

The host of the meeting, Anne Mie Emons, from Wageningen University opened the workshop with a talk on the 'Cell biology of cellulose production'. Plasma membranes from higher plant cells contain processive glycosyltransferases that catalyse the synthesis of (1 \rightarrow 4)- β -D-glucan (cellulose). Despite the importance of β -glucan synthases for the cell and the relatively simple chemical structure of their reaction products, the molecular mechanisms by which these enzymes function are poorly understood, in particular the detailed composition of the glucan synthase complexes remains unknown. She discussed with the other participants all experimental results that have led to the geometrical model for cell wall texture formation, which should be further validated. Electron Tomography Microscopy of the routing through the cell and position in the plasma membrane of the cellulose synthase complex would be one of the next research steps to be taken.

This was followed up by Bela Mulder, from the FOM Institute for Atomic and Molecular Physics, Amsterdam, discussing how 'The geometrical model for cellulose design' could be used as an in silico leading principle for choosing the right wet laboratory experiments. He argued that for decades physics has demonstrated that real insight in complex phenomena can only be reached when combining experimental results with quantitative mathematical models. Because of the huge amount of "omics" and microscopy studies delivering quantitative data molecular cell biology is now reaching this stage. In the study of the regulation of cellulose microfibril organization a landmark has been the development of a predictive mathematical formula, the core of the geo-model, which describes the orientation of every single cellulose microfibril under deposition at every time point. It can be used to make predictions about processes occurring within the cell and e.g. that in certain wall types the synthases should be inserted into the plasma membrane in domains.

Herman Höfte, INRA, Paris reported how 'Molecular biology of cellulose production' has given a tremendous insight in this matter, but still a lot has to be done before we can transfer our knowledge from model plants to trees. The cellulose synthase complexes are composed of hexameric subcomplexes, which, based on genetic and co-immunoprecipitation studies, contain 3 distinct types of catalytic subunits, the actual cellulose synthases (CESAs). Two sets of three evolutionary conserved cellulose synthases are required each for primary wall deposition in growing cells and secondary wall thickening in xylem cells. In addition to the genes, a membrane-bound endo- β -1,4-glucohydrolase (KOR1), a secreted chitinase-like protein (POM1), a membrane protein (KOB1), and a GPI-anchored protein (COB1) are required for cellulose synthesis. Intracellular trafficking of other components of the cellulose synthase machinery also appears to play an important regulatory role as shown by the regulated cycling of KOR1 in growing cells.

Simon Turner, University of Manchester, took up the discussion and went on from primary cell wall to 'Cellulose in secondary cell wall', the type of wall so relevant for woody material. During banded secondary wall formation, cellulose deposition is limited to discrete areas of the cell wall. These areas are clearly marked by bands of cortical microtubules that appear to be required to maintain the localisation of the cellulose synthase complex. The *irx1*, *irx3* and *irx5* mutants in *Arabidopsis* are all caused by defects in members of the *CesA* gene family. The *AtCesA4* (IRX5), *AtCesA7* (IRX3) and *AtCesA8* (IRX1) proteins all function in a non-redundant manner as part of a complex that is required to synthesise cellulose in the secondary cell wall. Green fluorescent protein fused to IRX3 suggests that the complex moves rapidly during secondary cell wall formation.

Mike Jarvis, University of Glasgow, reported on the 'Biophysics of cellulose; do we know how many polymers in one microfibril? There was a lively discussion, an extension of the discussion held in the earlier meeting of COST E-50 CEMARE in Warsaw on the number of cellulose polymers within a single cellulose microfibril and also on the differences that appear to exist in the dimensions of a single cellulose microfibril. All agreed that thick microfibrils such as present in algae and formed by groups of rosettes or cellulose synthase complexes different from the rosettes seen in the plasma membrane of higher plants, do not exist in higher plants.

Both in the contribution of Jarvis and that of the next speaker Marko Peura, Helsinki, who reported on 'Physical aspects of cellulose' biophysical measurement methods, were discussed. X-ray scattering techniques (diffraction and small-angle scattering) are suitable methods to study the crystallinity and arrangement of cellulose microfibrils in plant cell walls in a non-destructive way. Peura discussed microfibril angle, an important characteristic of woody material; the organisation of the microfibrils of the wood cell wall is a major parameter in controlling the stiffness, strength and toughness of wood. Methods show that within one single cellulose microfibril sites that are more crystalline exist next to other sites that are more amorphous.

After the lunch, Bjorn Sundberg, Umea, discussed 'Cell biology of poplar cellulose' Xylem vessels have several advantages for studying cellulose synthesis. Genomic studies of hybrid aspen, *Populus tremula* x *tremuloides*, and the black cottonwood, *Populus trichocarpa* indicate the presence of 18 distinct *CesA* genes. Expression profiling suggests that at least four of the genes are highly expressed during wood formation and/or tension wood formation. Studies on hybrid aspen indicate that a set of the secondary cell wall associated *CesA* genes are upregulated in the late stationary phases and that the high level of *CesA* gene expression correlates with increased level of cellulose biosynthesis.

Vincent Bulone, Stockholm switched to 'Cellulose production in vitro', a very promising technique and very relevant to our nanotechnology topic for the next day. A central aim is to establish in vitro cellulose synthesis in *Arabidopsis*, which seems probably achievable with Vincent Bulone's experience in other species. From work on other species it has appeared that the type of detergents to liberate the synthases is crucial. Having an in vitro system available in *Arabidopsis* would be a considerable advantage.

Tuula Teeri, Stockholm discussed not only the 'Molecular biology of poplar cellulose', but also showed how in Stockholm they are setting up a fantastic multidisciplinary centre for tree research, mainly poplar.

The meeting of this day was concluded by Tony Arioli, Bayer, Gent discussing 'Industry in the cellulose business'. It is becoming clear to everybody that plant derived cellulosic products have a big future for use in industry, but considerable knowledge has to be gained yet. Plant systems he suggested, should not only be Arabidopsis and poplar that were discussed this workshop, but in addition cotton, and for biofuel bulk mass producing grasses. Understanding plant development, in particular cell elongation, is important. In almost all plant cell types, the processes of cell elongation and cell wall production are coupled.

As a prelude of the topic of the next day, in the evening there was a lively discussion on electromechanical properties of cellulose of which Mike Jarvis made the following report:

Electromechanical properties of cellulose

In a news article that I wrote in 2003 on the crystal structures of cellulose I. and I. I speculated – just in passing – that if the two alternative hydrogen-bonding systems in each allomorph were separated by a small enough energy barrier they might be interconvertible under the influence of external signals such as electric fields (Jarvis 2003). The size of the actual energy barrier is not certain and might not be small at all. Subsequent MD simulations (Matthews et al. 2006) have suggested another mechanism by which local hydrogen-bond patterns might alternate spontaneously in time through rotation around the C5-C6 bond, although there is some question whether this may be a consequence of the force field used in the simulation.

This idea was picked up in a Macromolecules paper (Kim et al. 2006d) by a Korean group who had made a device from a thin cellulose acetate film (they called it 'paper' but this was a mistake in translation) sandwiched between two thin sheets of gold as electrodes. The device bent under the influence of an electric potential across the cellulose acetate. Because the authors made picturesque suggestions about how their device might be used, such as remote-controlled machines like flying insects, I was asked to comment on this paper for the American news magazine Science Now. I was not keen because I was not at all impressed by the Macromolecules paper. I was satisfied that the authors had made an interesting device but I did not think they had succeeded in explaining how it worked.

However a very edited version of my comments was published and brought me an interesting

Email from a retired American paper scientist, Gary Baum, who pointed out that this looked like an inverse piezoelectric effect and that piezoelectric properties of both wood and paper had been demonstrated in some detail 40 years ago. I have not been able to trace the original publication by Bazhenov that he mentioned, but the idea was taken up in the 1960s in Japan (Fukada 1968) and formed the basis of early attempts to measure the tensile modulus of wood acoustically (Galligan and Courteau 1965).

Since then the Korean group have published some more on potential applications of the principle behind their device, concentrating on different electrode coatings (Kim et al. 2006e), remote activation by microwaves (Kim et al. 2006b; Kim et al. 2006c) and possible printing applications (Kim et al. 2006a). They don't seem to have made progress towards definitive tests of the mechanism involved. For example cellulose acetate shows strong electroosmotic flow during electrophoresis and water transport from one side of the film to the other, under the influence of the electrical potential field, might be enough to make it bend.

Mike Jarvis

Fukada E (1968) Piezoelectricity as a fundamental Property of wood. Wood Science and Technology 2: 299-.

Galligan WL, Courteau RW (1965) Die Messung der Elastizität des Holzes durch Anwendung von mechanischen Langswellen und des piezoelektrischen Effekts von Holz. Holz als Roh-und Werkstoff 23: 290-&.

Jarvis M (2003) Chemistry -Cellulose stacks up. Nature 426: 611-612.

Kim J, Bae SH, Lim HG (2006a) Micro transfer printing on cellulose electro-active paper. Smart Materials & Structures 15: 889-892.

Kim J, Yang SY, Song KD, Jones S, Choi SH (2006b) Performance characterization of flexible dipole rectennas for smart actuator use. Smart Materials & Structures 15: 809-815.

Kim J, Yang SY, Song KD, Jones S, Elliott JR, Choi SH (2006c) Microwave power transmission using a flexible rectenna for microwave-powered aerial vehicles. Smart Materials & Structures 15: 1243-1248.

Kim J, Yun S, Ounaies Z (2006d) Discovery of cellulose as a smart material. *Macromolecules* 39: 42024206.
Kim J, Yun S, Song C (2006e) Performance of electro-active papers made with cellulose and multi-walled carbon nanotubes. In: *Advanced Nondestructive Evaluation I, Pts 1 and 2, Proceedings*. pp 166-169.
Matthews JF, Skopec CE, Mason PE, Zuccato P, Torget RW, Sugiyama J, Himmel ME, Brady JW (2006) Computer simulation studies of microcrystalline cellulose I beta. *Carbohydrate Research* 341: 138-152.

This was surely an interesting interlude between the topic of the COST CEMARE WG1 meeting of the 19th and the one of the 20th of December.

20 December

In the COST E-50 WG1 workshop on the 20th of December, 2006, we discussed the topic 'Nanotechnology and cellulose', which may seem to be a bit early, but it was very timely and interesting that people from different disciplines had been brought together; it was a sure sparkle for possible new interdisciplinary research in Europe.

Tuula Teeri, from Stockholm chaired this meeting and started the discussion with an 'Introduction of a new field and the role of molecular biology for nanotechnology and cellulose'. She asked the intriguing question: "Why would cellulase be needed for cellulose synthesis?" and reported about a microtubule associated protein (MAP-20) which is upregulated at the start of secondary cell wall formation. Another discussion point was the CBM, the cellulose binding module. The CBM is a natural anchor between cellulose and other molecules, which makes the module useful in nanotechnologically designed products. The day was primarily devoted to the question how the different disciplines could contribute to advances in this new field of nanotechnology and cellulose.

Anne Mie Emons, from Wageningen University, discussed different cell biological techniques that should be useful for this new type of research. Special attention was given to the LC-Polscope, a liquid crystal polarization microscope in which the polarizer is not just a filter allowing light through it in only one direction, but this filter is replaced by a liquid crystal that is electronically rotated and images are being made in the different positions. The software then makes an image of the birefringent material under study, not just in the two directions of the classical polarization microscope, but in a number of directions. In this way for instance a star made of polymers in all directions and which is being seen as a cross in a classical polarization microscope is seen as a complete star. Since imaging / measurement uses the intrinsic properties of the material and not added fluorochromes, this method is quantitative. She also discussed the benefits of Electron Tomography Microscopy for cellulose research.

Vincent Bulone, Stockholm gave an impressive report of the work that has been done in his laboratories in Grenoble, Lyon and now in Stockholm on cellulose and callose production in vitro, and its analysis. What was new to most scientists present is that also callose produces fibrillar material. Of course for nanotechnology, both polymers and even combinations of them, or of each of them with other composites, or with other organic or inorganic material, can be of tremendous importance in nano-technological future product design.

Mike Jarvis, Glasgow discussed in his presentation 'The importance of biophysics' tension and compression wood, and crystalline and non-crystalline cellulose, the latter being on the surface of the microfibril and the crystalline part being the core of it. The organization of the polymers in the core and especially the outer ones contribute to the dimension of the whole cellulose microfibril. Twisting of the microfibril could also contribute to the tensile modulus. Another point of importance for tensile properties of the material is the way in which hemicelluloses bridge cellulose microfibrils, most probable in a trellis-like configuration.

In 'The role of physics', Dieter Lloydl, Vienna, updated us on wide angle X-ray diffraction and small angle X-ray diffraction, the differences and the advantages for certain types of research. Much of this work has been done by Peter Fratzl in Austria, who is now at the MPI in Göltingen. Ingo Burgert, who is a close collaborator of Fratzl, was in the audience.

Markus Linder, Finland let bio-inspiration be the driving force for production of sheets, nanotubes of biomolecules with other molecules on top. Inspiring!

Lars Berglund, Stockholm, who is an engineer, showed us 'Engineering as the end goal' comparing glass fibres with cellulose crystals. His vision for future nanotechnology of cellulose was in combining cellulose with starch, glycerol, etc, to make new materials. He gave an example of the type of material that can be produced. Hierarchical foam structures in which the percentage of cellulose determines amount and shape of the 'cells' in the foam.

Bela Mulder, Amsterdam discussed 'The importance of modeling'. He discussed a theoretical model in which the deposition angle of cellulose microfibrils depends on the number of active synthases, the distance between the cellulose microfibrils within a lamella under deposition and the cell geometry. This so-called geo-model provides a unifying explanation for cellulose microfibril angle determination in all wall textures, which does not rely on any form of direct co-alignment with cortical microtubules. Especially, now that work with Arabidopsis mutants shows that also in elongating cells the orientations of the cortical microtubules and the cellulose microfibrils are not inevitably the same, this model is receiving increasing attention.

The contribution of Olli Ilkkala from Finland on several aspects of 'self-assembling proteins' was a real eye-opener for most cellulose researchers present. He talked about self-assembly, as competition and interaction, giving rise to hierarchies, entanglement of rods, connectivity, gelation, mechanical reinforcement, function and use of new products as rods and layers.

Finally, we had a lively discussion on the topics of the workshop, which was attended by 23 participants, not only the technicalities but in addition the need for brainstorming among scientists from different disciplines such as the people in this workshop who should and could inspire each other. The workshop showed that scientists from different backgrounds working on one substance, in this case cellulose microfibrils, have a lot to learn from each other.

Though no realistic targets were identified at this moment, it was clear that an interdisciplinary approach of cellulose in a nanotechnological context has a great future!

Report on COST E50 Workshop Working Groups 3 & 4

Modeling from Plant Wall to Plank Napier University, Edinburgh, Scotland

19-20th April 2007

The workshop was based around the question: “How do we use models at different scales to help understand the behaviour of timber containing reaction wood?”

The meeting began with an introduction by Dr Barry Gardiner (Forest Research, UK) to the problems caused by reaction wood in wood and how modelling might be able to help address these issues. This was followed by two plenary talks entitled “Properties of Timber Containing Reaction Wood” and “Modelling Wood” by Dr Marie Johansson of Chalmers University, Sweden and Dr Mike Jarvis of Glasgow University, Scotland respectively. Dr Johansson compared the mechanical properties of compression wood and normal wood. The presence of compression wood often results in increased distortion (bow and spring) because of higher longitudinal shrinkage when dried and also to brash failure under loading. Dr Jarvis discussed the philosophy of modelling and presented a review of modelling approaches and under what circumstances which models were appropriate. His talk was illustrated by a discussion of models aimed at explaining the influence of microfibril angle on the mechanical properties of wood fibres.

Two additional talks were presented by Dr Pekka Saranpää (METLA, Finland) and Dr Rupert Wimmer (Boku University, Austria). Dr Saranpää discussed how tree breeding and silviculture affect wood properties between sites, between stems, within stems and within annual rings. He also discussed models of wood properties that he and colleagues are developing. Dr Wimmer discussed the use of path analysis for modelling the relationships between wood attributes and pulp characteristics. Path analysis requires the identification of a causal pathway containing both direct and indirect effects. In this way, the issue of multi-collinearity between variables, which is a problem in multiple linear regression, can be dealt with.

The Workshop then broke into two groups in order to try to answer the following questions:

1. Identify the key problems
2. List the models that we are developing and what data we have
3. Identify issues where we need help from Working Groups 1 and 2
4. Identify what are the essential requirements we require for future effort (models, data, experiments, tools, proposals, collaborations, etc.)

Group I was concerned with working from tree to final product whereas Group II was focussed on scaling up from cell wall upwards (Figure 1).

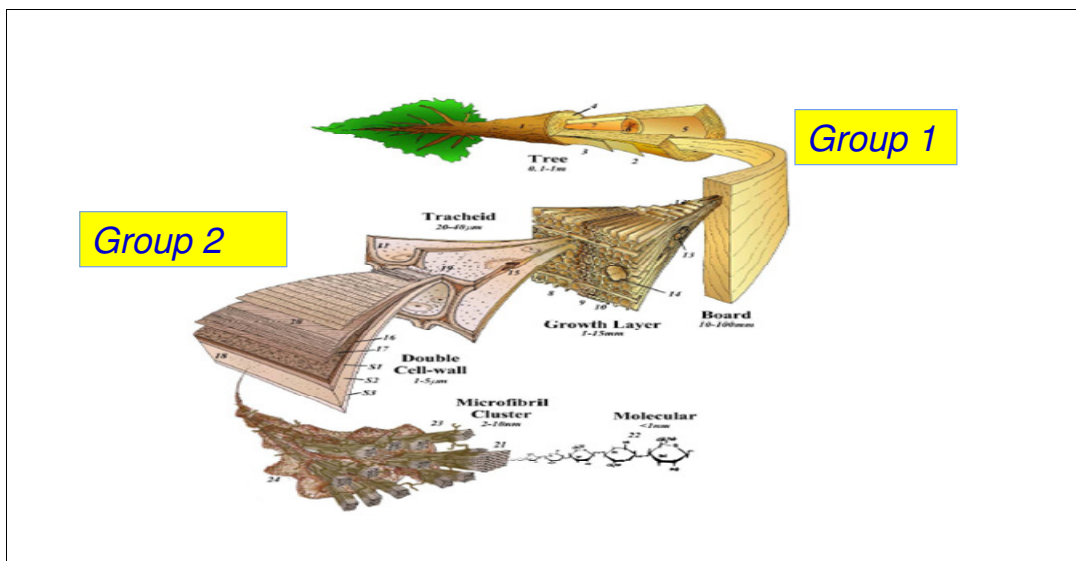


Figure 1. Schematic diagram showing the structure of a softwood tree at a range of scales (after Harrington, 2002).

At the end of the Workshop, the two groups came back together and reported their findings. The key outcomes were:

1. Need to know how important reaction wood is to the wood processing industry? Have any surveys of end-users and processors been undertaken and if so what conclusions were drawn?
2. Still have a fundamental requirement for how to identify and classify reaction wood despite over 100 years of research in this area.
3. Reaction wood is likely to be more of a problem for high-quality end products such as panels (distortion), glue-laminated beams and solid timber (distortion, stiffness and failure mode)
4. Predicting the location of reaction wood in tree stems is not yet possible
5. The drivers for reaction wood formation and the development of growth stresses in trees are not well understood.
6. Models exist for predicting the mechanical behaviour and distortion of wood but as yet these do not incorporate reaction wood.
7. Require more information on the mechanical and physical properties of reaction wood
8. Need to properly understand the response of timber to fluctuations in moisture content
9. Need improved tools to study cell wall structure
10. Need WG 1 & 2 to tell us whether models for cellulose and lignin are common for all species, better information on the chemistry of fibres and better tools to study cell wall structure (e.g. antibodies)
11. Need to understand the role of cavities which occur during cell wall formation

Finally, the Workshop concluded with key future requirements and potential future work. These were as follows

1. Need to improve the definition of reaction wood and to link this definition to properties and behaviour, rather than simply anatomy.
2. Need to complete a risk analysis to determine the economic cost of reaction wood to the European forest-based industries
3. Require fundamental research on cell wall formation
4. Need to develop a modelling framework to predict the behaviour of sawn timber/laminated timber
5. Require fundamental research into reaction wood and understanding heterogeneity
6. Need to produce a list on the CEMARE Web site of all on-going research into reaction wood in Europe

It was concluded that there is a need for a major coordinated research project and consideration needs to be given to a developing a 7th Framework proposal. In addition to this short report from the meeting, a more thorough summary document will be prepared which will elaborate on the key points covered here. This document will be circulated among the members of the COST action and will hopefully serve as a catalyst for developing future proposals for collaborative research.

Barry Gardiner and John Moore
Edinburgh
3 May 2007

Joint Working Group 2 – 3 – 4 Meeting 26-27 March 2007

“Regulation of lignin biosynthesis and reaction wood induction”

Laboratoire de Mécanique et Génie Civil, Université Montpellier 2
Campus St. Priest, Bat. 2, 860 Route de St. Priest, 34095 Montpellier, France

Draft Agenda

1. MONDAY 26/03/07

- 13:30 - 14:00 Welcome
- 14:00 - 17:00 Session on the regulation of lignin biosynthesis
chair: Kurt Fagerstedt (FI)
- 14:00 - 14:40 Introductory lecture by Kurt Fagerstedt (FI)
- 14:40 - 16:30 Discussion following the lecture on following subject: transcription factors taking part in the regulation of monolignol biosynthesis, regulation of transport of monolignols to the apoplast, and the regulation of hydrogen peroxide levels in the apoplast. Contributions on the bioinformatic level to account for progress in Poplar genome sequencing are welcome.
- 16:30 - 17:00 Synthesis and suggestions for definition of research priorities.

2. TUESDAY 27/03/07

- 09:00 - 12:00 Session on reaction wood induction
Chair: Mériem Fournier (FR)
- 09:00 - 09:40 General introduction by Mériem Fournier (FR): Overview on the induction of reaction wood: what's new since Archer and Wilson 1977?
- 09:40 – 10:00 Oral presentation by T. Alméras (FR): Tree functional diversity and gravitropism as a key process for tree growth in dense canopies. Some observations in the tropical rainforest.
- 10:00 - 11:30 Discussion on reaction wood induction : Questions from forestry and wood science to tree physiology, tree genomics and forest ecology ? Connexions between wood structural and chemical analysis and reaction wood biology : are we speaking the same language ?
- 11:30 -12:00 Synthesis and suggestions for definition of research priorities.
- 12:00-13:30 General discussion:** proposals for future actions (seminars, research projects ...)
- 12:00-13:30 Lunch** in a close-by restaurant
- 14:00-16:30 Management committee meeting**
MC agenda will include a discussion around a book project on tension wood.
Participation of concerned delegates outside the MC is welcome.

Workshop Potsdam September 26 th -28 th , 2007

Structure and function of primary and secondary cell walls

Programme

Wednesday, September 26 th

08:30 - 09:00 Registration

09:00 – 09:15 Welcome

WG1: Biosynthesis and structure of cellulose and polysaccharides

Chair persons: Anne Mie Emons, Uwe Schmitt

09:15 – 10:00 *Markus Pauly, Sascha Gille, Ulrike Haensel, Mark Ziemann*: Identification of cell wall mutants by a hydrolase screen (invited talk)

10:00 – 10:25 *Lutz Neumetzler, Nicolai Obel, Kazuchika Yamauchi, Ingo Burgert, Markus Pauly* Analysis of mutants with altered xyloglucan (axy) structures using Oligosaccharide Mass Profiling (OLIMP)

10:25 – 10:50 Coffee break

10:50 – 11:35 *Jordi Chan, Grant Calder, Samantha Fox, Clive Lloyd* Rotating microtubules and cellulose synthesis (invited talk)

11:35 – 12:00 *Jelmer Lindeboom, Anne Mie Emons* Pattern formation of cellulose microfibrils and cortical microtubules

12:00 – 12:25 *Kostya Shundyak, Bela Mulder* Emergence and stability of textures of cellulose microfibrils in the plant cell wall

12:25 – 12:50 *Andrew Parkin, Adriana Šturcová, J. Paul McLean, Clemens Altaner, Michael C. Jarvis* Microfibril width and structure in cellulose from primary walls of celery collenchyma and secondary walls of spruce wood

12:50 – 14:00 Lunch

WG2: Biosynthesis and modification of lignin

Chair persons: Katia Ruel, Kurt Fagerstedt

14:00 – 14:45 *Kazuhiko Fukushima* Formation and structure of lignin in tree xylem (invited talk)

14:45 – 15:10 *Kurt Fagerstedt, Kaisa Marjamaa, Eija Kukkola, Sanna Koutaniemi, Tino Warinowski, Teemu H. Teeri, Heidi Holkeri, Taina Lundell* Lignification and class III peroxidases of Norway spruce (*Picea abies*)

15:10 – 15:35 *Véronique Aguie, Laurence Foulon, Miyuki Takeuchi, David Cronier, Anouk Habrant, Araik Hambardzumyan, Roger Douillard, Brigitte Chabbert* Development of cellulose-based model systems for the study of interactions among wall components

15:35 – 16:10 Coffee break

16:10 – 16:55 *Lacey Samuels* New views of cell structure and lignin deposition during wood development (invited talk)

16:55 – 17:20 *Gerald Koch, Christian Lehringer, Uwe Schmitt* Application of scanning UV microspectrophotometry for the topochemical detection of aromatic compounds in the G-layers of tension wood fibres

17:20 – 17:45 *Susanne Huyskens-Keil, Werner B. Herppich* CO₂-mediated effects on biochemical properties of the cell wall and their influence on mechanical attributes of white Asparagus spears

Poster session 18:00 – 20:00

P1: *Véronique Douet, Mustapha Tiouabi, Eliane Abou-Mansour, Brigitte Pollet, Catherine Lapierre, Pia A Stieger* Mechanical stimuli and vascular tissue differentiation

P2: *Riikka Piispanen, Pekka Saranpää, Sune Linder* The effect of long-term nutrient optimisation on Norway spruce (*Picea abies* [L.] Karst.) fibre length and lignin concentration predicted by FTIR

P3: *Johnny Mukoko Bopopi, Olivier Vandeputte, Mondher El Jaziri, Brigitte Chabbert, Marie Baucher* Chemical characterization of cell walls from transgenic tobacco overexpressing *PtaRHE1* and *PtaERF1*, two genes linked to vascular development in aspen

P4: *Seija Kaakinen, Riikka Piispanen, Satu Lehto, Johanna Pohjanen, Urban Nilsson, Sune Linder, Pekka Saranpää, Elina Vapaavuori* Effect of nutrient optimisation on Norway spruce wood properties

P5: *Paul Ander, Geoffrey Daniel* Degradation of spruce pulp fibres by HCl and cellulases reflects different action on the fibre cell walls

P6: *Wolfgang Graf, Werner B. Herppich, Susanne Huyskens-Keil, Heiner Grüneberg* Cell wall chemistry and mechanical strength of the peduncle of cut roses

P7: *J. Dlouha* Relationship between anatomical features and viscoelastic properties of a selection of tropical species with contrasted growth strategies

P8: *Kazuchika Yamauchi, Willie Abasolo, Lutz Neumetzler, Markus Pauly, Ingo Burgert* Mechanical properties of Arabidopsis hypocotyls treated with XEG

P9: *Frédérique Nolin, Anouk Habrant, Godfrey Neutelings, Simon Hawkins, Brigitte Chabbert* Peroxidases and lignification in flax stem

P10: *K. Bytebier, O. Arnould, R. Arinero* Mechanical characterization of wood at the submicrometre scale:

a prospective study

Thursday, September 27 th

WG4: Relating wood and fibre properties to structure and formation

Chair persons: Barry Gardiner, Pekka Saranpää

09:00 – 09:45 *Peter Fratzl, Ingo Burgert* From air-humidity driven actuators in plants to biomimetic micro-devices

09:45 - 10:10 *Carole Assor, Tuan Dinh, Philippe Jacquin, Gilles Pilate, Patrick Perré* Mechanical tests on microsamples of normal and tension wood of poplar upon radial, tangential and longitudinal directions

10:10 – 10:35 *Mohammad R. Asgharipour, Lisbeth G. Thygesen* The effect of growth conditions on the amount of dislocations in hemp fibres

10:35 – 11:10 Coffee break

11:10 – 11:35 *Kristofer Gamstedt, Stig L. Bardage* Modelling approaches to three-dimensional hygroelastic behaviour of compression wood and their tracheids

11:35 – 12:00 *Jasna S. Stevanic, Lennart Salmén* Interaction among polymers in the primary cell wall of Norway spruce (*Picea abies* (L.) Karst.)

12:00 – 13:15 Lunch

WG3: Formation and induction of reaction wood

Chair persons: Meriem Fournier, Geoffrey Daniel

13:15 – 14:00 *Brian Butterfield* Towards understanding compression wood (invited talk)

14:00 – 14:25 *Gilles Pilate, Miyuki Takeuchi, Dominique Arnaud, Annabelle Dejardin, Françoise Laurans, Marie-Claude Lesage-Descauses, Régis Fichoti, Franck Brignolas, Jean-Charles Leple.* Functional genomics of fibre differentiation in *Populus 4*

14:25 – 14:50 *Primož Oven, Maks Merela, Igor Serša* Structural response and moisture alterations in wounded tissues of beech

14:50 – 15:15 Coffee break

15:15 – 16:00 *Fang Huang, Marcelo K. Zago, Helene Robert, Ab Quint, Carlos S. Ampudia, Remko Offringa* Plant AGC protein kinases: a compass that orients auxin-dependent plant growth and –development (invited talk)

16:00 – 16:25 *Bruno Clair, Françoise Quignard, Pierre Cabrolier, Francesco Di Renzo, Joseph Gril* Characterisation of the non-cellulosic component of G-layer

16:25 – 16:50 *Luna Goswami, Karin Jungnikl, John Dunlop, Catherine Coutand, George Jeronimidis, Peter Fratzl, Ingo Burgert* Enzymatic removal of the G-layer - New insights into its mechanical Role

Friday, September 28th

09:00 – 10:45 Individual working group meetings

10:45 – 11:15 Coffee break

11:15 – 12:30 Final session

12:30 – 14:00 Lunch

14:00 – 16:00 Management Committee Meeting

JOINT WORKSHOP WITH E41. MAY 19-21, 2008 TURKU / ÅBO

Sunday, 18 May

Possibility to go on "guided" town tours, please see separate info on web pages

Monday, 19 May

- 9- Registration and coffee
- 9.45-10.00 **Opening words, practical issues (Stefan Willför)**
- 10.00-10.45 **Catherine Lapierre** "*Lignin structural variability as revealed by thioacidolysis*"
- 10.45-11.15 **Anne Mie Emons** "*Measuring cellulose biosynthesis*"
- 11.15-11.45 **Olivier Arnould** "*Mechanical characterization of wood viscoelasticity at the submicrometre scale*"
- 12-13 **Lunch**
- 13.00-13.45 **Dimitris S. Argyropoulos** "*Toward the Quantitative 31P-NMR analysis of lignocellulosic materials in ionic liquids*"
- 13.45-14.15 **Kurt Fagerstedt** "*Regulation of lignification*"
- 14.15-15.30 **Poster session with short three-minute-introductions + coffee**
- 15.30-16.00 **Marco Orlandi** "*The EPR spectroscopy for the assessment of lignin radical formation*"
- 16.00-16.30 **Gerald Koch** "*Application of scanning UV microspectrophotometry for the topochemical detection of lignin and phenolic extractives in wood cell walls*"
- 16.30-18.00 **E41 MC meeting**
- 16.30-18.00 **E50 Working Group Meetings**
- 18.00-19.30 **Reception by City of Turku + laboratory visits**
(Åbo Akademi Gadolinia building)

Tuesday, 20 May

- 8-30 Registration
- 9.00-9.30 **Opening words, practical issues (Jorma Mattinen (Rector of Åbo Akademi), Stefan Willför, Lars Gädda?)**
- 9.30-10.15 **Jorge Colodette** "*The effect of eucalyptus wood chemistry on pulping and pulp bleachability and properties*"
- 10.15-10.45 **Coffee**
- 10.45-11.15 **Haiyang Liu** "*Application of natural hollow fibres to repair concrete cracks*"
- 11.15-11.45 **Denilson da Silva Perez** "*NIRS characterisation of pulps obtained from different wood species (pure and mixture) pooled into single calibrations*"
- 12-13 **Lunch**
- 13.00-13.45 **Bjarne Holmbom** "*Analytical tools for pulp and paper process research*"
- 13.45-14.15 **Clemens Altaner** "*Measuring compression wood severity in spruce*"
- 14.15-16.00 **Poster session with short three-minute-introductions + coffee**
- 16.00-16.30 **Annabelle Caron** "*Analysis of wood extracts: Comparison between Chromatographic and spectroscopic techniques*"
- 16.30-17.00 **Heiko Winter** "*Changes in the composition of wood extractives of Norway spruce applying different log storage methods*"
- 18.00-23 **Archipelago dinner at L'Escale in Nagu (bus transport from Åbo Akademi)**

Wednesday, 21 May

- 8-30 Registration
- 9.00-9.45 **Derek Gray** "*Cellulose nanocrystals*"
- 9.45-10.15 **Callum Hill** "*Fibre saturation point of lignocellulosic materials*"
- 10.15-10.45 **Coffee**
- 10.45-11.15 **Juergen Odermatt** "*More information from pyrograms*"
- 11.15-12.00 **Henk Schols** "*Oligosaccharide analysis, Maldi-ToF...*"
- 12-13 **Lunch**

- 13.00-13.45 **Panel discussion** *“Changing demands in analytics towards complete wood utilization”* (Jorge Colodette, Derek Gray, Herbert Sixta, Liisa Viikari, Cherryleen Garcia-Lindgren/Christine Hagström-Näsi) Panelists still open
- 13.45-14.15 **Coffee**
- 14.15-15.15 **E41 MC meeting + feedback from evaluators**

Poster session Monday (1 h 15 min)

Anni Lähdetie *“Reflectance UV-Vis and UV resonance Raman spectroscopy of lignin model compounds and bleached pulps”*

Arnis Treimanis *“UV-spectroscopy gathers momentum aided by sequential pulp fibre walls compounds extraction”*

Sirje Liukko *“Evaluation of UV-VIS reflectance spectroscopy procedures in bleaching studies of hardwood pulps”*

Janis Gravitis *“? different lignins functional groups analysis and FTIR. Very interesting data from DSC”*

Primož Oven *“Use of PIXE, 3D MRI and traditional microscopy for research of wounded tissues in beech”*

Maija-Liisa Mattinen *“Laccase-catalysed polymerization of small molecular aromatics”*

Elena Tokareva *“ToF-SIMS/SEM of wood...”*

Claudia Crestini *“Title to be announced later”*

Poster session Tuesday (1 h 45 min)

Tanja Trafela *“Determination of mechanical properties of commercial pulp samples using IR spectroscopy/chemometrics”*

M.G. Sierra Beltran *“Wood fibres as reinforcement in cementitious materials”*

Cornelia Vasile *“XPS, ATR-FTIR, XRD and SEM investigationS on grafted Spanish broom (Spartium junceum) fibres with fatty acids under cold plasma conditions”*

Maarit Karonen *“NMR studies of bioactive woody plant extractives”*

Georgeta Cazacu *“Spectroscopic and thermal characterization of a new phosphorus containing lignin-epoxy resin”*

Paula Eronen *“Characterization of cellulose polymorphy by combined confocal Raman spectroscopy and atomic force microscopy”*

Janja Zule *“Polyphenols in stemwood, knots and branches of European larch”*

Ann-Sofie Leppänen *“Analytics of modified galactoglucomannans”*

Bodo Saake *“Chromatographic and spectroscopic analysis of xylans”*

Riikka Piispanen *“A study of lignans in Norway spruce (Picea abies [L.] Karst.) knotwood: The effect of knot size and fertilisation in northern and southern Finland”*

Potthast, Antje *“Does cellulose integrity suffer during carbanilation in DMSO-containing mixtures?”*

Frederique Bertaud *“Title to be announced later”*

JOINT WG3 AND WG4 WORKSHOP APRIL 11.-12. 2008, LJUBLJANA, SLOVENIA

Wound Reactions In Trees And Wood Quality

Programme

Friday, 11. April 2008

8.00 - 9.00: Registration

9:00 - 9:05: Welcoming address by the host

Chair person: Primož Oven

9:05 – 9: 35: Schmitt U. Johann Heinrich von Thünen-In stitute, Federal Research Institute for Rural Areas, Forestry and Fisheries, Institute for Wood Technology and Wood Biolog y, Leuschnerstr. 91, 21031 Hamburg, On the fine structure of wound reactions in the xylem of hardwoods Germany.

9:35 – 10:05: Delvaux Cl., H. Beeckman. Laboratory Tropical and Subtropical Agronomy and Ethnobotany, Influence of bark Department Plant Production, University of Ghent, Laboratory for Wood Biology. harvesting on xylem vessel density and size of 10 medicinal tree species (Benin)

10:05 – 10:10: Schmitz N. , Kairo J.G. , Beeckman H. , Koedam N. Vrije Universiteit Brussel (VUB), Laboratory for Plant Biology and Nature, Management (APNA), Pleinlaan 2, 1050 Brussels, Belgium. 2) Royal Museum for Central Africa (RMCA), Laboratory of Wood Biology and Xylarium, Leuven sesteenweg 13, 3080, Tervuren, Belgium. 3) Kenya Marine and Fisheries Research Institute (KMFRI), P.O. Box 8165 1, Wound response in the mangrove species *Avicennia marina* (Poster) Mombasa, Kenya.

10: 10 – 10:40: Coffee break

10:40 – 12.00: Discussion

- Formation, regulation and variability of wound-tissues in hardwoods,

- Topics for further research

12.00 -14:00: Lunch

Chair person: Uwe Schmitt

14.00 – 14.30: Oven P. University of Ljubljana, Biotechnical Faculty, Department of Wood Science and Anatomical response of the Technology, Rožna dolina VIII/34, SI-1000 Ljubljana, Slovenia. secondary phloem and cambium in conifers to mechanical wounding

14: 30 – 15: 00: Harju A., M. Venäläinen. Finnish Forest Research Institute (Metla), Induced production of stilbenes and lignans in Scots pine Punkaharju Research Unit. seedlings

15:00- 15:05: Venäläinen M., Harju A., Willför S., Suvi P., Pavillet D. Laakso T. Finnish Forest Research Institute (Metla), Punkaharju Research Unit, Åbo Academi, Process Chemistry Centre, Ecole Nationale Supérieure Agronomique de Montpellier, Finnish Forest Research Institute (Metla), Vantaa Compartmentalization of injured Scots pine sapwood (Poster) Research Unit.

15:05 – 15:10: Jyske T. , Mäkinen H. , Nöjd, P. and Spiecker, H. Finnish Forest Research Institute, Vantaa Research Unit, P.O. Box 18, FI-01301 Vantaa, Finland, Albert-Ludwig University, Institute The for Forest Growth, Department for Forest Growth, Tennenbacher Straße 4, D-79106 Freiburg, Germany. effect of severe drought on xylem formation in Norway spruce (Poster)

15:10 – 15:40: Coffee break

15:40 – 17:00: Discussion

- Response of conifers to wounding: State-of-art and terminology,

- Topics for further research

19:00 Dinner

3 COST E50 CEMARE, Wound reactions in trees and wood quality, Workshop: April 11.-12. 2008, Ljubljana, Slovenia.

Saturday, 12. April 2008

Chair person: Uwe Schmitt

09:00 – 9:30: Koch, G. Johann Heinrich von Thünen-Institute, Federal Research Institute for Rural Areas, Forestry

and Fisheries, Institute for Wood Technology and Wood Biology, Leuschnerstr. 91, 21031 Hamburg, Discolouration of wood in the living tree and during processing Germany.

9:30 – 10:00: Torelli, N. Aetiology and Slovenian Forestry Institute. Vecna pot 2. 1000 Ljubljana,

Slovenia. properties of wet-wood in silver fir

10:00 – 10:05: Merela M. , Oven P., Mikac U., Serša I. : Department of Wood Science and Technology, Biotechnical Faculty, University of Ljubljana, Rozna dolina VIII/34, 1000 Ljubljana, Jožef Stefan Institute, 2 Wound response in beech investigated by 3D MRI (Poster) Jamova 39, 1000 Ljubljana.

10:05 – 10:10: Straže A, Gorišek Ž. Department of Wood Science and Technology, Biotechnical Faculty, Reduction of discolouration during University of Ljubljana, Rozna dolina VIII/34, 1000 Ljubljana. beech wood (*Fagus sylvatica* L.) conventional drying by use of leaves transpirational pre-drying (Poster)

10:10 – 10:40: Coffee break

10:40 – 12:00 : Discussion and conclusions

-state-of-art and relevancy of discolorations and wound-tissues for wood industry

-further research

-publication of wound reactions in trees

12:00 – 14:00 Lunch

14:00 End of the workshop

WORKSHOP. DUBENDORF. 27-29 OCTOBER 2008

Programme

Monday, 27th October 2008

7:30 – 8:45 Registration and Coffee

8:45 – 9:00 Welcome and Introduction

Welcome – Klaus Richter, Head of Empas Wood Laboratory

Introduction to COST E50 – John Barnett, Chairman of the Action

Session 1 Cellulose (Fundamentals)

(Moderated by John Barnett)

9:00 Structural factors of cellulose revealed by FTIR, L. Salmén

9:30 Characterization of cellulose architecture in plant cell walls, C. Cifuentes, J. Lindeboom, T. Franssen-Verheijen, A. M. C. Emons

10:00 Probing disorder and lateral dimensions of cellulose microfibrils by diffuse X-ray diffraction, A. Fernandes, C. M. Altaner, M. C. Jarvis

10:30 – 11:00 Coffee Break

Session 2 Cellulose (Applications)

(Moderated by Anne Mie Emons)

11:00 Polymer nanocomposites reinforced with polysaccharide nanocrystals, A. Dufresne (Keynote)

11:45 Nanofibrillated cellulose for technical applications, T. Zimmermann, N. Bordeanu, C. Eyholzer, K. Richter

12:15 New materials from the development of microfibrillar cellulose (MFC), M. Ankerfors, T. Lindström

12:45 – 14:00 Lunch

Session 3 Cellulose (Applications)

(Moderated by Tanja Zimmermann)

14:00 Scalable industrial processing of nanomaterials using Microfluidizer™ high shear fluid processors, T. Panagiotou

14:30 Porous nanocellulosics, A. Svagan, H. Sehaqui, Q. Zhou, L.A. Berglund

15:00 Structural characterisation of nanocellulose films – from micro to nano, K. Syverud, G. Chinga-Carrasco

15:30 – 16:00 Coffee Break

Session 4 Cellulose (Applications)

(Moderated by Lennart Salmén)

16:00 Materials science aspects on ultrathin films of cell wall components, Eero Konturri, Laura Nyfors, Janne Laine

16:30 Dynamic mechanical and thermal properties of silane-treated soft-wood fibre PHB films, A. Gregorova, R. Wimmer, M. Hrabalova, M. Koller, G. Braunegg

17:00 From nanoscale to millimetres: characterisation of biological materials using x-rays, Marko Peura, Kirsi Leppänen, Kari Pirkkalainen, Seppo Andersson, Tommi Markkanen, Jussi-Petteri Suuronen, Aki Kallonen, Ritva Serimaa

Session 5 Poster session (Receipt and aperitif)

17:30 – 20:00

Workshop Tuesday, 28th October 2008

Session 6 Lignin (Fundamentals)

(Moderated by Alfred Abächerli)

9:00 Workshop introduction: Current approaches to lignin production and lignin utilisation through the ILI network, A. Abächerli

9:30 Peroxidases and lignification during development in Norway spruce, K. V. Fagerstedt, E. M. Kukkola, K. Marjamaa, A-C. Ritschkoff, S. Raiskila, P. Saranpää

10:00 Valorization of biorefinery lignins, R. Gosselink, J. E. G. van Dam

10:30 – 11:00 Coffee Break

Session 7 Lignin (Analytics)

(Moderated by Kurt Fagerstedt)

11:00 Fractionation of lignocellulosic biomass for production of high quality lignin (and fermentable sugars) by a modified organosolv process, W. J. J. Huijgen, R. R. van der Laan, J. H. Reith

11:30 Separation of lignin and hemicelluloses in hardwood black liquor by ultrafiltration, A.-S. Jönsson, A. Grönlund, O. Wallberg

12:00 GPC analysis of a Soda lignin fractionated by use of ultrafiltration, Q. T. Nguyen

12:30 -14:00 Lunch and Poster Presentation

Session 8 Lignin (Posters and Short Oral Presentations)
(Moderated by R. Gosslink)

14:00 Wood cell wall nanostructures: theoretical and experimental considerations, Janis Gravitis

14:15 Cross-condensation reactions between furfuryl alcohol and the lignin models vanillyl alcohol and veratryl alcohol: a combined ATR-FT-IR spectroscopic and molecular modelling study, S. Barsberg, L. Garbrecht

14:30 Radical scavenging capacity of lignin derivatives and their oxidative stabilisation effect on polyethylene, P. N. Diouf, H. Nadji, B. Riedl, T. Stevanovic

14:45 Lignin SEC combined with a diode array detector, S. Baumberger

15:00 Lignin valorisation by (catalytic) fast pyrolysis, P. J. de Wild

15:15 Lignocellulosic composites obtained with the lignin-based binder for forestry needs, G. Shulga, V. Shakels, A. Verovkins, B. Neiberte, T. Betkers, I. Klayvinsh, G. Kolesnikovs

15:30 – 16:00 Coffee and Poster Session

Session 9 Lignin (Posters and Panel Discussion)
(Moderated by A. Abächerli)

16:00 Oxidation of Kraft lignin by aqueous H₃PMo₁₂O₄₀ in the presence of alcohols, T. Voitl, M. V. Nagel, P. R. von Rohr

16:05 Enzymatic functionalisation of fibre forming polymers using lignin substrates, H. Krajnc, M. Schroeder, V. Kokol, G. M. Guebitz

16:10 FT-ICR, the structure and supramolecular structure of lignin, M. d'Auria

16:15 Anaerobic degradation of Lignin in waste waters from annual plants pulping, J. Fellegi, I. Bodik, M. Hutta, R. Gora

16:20 Biosynthesis of vanillin, W. Zimmermann

16:25 Comparative analysis of functional groups of lignin with multiple methods, V. I. Popa, T. Malutan

16:30 Influence of lignin on emulsions of extractive substances, M. V. Trufanova, S. B. Selyanina, N. I. Afanasiev, N. V. Selivanova

17:00 – 18:00 ILI General Assembly (open only for ILI members)

Workshop Wednesday, 29th October 2008

Session 10
(Moderated by Michael C. Jarvis)

9:00 Toward an objective description of the G-layer of tension wood, Shanshan Chang, Bruno Clair, Julien Ruelle, Jacques Beauchêne, Francesco Di Renzo, Françoise Quignard

9:30 Wood Properties in uneven-aged Norway Spruce forests: a case study in two stands in southern Finland, Riika Piispanen, Sauli Valkonen, Pekka Saranpää

10:00 Mechanical properties of genetically modified poplar cell walls, Bo Zhang, Michaela Eder, Björn Sundberg, Ingo Burgert

10:30 – 11:00 Coffee Break

11:00 – 12:00 Parallel Working Group Sessions

WG 1: Cellulose / Polysaccharides

WG 2: Lignin

WG 3 & 4: Reaction Wood / Properties

12:00 Reports of Working Group Leaders

12:30 – 13:30 Lunch

13:30 – 15:30 Management Committee Meeting

Oral Presentations

Lennard Salmén

Carolina Cifuentes, Jelmer Lindeboom, Tiny Franssen-Verheijen, Anne Mie C. Emons

Anwasha Fernandes, Clemens M. Altaner, Michael C. Jarvis

Alain Dufresne

Tanja Zimmermann, Nico Bordeanu, Christian Eyholzer, Klaus Richter
Mikael Ankerfors, Tom Lindström
Thomai Panagiotou
A. Svagan, H. Sehaqui, Q. Zhou, L.A. Berglund
K. Syverud, Gary Chinga-Carrasco
Eero Konturri, Laura Nyfors, Janne Laine
A. Gregorova, R. Wimmer, M. Hrabalova, M. Koller, G. Braunegg
A. Abächerli
K. V. Fagerstedt, E. M. Kukkola, K. Marjamaa, A-C. Ritschkoff, S. Raiskila, P. Saranpää
R. Gosselink, J. E. G. van Dam
W. J. J. Huijgen, R. R. van der Laan, J. H. Reith
A.-S. Jönsson, A. Grönlund, O. Wallberg
Q. T. Nguyen
Shanshan Chang, Bruno Clair, Julien Ruelle, Jacques Beauchêne, Francesco Di Renzo, Francoise Quignard
Riika Piispanen, Sauli Valkonen, Pekka Saranpää
Bo Zhang, Michaela Eder, Björn Sundberg, Ingo Burgert
Marko Peura, Kirsi Leppänen, Kari Pirkkalainen, Seppo Andersson, Tommi Markkanen, Jussi-Petterli Suuronen, Aki Kallonen, Ritva Serimaa

Posters

Cellulose nanofibers from plant sources, Kentaro Abe, Hiroyuki Yano
Assessment of energy flows in self-binding and layered wood composites, Janis Abolins, S. Kostjukova, A. Buikis, J. Gravitis
Peeling of cellulose fibril material from refined softwood TMH pulps with HCL treatments: characterisation and possible use, Paul Ander, Stig Bardage
Comparative study of pine and spruce fibre populations and their impact on thermo mechanical pulp, Stig L. Bardage
Chemical tailoring and characterisation of cellulose nanofibrils, N. Bordeanu, F. Lopez-Suevos, Ch. Eyholzer, T. Zimmermann, K. Richter
Deformation induced by ethanol substitution in normal and tension wood of chestnut and simarouba, Shanshan Chang, Bruno Clair, Joseph Gril, Tancrede Almeras
Insights into orientation of plant cell wall polymers by polarised Raman microscopy, Gierlinger, N., König, C., Luss, S., Eder, M., Burgert, I.
Raman imaging – a powerful tool for plant ultrastructure studies, Tuomas A. Hänninen, Eero Kontturi, Tapani Vuorinen
Contribution to the lignin modification by hydroxymethylation and epoxidation, Theodor Malutan, Valentin I. Popa, Raluca Parpalea
Investigation of strength properties and chemical constituents of Beech (*Fagus orientalis*) at the early stage of white rot, Hüseyin Sivrikaya, Ibrahim Tümen
Phytomass cell wall macromolecules characterization after steam explosion and applications in wood composites, Ramunas Tupciauskas, Janis Abolins, Andris Veveris, Brigita Neiberte, Anrijs Verovkins, Marlei Scariot, Enrico Ortega, Janis Gravitis
Aspects concerning some bioprotection agents based on natural aromatic compounds and their copper complexes, Elena Ungureanu, Adina-Mirela Capraru, Valentin I. Poapa
Posters with short oral presentations (10 minutes)
Wood cell wall nanostructures: theoretical and experimental considerations, Janis Gravitis
Cross-condensation reactions between furfuryl alcohol and the lignin models vanillyl alcohol and veratryl alcohol: a combined ATR-FT-IR spectroscopic and molecular modelling study, S. Barsberg, L. Garbrecht
Radical scavenging capacity of lignin derivatives and their oxidative stabilisation effect on polyethylene, P. N. Diouf, H. Nadji, B. Riedl, T. Stevanovic
Lignin SEC combined with a diode array detector, S. Baumberger
Lignin valorisation by (catalytic) fast pyrolysis, P. J. de Wild
Lignocellulosic composites obtained with the lignin-based binder for forestry needs, G. Shulga, V. Shakels, A. Verovkins, B. Neiberte, T. Betkers, I. Klayvinsh, G. Kolesnikovs
Posters and Panel Discussion (2 slides)

Oxidation of Kraft lignin by aqueous $H_3PMo_{12}O_{40}$ in the presence of alcohols, T. Voitl, M. V. Nagel, P. R. von Rohr
Enzymatic functionalisation of fibre forming polymers using lignin substrates, H. Krajnc, M. Schroeder, V. Kokol, G. M. Guebitz
FT-ICR, the structure and supramolecular structure of lignin, M. d'Auria
Anaerobic degradation of Lignin in waste waters from annual plants pulping, J. Fellegi, I. Bodik, M. Hutta, R. Gora
Biosynthesis of vanillin, W. Zimmermann
Comparative analysis of functional groups of lignin with multiple methods, V. I. Popa, T. Malutan
Influence of lignin on emulsions of extractive substances, M. V. Trufanova, S. B. Selyanina, N. I. Afanasiev, N. V. Selivanova

Joint Meeting WG3/WG4 in Nancy 17th-18th March 2009

Topic of the workshop:

Many works in integrative biology concern tropisms in plants. Within this large topic, woody plants bring the originality of long term movements based on reaction wood formation and function. A great challenge is to connect these physiological approaches to ecological and forest management questioning:

- what are the natural variations of reaction wood structures, properties and dynamics at different scales ?
- what are their ecological significance according to plant strategies of growth, and environmental adaptation ?
- how human practices as breeding or silviculture influence the natural processes ?
- how can the integration of knowledge at different scales – from the cell wall to the species or community level – contribute to answer those questions ?

Discussing these questions with scientists of different background, from cell wall biochemistry to forest yield and growth, was the aim of this COST E50 event. Despite a rather weak participation, the meeting created an opportunity to have detailed presentations and strong interactions between the present scientists all along these two days.

As it can be seen on the [website](#) dedicated to this meeting, The different presentations gave an interesting insight across the different scientific fields involved in both central topics of the working groups concerned by the meeting : WG3 Formation and induction of reaction wood and WG4: Relating wood and fibre properties to structure and formation.

The first half day has been focused on reaction at tree and stand levels, with special interest about stand management and ecology. The session began with a clear review of the knowledge about the effect of site and silviculture about compression wood. Then a study was presented to detect the effect of gravitropism on the formation of tension wood within the trunk of mature beech trees. Then, the last talk was about an ecological study on the efficiency of reaction wood and which are the relationships with tree growth strategies according to their temperament and the availability of light

The morning of the second day has been dedicated to cellular level. The presentation given by Björn Sundberg gave a review of the current knowledge about the roles of auxin, gibberellins and ethylene in plant growth showing results coming from experiences modifying the behaviour of plant by external applications or by modifying the sensitivity of the plant itself. Then studies have been shown for providing some new information through the use of recent techniques dedicated to the observation of tension wood in different wood species. The aims were a better knowledge of the fine structure of the fibers, their chemical composition and the presence of aromatic compounds within the cell walls. Besides, the sample preparation itself with a special attention to the use of solvent has a impact on the cells with some analogies with to mechanisms occurring during drying and which modify the properties of the cell walls.

The meeting ended with demonstrations of measurements on standing trees and visits of laboratory facilities located in the INRA Research Centre at Champenoux and at AgroParisTech Engref located at Nancy.

Programme of Final meeting of COST E50 –Systems Biology for Plant Design

Wageningen July 8-11 2009

PROGRAM (28 May 2009)

Wednesday 8 July

17.00 – 19.00 h: Registration in FORUM

Thursday 9 July

Morning session

Chair person: Anne Mie Emons, Plant Cell Biology, Wageningen University

09.45: John Barnett, Chairman EU COST E40 action: Opening

10.00: Raoul Bino, Director Plant Science Group of Wageningen University: Welcome

PLANT CELL WALL OPENING PRESENTATION

10.15: Markus Gunl, Jacob Jensen, Amancio Souza, Lutz Neumetzler, Florian Kraemer, Ingo Burgert, and Markus Pauly: KEEPING MICROFIBRILS TIGHT: ELUCIDATING THE FUNCTION OF HEMICELLULOSES BY TAPPING INTO GENETIC RESOURCES
DOE-Plant Research Lab, Michigan State University, East Lansing, USA, 2Max-Planck Institute for molecular plant physiology, Golm, Germany, 3Max-Planck Institute of colloids and interfaces, Golm, Germany

CELLULOSE

Chair person: Ingo Burgert, MPIKG Golm, Germany

11.00: Marek Mutwil, Björn Usadel, Moritz Schütte, Oliver Ebenhöf, Ann Loraine, and Staffan Persson: A SYSTEMS APPROACH TO CELLULOSE SYNTHESIS", Max-Planck-Institute for Molecular Plant Physiology, Am Mühlenberg 1, 14476 Potsdam, Germany; Ann Loraine: Department of Bioinformatics and Genomics, North Carolina Research Campus, University of North Carolina at Charlotte, 203 Oak Avenue, Kannapolis, NC 28081, USA

11.30: Vincent Bulone, CELLULOSE BIOSYNTHESIS: STATE OF THE ART, CHALLENGES AND PERSPECTIVES, Division of Glycoscience, School of Biotechnology, Royal Institute of Technology (KTH), AlbaNova University Centre, SE-10691 Stockholm, Sweden

CELLULOSE AND MICROTUBULES

12.00: Ryan Gutierrez¹, Jelmer J. Lindeboom², Alex R. Paredez³, Anne Mie C. Emons^{2,4}, and David W. Ehrhardt¹ THE CORTICAL MICROTUBULE ARRAY ORGANIZES CELLULOSE SYNTHASE TRAFFICKING AND INSERTION INTO THE PLASMA MEMBRANE;
¹Department of Plant Biology, Carnegie Institution for Science, and Department of Biological Sciences, Stanford University, USA; ²Laboratory of Plant Cell Biology, Wageningen University and ⁴Department of Biomolecular Systems, FOM Institute for Atomic and Molecular Physics, Amsterdam The Netherlands; ³Department of Molecular and Cellular Biology, University of California, Berkeley, USA.

12.30: Simon Tindemans, Rhoda Hawkins, Bela Mulder, Simon Tindemans: LAYING DOWN THE TRACKS: MODELLING SELF-ORGANISATION IN THE CORTICAL MICROTUBULE ARRAY; FOM Institute AMOLF Amsterdam/Wageningen University, the Netherlands

13.15 LUNCH IN RESTAURANT OF THE FUTURE

Afternoon session

PLANT DEVELOPMENT

Chair person: Ton Bisseling, Molecular Biology, Wageningen University

14.15: Ben Scheres, ARCHITECTURE FROM STEM CELL CENTRED FEEDBACK NETWORKS. Department of Molecular Genetics, Utrecht University, Padualaan 8, 3584 CH Utrecht, The Netherlands .

15.00: Charlie Hodgman, CHANGES IN CELL-WALL COMPOSITION ARE THE KEY TO REGULATION OF ROOT GROWTH AND DEVELOPMENT, Bioinformatics and Systems

Biology, University of Nottingham, UK

15.30: Julia Rausenberger,^{1, 2}, Andrea Hussong,², Stefan Kircher,² Daniel Kirchenbauer,² Jens Timmer,^{3, 4} Ferenc Nagy,⁴, Eberhard Schäfer,², and Christian Fleck^{1,2}, FROM PROTEIN DYNAMICS TO PHYSIOLOGY: NEW INSIGHTS INTO PHYTOCHROME B MEDIATED PHOTOMORPHOGENESIS ¹ Centre for Biological Systems Analysis; University of Freiburg; Habsburgerstr. 49; 79104; ² Institute of Biology II; University of Freiburg; Schänzlestraße 1; 79104; ³ Institute of Physics; University of Freiburg; Hermann-Herder-Straße 3; 79104 Freiburg; ⁴ Freiburg Institute for Advanced Studies (FRIAS); University of Freiburg; Albertstr. 19; 79104 Freiburg; Germany

16.00: tea

Selected presentations WG 1 and 2:

Chair person: Uwe Schmitt, Hamburg

16.30 Clara Sánchez-Rodríguez¹, Sven-Matthias Ehrlich¹, Andrew Carroll², and Staffan Persson¹: CHARACTERIZATION OF A NOVEL VESICLE TRAFFICKING PROTEIN POTENTIALLY INVOLVED IN PRIMARY WALL CELLULOSE PRODUCTION, ¹Max-Planck-Institute for Molecular Plant Physiology, Am Mühlenberg 1, 14476 Potsdam, Germany. ² EBI, 130 Calvin Hall, MC 5230, Berkeley, California 94720, USA.

16.50: Volker Bischoff*, Virginie Gascioli, Thierry Desprez, Elizabeth Faris Crowell, Herman Höfte, Samantha Vernhettes, Martine Gonneau: CESA5 IS A MEMBER OF THE PRIMARY CELLULOSE SYNTHASE COMPLEX AND IS REGULATED BY LIGHT, Laboratoire de Biologie Cellulaire, Institut Jean-Pierre Bourgin, INRA, Route de Saint-Cyr, 78026 Versailles, France

17.10: Tae-Wuk Kim, Shenheng Guan, Yu Sun, Zhiping Deng, Wenqiang Tang, Jian-Xiu Shang, Ying Sun, Alma L. Burlingame & Zhi-Yong Wang: THE SIGNALLING PATHWAY AND TRANSCRIPTIONAL NETWORK FOR BRASSINOSTEROID ACTIONS, ¹Department of Plant Biology, Carnegie Institution for Science, Stanford, CA 94305. ²Department of Pharmaceutical Chemistry, University of California, San Francisco, CA 94143. ³Institute of Molecular Cell Biology, Hebei Normal University, Shijiazhuang, Hebei, 050016, China.

17.30: Kurt V. Fagerstedt¹, K. Marjamaa², E.M. Kukkola¹: LIGNIFICATION AND THE ROLE OF CLASS III PLANT PEROXIDASES IN ITS POLYMERISATION IN NORWAY SPRUCE, ¹Department of Biological and Environmental Sciences, Plant Biology, P.O. Box 65, FI-00014 Helsinki University, Finland, ²Technical Research Center of Finland (VTT), PL 1000, 02044 VTT, Finland

18.00: BUFFET IN GRAND CAFE FORUM

19.00-21.00: POSTER SESSION

Friday 10 July

Morning session

MECHANICS AND LIGNIFICATION

Chair person: Kurt Fagerstedt, Plant Biology, Helsinki University

09.00: Ingo Burgert, Michaela Eder, Bo Zhang, Markus Rüggeberg: MICROMECHANICAL AND (NANO)STRUCTURAL CHARACTERIZATION OF PRIMARY AND SECONDARY CELL WALLS, Max-Planck-Institute of Colloids and Interfaces, Department of Biomaterials, Research Campus Golm, Potsdam, Germany

09.30: Ruben Vanholme, Véronique Storme, Kris Morreel, Geert Goeminne, Jorgen Christensen, Antje Rohde, Eric M essens and Wout Boerjan: SYSTEMS BIOLOGY OF LIGNIFICATION AND RELEVANCE TO BIOFUELS, VIB Department of Plant Systems Biology; UGent Department of Plant Biotechnology and Genetics, Technologiepark 927, 9052, Gent, Belgium

10.00 Roeland Merks^{(1,2,*),} Frederik van Parijs^{(3,4),} and Wout Boerjan^(3,4) MODELING LIGNIN POLYMERISATION: TOWARDS A RATIONAL DESIGN OF LIGNIN STRUCTURE

FOR BIOFUELS 1. NCSB-NISB, Science Park 123, 1098 XG Amsterdam 2.CWI, Science Park 123, 1098 XG Amsterdam 3.VIB Department of Plant Systems Biology, Technologiepark 927, B-9052 Ghent, Belgium, 4. Department of Molecular Genetics, Ghent University, Technologiepark 927, B-9052, Ghent, Belgium
10.30 COFFEE

BIOLOGICAL NETWORKS

Chair person : Bela Mulder, FOM Institute AMOLF, Amsterdam

11.00: Gerco Angenent, TRANSCRIPTIONAL NETWORKS IN FLOWER DEVELOPMENT, Wageningen University and Research Center, The Netherlands

11.30: Pieter Rein ten Wolde, HOW WALKING SLOWER CAN MAKE YOU RESPOND FASTER. FOM Institute AMOLF Amsterdam, the Netherlands

12.00: Phong Tran: FISSION YEAST CYTOSKELETON AND CELL SHAPE REGULATION, University of Pennsylvania, Philadelphia, PA 19104 USA Institut Curie - CNRS, Paris, 75005 France

12.30 LUNCH IN FORUM

Afternoon session

THE NEXT STEP: TOWARDS DESIGN

Chair person : Anne Mie Emons, Plant Cell biology, Wageningen University

13.30: Silvester de Nooijer, Ton Bisseling NUCLEAR ORGANISATION BY NONSPECIFIC INTERACTIONS, Molecular Biology, Wageningen University, the Netherlands

14.00: Björn Usadel MODELING VARYING LEVELS OF CARBON IN THE PLANT BY INTEGRATING OMICS DATA, Max Planck Institute for Molecular Plant Physiology, Germany

14.30: Peter Fratzl and Ingo Burgert FIBRIL DESIGN FOR MECHANICAL FUNCTION, Max Planck Institute of Colloids and Interfaces, Potsdam, Germany

15.00: Lars A. Berglund BIOINSPIRED COMPOSITES – FROM MECHANICALLY FUNCTIONAL

PLANT SYSTEMS TO SYNTHETIC BIOLOGY, Royal Inst of Technology, Dept of Fiber and Polymer Technology, SE-100 44 Stockholm, Sweden

15.30: TEA

Selected presentations WG 3 and 4:

Chair person : Joseph Gril, Mechanics and Civil Engineering, CNRS/University of Montpellier

16.00: Tancreède Alméras*, Bruno Clair, Joseph Gril, THE ORIGIN OF MATURATION STRESS IN TENSION WOOD: USING A MICRO-MECHANICAL MODEL TO DISCRIMINATE BETWEEN HYPOTHETIC MECHANISM, Laboratory Mechanics and Civil Engineering, CNRS/University Montpellier 2, Place E. Bataillon, cc048, 34095 Montpellier cedex 5, France

16.30: Adriana Gregorova*, Marta Hrabalova, Rupert Wimmer , Bodo Saake, Clemens Altaner, PROPERTY-DESIGN OF BIOPOLYMER-COMPOSITES USING JUVENILE, MATURE AND COMPRESSION WOOD FIBRES FROM SITKA SPRUCE, Institute of Wood Science and Technology, BOKU Vienna, Peter-Jordan Strasse 82, 1190 Vienna, Austria, Institute for Natural Materials Technology, BOKU Vienna, Austria, Wood Technology and Wood-based Composites, Georg-August-University Göttingen, Germany, Johann Heinrich von Thünen-Institut, Hamburg, Germany Department of Chemistry, University of Glasgow, Glasgow, UK

17.00: Leplé Jean-Charles1*, Lesage-Descauses Marie-Claude1, Fedirko Estelle1, Fichot Régis1, Desplat Nelly1, Renou Jean-Pierre2, Balzergue Sandrine2, Bourgait Isabelle1, Laurans Françoise1, Millet Nadège1, Moreau Alain1, Déjardin Annabelle1, Pilate Gilles1, GENOME-WIDE ANALYSIS OF THE FASCICLIN-LIKE ARABINOGALACTAN (FLA) GENE FAMILY IN POPULUS TRICHOCARPA AND THEIR EXPRESSION PROFILING IN TENSION WOOD, INRA, Amélioration Génétique et Physiologie Forestières, Orléans, BP 20619

Ardon, 45166 Olivet, France, 2INRA, UMR1165 Unité de Recherche en Génomique Végétale, Centre de Versailles-Grignon, 2 rue Gaston Crémieux CP 5708, 91057 Evry, France

17.30: Rahime Bag, Johnny Beaugrand, Bernard Kurek and Patrice Dole, SELECTIVE REMOVING OF CELL WALL EXTRACTIVE MOLECULES INFLUENCES LIGNIN AND HEMICELLULOSE VISCOELASTIC PROPERTIES IN WOODY HEMP CORE, Laboratory of Fractionation of Agricultural Resources and Environment, INRA (French National Institute for Agricultural Research) Reims, 2 Esplanade Roland Garros 51686 Reims, France

20.00: CONGRESS DINER IN HOTEL RESTAURANT “DE WAGENINGSE BERG”.

Saturday 11 July

09.00: 4 Parallel sessions of the working groups of COST E50

10.30: COFFEE

11.00: MANAGEMENT COMMITTEE MEETING COST E50

13.00: LUNCH AND END

APPENDIX 3: SCIENTIFIC AND TECHNICAL COOPERATION

Information currently available is listed below.

INRA-PIAF Clermont-Ferrand collaborations: with Max-Planck Institute of Colloids and Interfaces, Potsdam, with INRA Orleans, with LMGC Montpellier, with University of Reading.

SLU - Dept of Wood Science has collaboration with the Institut für Botanik, University of Innsbruck, Austria.

Collaboration between the SIRT (Scottish Integrated Research on Timber) project and the COST E50 action. SIRT involves:

Glasgow University

Napier University

Forest Research. A working group within the SIRT project looks specifically at compression wood.

There is also collaboration with BRE following an EU Compression Wood project.

Collaboration between University of Hamburg and:

Federal Research Centre for Forestry and Forest Products and Hamburg, Institute for Wood Biology and Wood Protection – Dr. Uwe Schmitt

WURC in Uppsala. He worked on the following topic there: "Fine structural and topochemical investigations on tension wood fibres in *Acer*, *Fagus* and *Quercus*"

The University of Kiel, Institute of Experimental and Applied Physics, Department of Solid State Physics.

The Institut National de la Recherche Agronomique (INRA) umr Physiologie Intégrative de l'Arbre Fruitier et Forestier (PIAF).

Wageningen University, Laboratory of Plant Cell Biology. Wageningen, The Netherlands.

Collaboration between METLA (Finland) and:

BOKU, Vienna

Max Planck Institute, Golm

WURC, Uppsala

University of Kiel

University of Hamburg

CERMAV, Grenoble

Cooperative links have been created between the Department of Biosciences of the University of Helsinki and:

- Prof. Katia Ruel of CERMAV in Grenoble working with the localisation of specific lignin structures in cell wall layers in various tree species.
- Dr. David Clapham at the Swedish Agricultural University, SLU, in Uppsala. We have been collaborating in the transformation of Norway spruce with genes cloned in our laboratory in Helsinki.
- Dr. Kirsi-Marja Oksman-Caldentey at the State Technical Research Institute of Finland concerning peroxidase transformation of *Catharanthus* with genes cloned in our laboratory.
- the Finnish Forest Research Institute through Dr. Pekka Saranpää and Dr. Elina Vapaavuori in research on tree growth of various clones in different environments.
- Assoc. Prof. Lacey Samuels at the Department of Botany, University of British Columbia, Vancouver, Canada. Assoc. Prof. Lacey Samuels has long standing experience in ultrastructural work with conifers and we are going to collaborate in research concerning monolignol transport into the apoplast in Norway spruce. Cooperation has been strengthened in the Cost action E50 symposium in Potsdam, Germany, in September, 2007.
- Cooperation has been started with Dr. Anna Kärkönen from Department of Applied Biology

of Helsinki University. This collaboration centers on the use lignin producing Norway spruce suspension culture A3/85, which is able to produce native-like lignin and secrete it into the nutrient medium. Anna Kärkönen has also expertise in autoradiographic methods, which will be used in our common project.

- Ongoing cooperation with the Finnish Forest Research Institute has been strengthened with Dr. Pekka Saranpää and Dr. Elina Vapaavuori in research on tree growth of various clones in different environments.

Ongoing cooperation with the Finnish Forest Research Institute has been strengthened with Dr. Pekka Saranpää and Dr. Elina Vapaavuori in research on tree growth of various clones in different environments.

Cooperative links have been established between CERMAV, Grenoble and:

- Royal Holloway, University of London with Dr P Bolwell, working on xylans and lignin biosynthesis
- CSIC-Dept Genetica Molecular Barcelona (Spain) with Prof. P.Puigdomenech and Dr. D. Caparros-Ruiz on xylans and lignin biosynthesis in Maize
- Landers Interuniversity Institute for Biotechnology, Dept of Plant Genetics (Belgium) with Dr. W. Boerjan and Dr. J. Christensen on polysaccharides and lignin biosynthesis in transgenic Poplar
- Biocenter Helsinki (Finlande) with Dr. K. Fagerstedt on lignin biosynthesis
- Dept de Engenharia, Univ. Biologica de Minho, Portugal with Dr. M. Gama on role of CBMs
- Dept di Scienze ambientali, Seconda Universita di Napoli, Italy
- Department of Botany, The University of British Columbia with Professor Patrick Martone to work on lignin in algae
- Department of Biochemistry, University of Wisconsin, USA, with Dr John Ralph
- Dr Barry Gardiner (E50 MC member and WG4 leader.
- Norwegian University of Life Sciences to study lignin in abscission zones.
- Xinjiang Academy of Agricultural Sciences (Urumqi, China) to study cotton fibres
- Universidad de Sao Paulo, Brazil, to study the cell wall as a source of bioenergy
- University of Leeds (UK). To investigate methods for analysis of wall structure using electron microscopy with Dr Paul Knox.

Collaboration between Eidgenössische Materialprüfungs- und Forschungsanstalt, Dübendorf, and:

- Max-Planck-Institute of Colloids and Interfaces, Department of Biomaterials, Potsdam, Germany
- Green Composites Group, Department of Material Sciences and Process Engineering, University of Natural Resources and Applied Life Sciences, BOKU-Vienna
- Department for Agrobiotechnology, IFA-Tulln, Institute for Natural Materials Tulln, Austria

Collaborations have been set up involving the Cellulose Nanocomposites Group at Dübendorf, Switzerland under the leadership of Management Committee member Dr Tanja Zimmermann as follows:

- Start of a PhD thesis, Christian Eyholzer, financed by SBF ("Staatssekretariat für Bildung und Forschung") in the framework of COST E50 (Title: Cellulose fibrils: Isolation, characterisation and reinforcing potential for biodegradable polymers). This project is in collaboration with the Swedish Lulea-University (Prof. Kristiina Oksman who acts as supervisor)

- An application was made as partners for two projects within the 7th framework program of the EC. At the moment this appears to have been successful in one of the projects: "Development of sustainable composite materials" (using cellulose nanostructures)), guided by STFI, Sweden).

CNRS, Montpellier has been involved in the following collaborations:

- Collaboration between French teams: Ecofog (French Guyana), LMGC and AMAP Montpellier, PIAF Clermont, Lerfob Nancy
- Cooperation with Nagoya University (H. Yamamoto) and Kyoto University (J. Sugiyama) for the study of tension wood of species from French Guyana
- 1 year CNRS post-doc position for the study of the viscoelastic behaviour of reaction woods from French Guyana
- Collaboration with Ecofog, INRA Orléans, Kyoto University
- Grenoble synchrotron for the study of crystal strain of Poplar tension wood

Collaboration between STFI Stockholm and The University of Glasgow, UK

Collaboration between WURC, Uppsala and EMPA, Zurich working with structural changes and reaction wood.

During 2008 IBAF took part into a project proposal coordinated by the industrial company Chemtex spa, Italy, on second generation bioethanol for grant application on the Project Industria 2015 launched by the Italian government Topic Energetic efficiency.

Transfer of results

Cooperation with the Central Laboratory of Wood Processing Industries, KCL, concerning the practical use of our research results on plant peroxidases has been an important part of our research during 2007-2008. A progress report has been written..

Contracts between Cermav - CNRS, Grenoble and:

- Région Rhône-Alpes (Thématiques Prioritaires, Domaine 9 : Développement durable)- 2003-2006 on the « Evolution of pulp micromorphology during recycling treatments »
- AGRICE : French Contract concerning flax and wheat straw plant and pulps
- AGRICE (2006-2008), Production of surface functionalised cellulosic fibres in view of various applications
- The Cellulose Nanocomposites Group at Dübendorf 3 has several industrial collaborations (e.g. Collano – a Swiss company that produces adhesives, Homag AG – Swiss company that produces tobacco foils, Emmi - Swiss Cheese producer, Rettenmaier & Söhne - Production of cellulose nanofibrils, up-scaling. we are planning to apply for a patent concerning dry redispersable fibrils.

APPENDIX 4: STSMs

Year 1

STSMs: No STSMs took place in the first year of the Action. This was a result of uncertainty about the budget and in accordance with the advice of Scientific Officer Guenther Siegel. The increase in year 2 was due to funds suddenly being made available halfway through the year. Again in year 3, we were encouraged to be cautious about spending money on STSMs by Guenther Siegel and applicants were encouraged to plan for an STSM in year 4 should money be available.

Year 2:

1. Riikka Piispanen from Finnish Forest Research Institute, Vantaa, Finland
Period 04/09/06 – 16/09/06
Hosted by the Max Planck Institute, Potsdam, Germany
2. Carolina Cifuentes from Laboratory of Plant Cell Biology, Wageningen University, The Netherlands
Period 04/09/2006 to 30/09/2006
Hosted by Professors Tuula Teeri and Vincent Bulone, Royal Institute for Technology, Stockholm, Sweden
3. Valérie Chevalier-Billosta Billosta from Centre de Recherche sur les Macromolécules Végétales (CERMAV), Grenoble, France.
Period 18/09/06 – 07/10/06
Hosted by Prof. Kurt Fagerstedt and Dr. Eija Kukkola, the University of Helsinki, Finland.
4. Pia Angela Stieger Cecchini from Université de Neuchâtel, Switzerland
Period 19/11/2006 to 3/12/2006
Hosted by Professor Catherine Lapiere, Dr. Brigitte Pollet, Institut National de la Recherche Agronomique-Institut National d'Agronomie de Paris-Grignon, Département de Chimie Biologique Thiverval-Grignon, France
5. Carol Assor from INRA (Nancy)
Period 3/12/2006 to 9/12/2006
Hosted by Lennart Salman, STFI Packforsk Group, Stockholm.
6. Jimmy Berrio-Sierra, Centre de Recherche sur les Macromolécules Végétales (CERMAV/CNRS), BP 53, 38041 Grenoble Cedex 9, France
Period: 18/02/2007 to 24/02/2007
Hosted by Ingo Burgert, Max-Planck-Institute of Colloids and Interfaces, Department of Biomaterials, 14424 Potsdam, Germany.
7. Bertrand Marcon, Montpellier, France
Period: 08/04/07 – 15/04/07
Hosted by Laurent Stainer, FNRS, Liege, Belgium
8. Tuula Jyske, Finnish Forest Research, Vantaa, Finland
23/04/07 – 27/04/07
Hosted by Primoz Oven, Ljubljana, Slovenia
9. Nele Schmitz, Brussels, Belgium
Period: 16/04/07 – 13/05/07
Hosted by Gerald Koch, Hamburg, Germany
10. Johnny Bopopi, Brussels, Belgium
Period: 22/05/07 – 08/06/07
Hosted by Brigitte Chabbert, Reims, France

Year 3:

1. Alicja Banasiak, University of Wroclaw, Poland
Period: 1/10/2007 to 30/11/2007
Hosted by Ewa Mellerowicz, Swedish University of Agricultural Sciences (SLU), Umea, Sweden
2. Magdalena Krzeslowska, Laboratory of General Botany, Adam Mickiewicz University, Umultowska 89, 61-614 Poznan, Poland
Period: 12.10. 2007 – 12 12.2007

Hosted by Professor Ewa Mellerowicz , Umea Plant Science Center, Department of Forest Genetics and Plant Physiology, Swedish University of Agricultural Sciences, 901-83 Umea, Sweden

3. Clemens Altener, University of Glasgow, UK

Period: 11/11/07 – 24/11/07

Hosted by Lennart Salmen, STFI, Stockholm

4. Ville Koistinen, University of Helsinki, Finland

Period: 30/05/08 – 06/07/08

Lacey Samuels, Univerisy of British Columbia, Canada.

Year 4:

1. Cedric Monero, Montpellier, France

Period: 18/08/08 – 29/08/089

Hosted by Karin Hofstetter, Vienna, Austria

2. Frederique, Nolin, Reims, France

Period: 24.08.08 – 24/09/08

Hosted by Kurt fagerstedt, University of Helsinki, Finland

3. Karl Bytebier, Montpellier, France

30/11/08 – 07/12/08

Hosted by Karin Hofstetter, Vienna, Austria

4. Edita, Jasiukaityte, Ljubljana, Slovenia

Period: 15/01/09 – 15/04/09

Hosted by Claudia Crestini, Rome, Italy

5. Leena Vihermaa, University of Glasgow, UK

Period: 04/02/09 – 20/02/09

Hosted by Cyrille Rathgeber, INRA, Nancy, France

6. David Auty, University of Aberdeen, UK

Period: 23/03/09 – 03/04/09

Hosted by Sven-Olof Lundqvist, STFI Packforst, Stockholm, Sweden

7. Marta Hrablova, Vienna, Austria

Period: 15/04/09 – 30/04/09

Hosted by Tanja Zimmermann, EMPA, Dubendorf, Switzerland

8. Adriana Gregorova, BOKU, Vienna

Period: 20/04/09 – 10/05/09

Hosted by Lennart Salmen, STFI-Packforst, Stockholm, Sweden

9. Cindy Mettraux and Pia Stieger, Université de Neuchâtel, Switzerland

Period: 27/04.09 - 15/05/09

Hosted by Professor Jan Traas, Ecole Normale Superieure, Lyon, France

10. Leena Vihermaa, University of Glasgow, UK

Period: 28/04/09 – 25/05/09

Hosted by Clemens Altener, University of Auckland, New Zealand

APPENDIX5: PUBLICATIONS AND REPORTS

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