

**Wood Biopolymer Science for
“New materials from trees”
Finnish-Swedish Joint Summer School 2016
August 29 – September 2**

**Käringsund Resort
Åland
Finland**

Learning Outcome:

- 1. Understand the biosynthesis processes of each cellulose, hemicelluloses and lignin, what monomers are involved, where the biosynthesis is taking place and how the biosynthesis is orchestrated with cell wall assembly and what are the functions of these different wood biopolymers in wood.**
- 2. Understand structural differences between wood biopolymers; cellulose, hemicelluloses, lignin.**
- 3. Knowledge about how the cellulose molecules are interacting in wet and dry state. Knowledge about crystalline structures of cellulose and different methods to determine it.**
- 4. Knowledge about chemical and physical properties of cellulose including reactivity in different conditions. Understand the regeneration process and knowledge about derivatization of cellulose and properties of cellulose derivatives.**
- 5. Knowledge about characterization of the structure of hemicelluloses.**
- 6. Structure property relationship of hemicelluloses.**
- 7. Knowledge about lignin structure and crosslinking.**
- 8. Have a big picture how the differences in chemical composition cellulose, hemicellulose and lignin affect the cell wall properties and how they are affected by different biomass fractionation processes and how their inherent properties can be utilized in developing new materials trees**

Note to lecturers!

- The time for lecture duration includes time for questions and discussions (>5 min for 45 min lecture and > 10 min for 60 min lecture)**
- The time can also include 5 min stretching time if there is not break afterwards to follow.**

Schedules

Sunday, August 28, Arrival and kick-off

- Ferry from Stockholm and Åbo arrives in Mariehamn 14:10, bus transportation to Kräingsund
- Ferry from Grislehamn arrives at Eckerö 18:00
- Gather-together and orientation
- Reception and dinner

Monday, August 29, Introduction to wood biopolymers

08:00 Breakfast

09:00 Introduction to AAU/PCC (15 min)

Prof. Stefan Willför, Åbo Akademi

Introduction to WWSC Academy (15 min)

Prof. Paul Gatenholm, Chalmers

09:30 Polymer science for wood biopolymers (45 min)

Prof. Paul Gatenholm, Chalmers

10:15 Coffee

10:45 Carbohydrate chemistry (basics, reactions and derivatives) (45 min)

Docent Chunlin Xu, Åbo Akademi

Preparation for Friday **lignin** workshop (15 min)

Prof. Ilkka Kilpeläinen, Helsinki University

11:45 Lunch

13:00 Field study of wood biopolymers, outdoors activity (2 h)

15:00 Structural diversity of hemicelluloses and assembly in cell wall (60 min)

Prof Maija Tenkanen, Helsinki University

16:00 Lignin synthesis and assembly during cell wall formation (60 min)

Speaker to be confirmed

17:00 Group work

19:00 Dinner

Tuesday, August 30, Cellulose

07:00 Breakfast

08:15 Biosynthesis and assembly of cellulose in cell wall (60 min)
and

Organization of cellulose in solid structure, crystallinity (60 min)

Dr. Thomas Larsson, KTH

10:15 Coffee

10:45 Solubility of cellulose (60 min)

Prof. Björn Lindman, Lund University

12:00 Lunch

13:00 Physical and chemical properties of cellulose in pulps, fibers and solution and Regeneration processes of cellulose (2 h)

Prof. Hebert Sixta, Aalto University

14:45 Coffee

15:15 Derivatization of cellulose (45 min)

Docent Alistair W. T. King, University of Helsinki

16:15 Physical properties of cellulose derivatives (45 min)

Prof. Björn Lindman, Lund University

17:00 Group work

19:00 Dinner

Wednesday, August 31, Hemicelluloses: basics, fractionation and modification

07:00 Breakfast

08:15 Hemicelluloses and pectins important terms and definition, structure and occurrence (2 h)

Prof. Stefan Willför, Åbo Akademi

10:00 Coffee

10:30 Isolation of native wood biopolymers and effect on the structure (45 min)

Prof. Stefan Willför, Åbo Akademi

11:15 Xyloglucans, structure, occurrence and applications (45 min)

Docent Chunlin Xu, Åbo Akademi

12:00 Lunch

13:15 Functionalization of hemicelluloses (60 min)

Prof. Stefan Willför and Docent Chunlin Xu, Åbo Akademi

14:15 Coffee

14:45 Enzymatic modification of hemicelluloses and material applications (60 min)

Maija Tenkanen, University of Helsinki and Paul Gatenholm, Chalmers

16:00 Excursion to Stallhagen Brewery

Dinner

Thursday, September 1, Structure determination and properties

08:00 Breakfast

09:15 Analysis of polysaccharides – depolymerization & identification (60 min)

Docent Anna Sundberg, Åbo Akademi University

10:15 Coffee

10:45 Characterization of polysaccharides by chromatography and mass spectrometry (60 min)

Docent Chunlin Xu, Åbo Akademi

12:00 Lunch

13:15 Analysis of polysaccharides – molar mass determination (basics, branching information) (60 min)

Docent Chunlin Xu, Åbo Akademi

14:15 Solution properties of non-cellulosic polysaccharides (45 min)

Docent Chunlin Xu, Åbo Akademi

15:00 Group work and field activities

19:00 Dinner

Friday, September 2, Lignin, NMR and Ionic Liquids

07:00 Breakfast

08:00 Ionic liquids and electrolytes in biomass processing (60 min)
and

Lignin structure and results from group works on lignin (selected modulators) (60 min)

Prof. Ilkka Kilpeläinen, Helsinki University

10:00 Group work

Course evaluation.

11:15 Closing of the course

11:30 Check out and Light lunch (Sandwich and coffee)

12:30 Bus leaves Käringsund

Ferries to Åbo and Stockholm departures from Mariehamn at 14:25

13:30 Ferry to Grisslehamn departures from Eckerö