

Wood Research and Education in Germany

by
Holger Miltz
Georg-August University
Göttingen

Own background

- Study of Wood Science and Technology (University Hamburg)
- 13 years director of Wood Research and Testing Institutes TNO/ SHR in Netherlands
- Since 2000: Full Professor/ Director Institute of Wood Biology and Wood Technology/ Göttingen University (D)

Some words about...

- Faculty
- Forestry Education in Germany
- Wood Science in Germany
- Own research

Georg-August University Göttingen

- Founded 1734
- 13 Faculties
- Approx. 25.000 students
- Several Max-Planck Institutes



Centrally in „new“ Germany and Europe



Historical Göttingen



Institute of Wood Biology and Wood Technology
Georg-August University of Göttingen

Historical Göttingen



Education in „Wood Science“ in Germany

- High School until approx 18-19 years age
- University or „Fachhochschule“ (more practical level)
 - BSc: Fachhochschule and Universities (3 years)
 - MSc: Universities (2 years)
 - Former system: University: Diploma study 5-6 years/ FH Diploma study 3-4 years

Wood Science and Technology in Germany

- Fachhochschulen:
 - Rosenheim
 - Eberswalde
 - Hildesheim
 - Mosbach

Wood Science and Technology in Germany

- Universities:
 - Hamburg: Wood Science Diploma
 - Dresden: Master
 - Göttingen: Master

 - (Freiburg, München: part of Forestry education)






Study programmes

Bachelor of Science				
Semester ¹⁾		Compulsory ²⁾	Comp. elective ³⁾	Examinations
1. (WT)		21		• • • 16 examinations in compulsory courses 15 examinations in compulsory/elective courses Bachelor Thesis
2. (ST)		23	2	
3. (WT)	Trainee Programme Part I (at least 3 months in a Forest Enterprise)			
4. (ST)		20	2	
5. (WT)	Bachelor's Thesis	22	2	
6. (ST)		22	2	

1) WT = winter term
ST = summer term

2) WHT = weekly hours per term

3) The number of compulsory elective courses/lessons amounts to 8 WHT. The distribution on the different terms can individually be determined by each student.

Master of Science								
Semester	Master Programmes					Compulsory ⁴⁾	Comp. elective ⁴⁾	Examination
1. (WT)						total ≈ 42	total ≈ 24	• • • Examinations in compulsory and compulsory elective courses (1 st , 3 rd term) Project (in 2 nd or 3 rd term) Master Thesis
2. (ST)	Forest Management and Utilization	Nature Conservation and Forest Ecology	Wood Biology and Technology	Forest Ecosystem Research and Information Processing	Tropical and International Forestry			
3. (WT)						total = 70		
4. (ST)						Master's Thesis 6 months		

Institute of Wood &
Georg-August Uni

Faculty
of
Forest Sciences
and
Forest Ecology



Education at Forestry Faculty Göttingen

- **Bachelor (BSc)** „Forestry Sciences and Forest Ecology“: 150 students per year
- 5 different Forestry related **Master programmes (MSc)**: 100 students/year
- 2 International oriented **PhD programmes**:
 - Forestry
 - Wood Science and Technology

5 Forestry Masters in Göttingen

- Forest Management and Utilisation
- Conservation and Forest Ecology
- Forest Ecosystem Analysis and Information Processing
- Tropical and International Forestry
- Wood Science and Technology

PhD Programmes



Forest Sciences and Forest Ecology

- general issues, 3 year programme (18 Credits), German or English



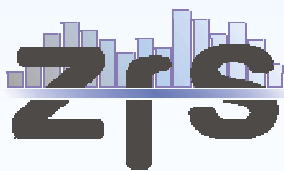
Wood Biology and Wood Technology

- specialized programme, 3 years (36 Credits), English



Environmental Informatics

- specialized programme, 3 years, German or English



Applied Statistics and Empirical Methods

- managed by the mathematical faculty, 3 year programme, English,
- thesis related to forestry,
doctorate by the Faculty of Forest Sciences and Forest Ecology

Institutes at Forestry Faculty

- 13 institutes (20 professors) covering from soil, plant, growth, management, wildlife, end products
- Forest Ecosystem Research Center
- Center for Sustainable Wood Uses

Wood Science Education in Göttingen

- BSc level: Forestry!
 - Basic courses wood science and wood technology
 - Properties of timber species
- MSc level: 20 students per year, 2 years
- PhD level: approx. 40 (3 years)

MSc in Wood Science (2 years+)

- Basic courses
 - wood chemistry
 - wood biology
 - wood physics
 - (Forest engineering)
 - (mathematics, statistics, economics,...)

MSc in Wood Science (2 years+)

- Technological courses
 - biotechnology!
 - pulp and paper
 - board materials
 - coating and adhesives
 - fungal degradation
 - wood preservation
 - drying

Schwerpunkt 3: „Holzbiologie und Holztechnologie“ (HH) ”Wood Biology and Wood Technology“

1. Sem. (WS)	Holzbereitstellung	Schnittholz und Holzeigenschaften	Biologische Grundlagen der Holzproduktion und der Biotechnologie	Wahl
	7 Credits	6 Credits	7 Credits	9 Credits
	5 SWS	4 SWS	5 SWS	∅ 6 SWS
2. Sem. (SS)	Züchtung und Holzbiotechnologie	Holzchemie und Holzwerkstoffe	Angewandte Holzanatomie	Holzmarkt und Umweltpolitik
	7 Credits	6 Credits	7 Credits	8 Credits
	5 SWS	4 SWS	5 SWS	6 SWS
3. Sem. (WS)	Projekt: Holztechnologie und Holzprodukte / Holzwerkstoffe ----- oder ----- Molekulare Holzbiotechnologie	Neuartige Technologien und Umweltschutz	Wahl	
	12 Credits	6 Credits	15 Credits	
	8 SWS	4 SWS	∅ 10 SWS	
4. Sem. (SS)	Masterarbeit 30 Credits (6 Monate)		Abschluss: Master of Science	

MSc in Wood Science (2 years+)

- Practical period (3 months)
- Research semester
- MSc thesis (6 months)

Wood Research in Göttingen

- Institute of Wood Biology and Wood Technology
- Institute of Forest Botany
- Institute of Forest Zoology
- Institute of Forest Genetics
- Institute of Forest Economics
 - 8 full professors
 - 3 added professors

Wood Research in Göttingen

- Institute of Wood Biology and Wood Technology:
 - 3 professors
 - 32 employees (18 PhD students)
 - Teaching and Research

Saw mill/ machining



Process laboratory



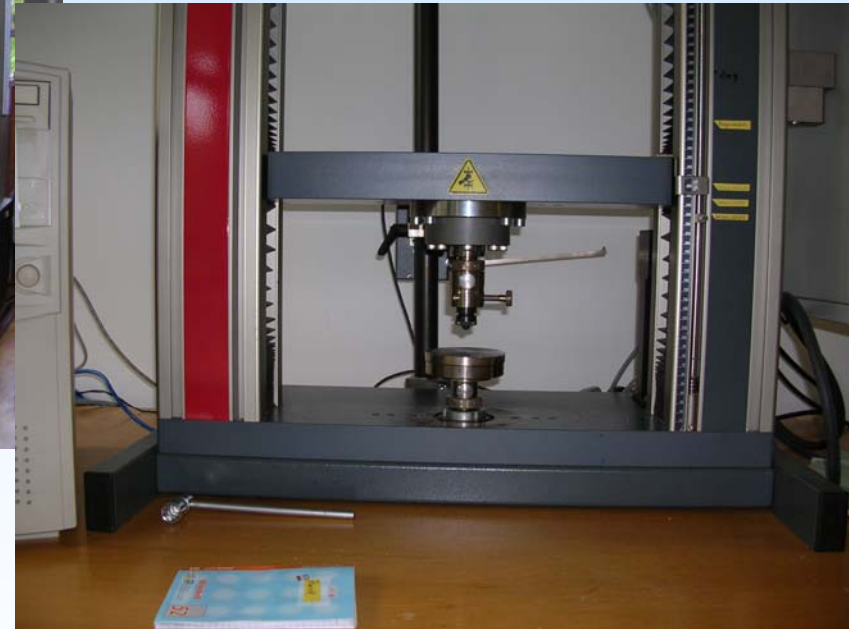
Institute of Wood Biology and Wood Technology
Georg-August University of Göttingen

laboratories



Institute of Wood Biology and Wood Technology
Georg-August University of Göttingen

Physical labs



Institute of Wood Biology and Wood Technology
Georg-August University of Göttingen

Wood composites laboratories



Competence center wood



Uni Göttingen

WKI

TU Braunschweig

FH Göttingen

Institute of Wood Biology and Wood Technology
Georg-August University of Göttingen



Field testing



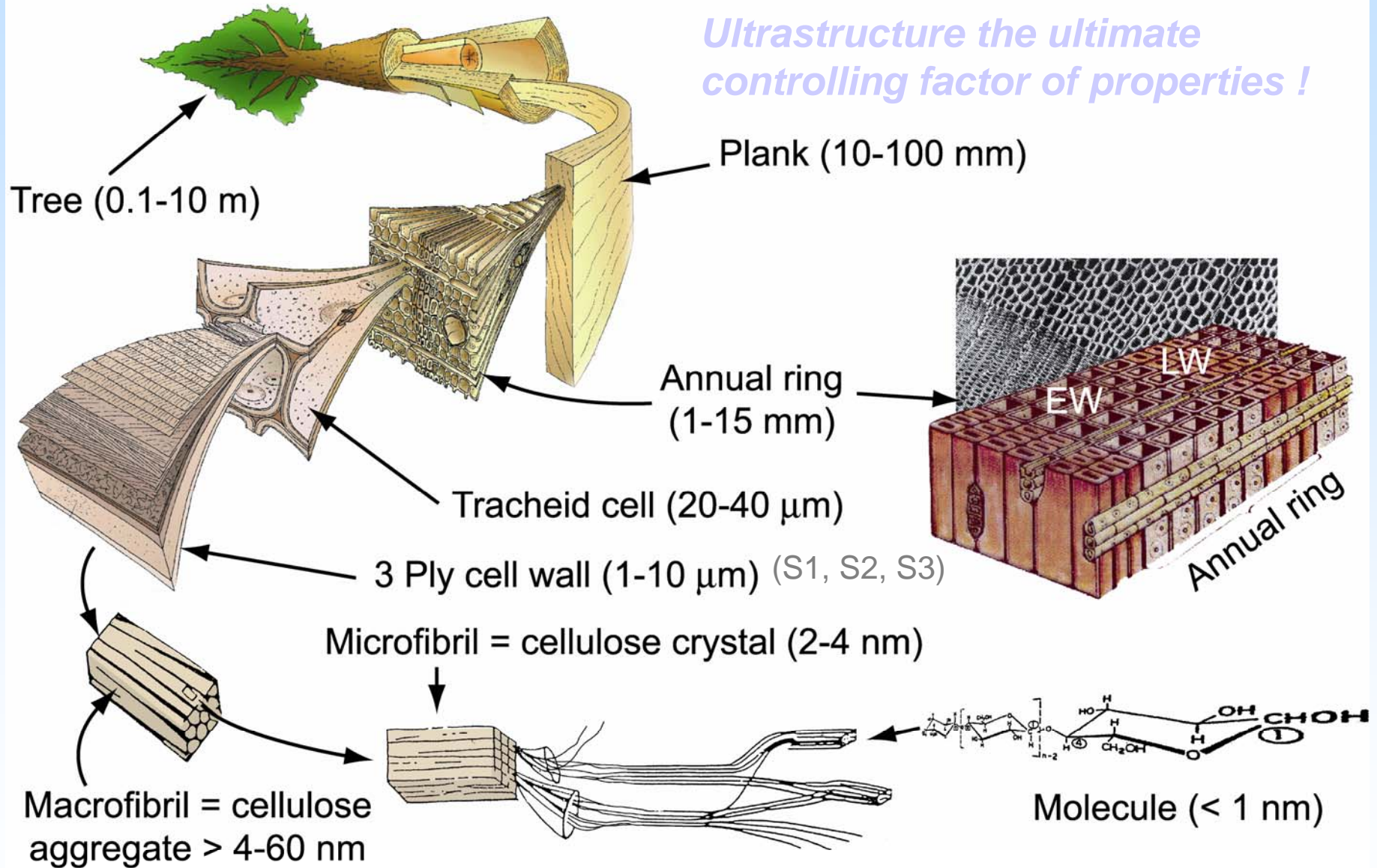
Research items

- Enzymatic wood degradation
- Biotechnology in wood technology
- Biosensors and early warning systems (insects)
- Wood formation

Softwood structure

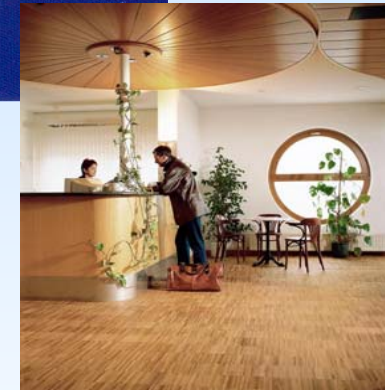
(Mod. J. Harrington)

Ultrastructure the ultimate controlling factor of properties !



Research area „Wood Quality“

- „Influence of forestry measures on wood quality“
 - Fibers
 - Sawn wood
 - End products

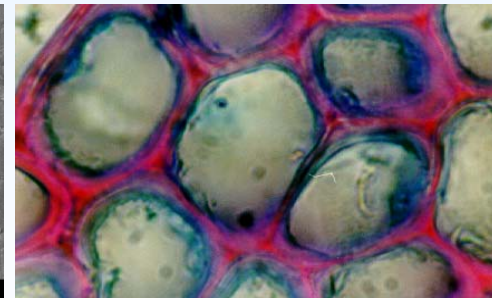
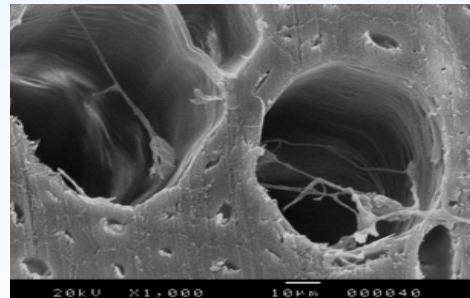
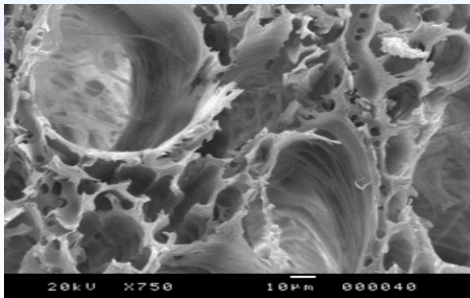


Main projects:

- Wood quality:
 - Red heart beechwood
 - Fibre and wood quality of *Abies grandis*
 - Non-destructive measurement of stem failures
 - Wood quality Mexican wood species

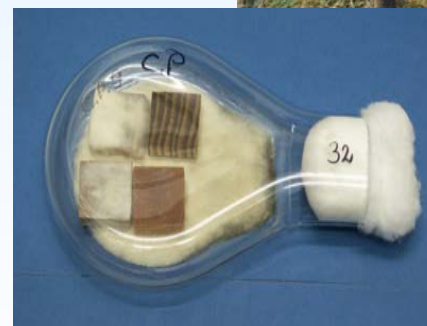
Biological deterioration of wood by fungi

- Natural resistance of wood species
- Wood preservatives
- New treatment technology
- Fundamental studies

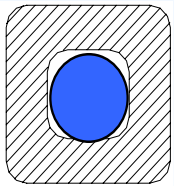
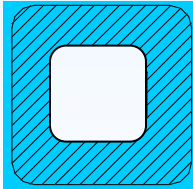
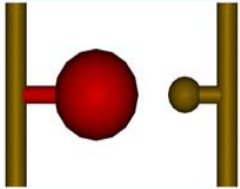
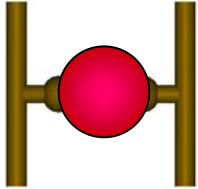
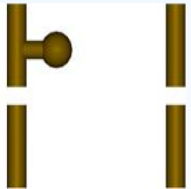


Ungoing projects:

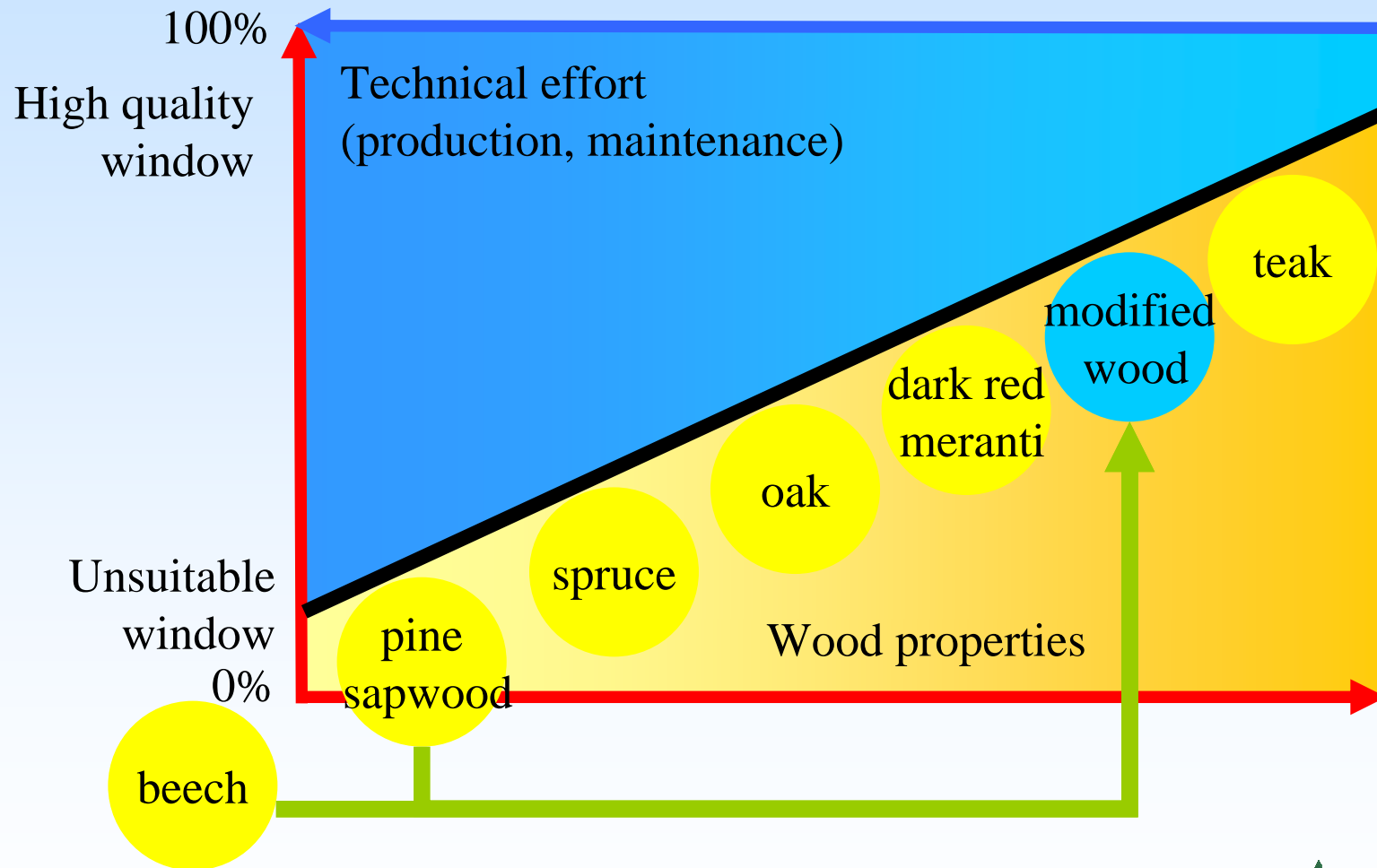
- Development of test methods for modified wood and WPC
- Non-destructive testing methods in wood durability evaluation (vibration, ultrasonic)
- Mode of protection of modified wood
- Partner in European round robin tests






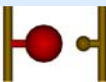






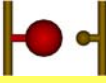








Wood modification

Filling the cell lumen	Filling the cell wall	Reaction with Hydroxyl-groups	Cross-linking of Hydroxyl-groups	Destruction in cell wall structure?
				

Wood modification

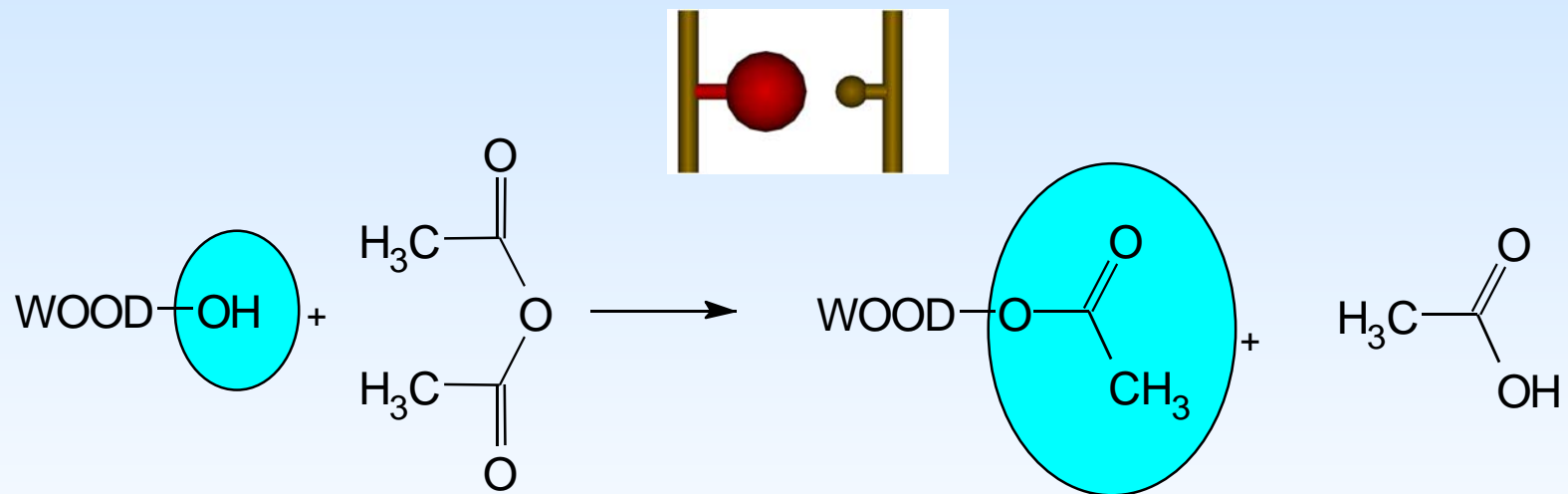


Wood Modification Processes

Modification process	On Market	Principle		
Heat treatment	X			
Acetylation	(X)			
Melamine treatment	(X)			
Interlace treatment	(X)			 
Furfurylation	X			
Silicium/Silicon /Silane	(x)			 
Oil / Wax	X			
Chitosan				

More detailed overview of wood modification technology?

Acetylation of wood



Wood and acetic anhydride -> acetylated timber and acetic acid

Pilot Plant Acetylation (SHR Arnhem, NL)

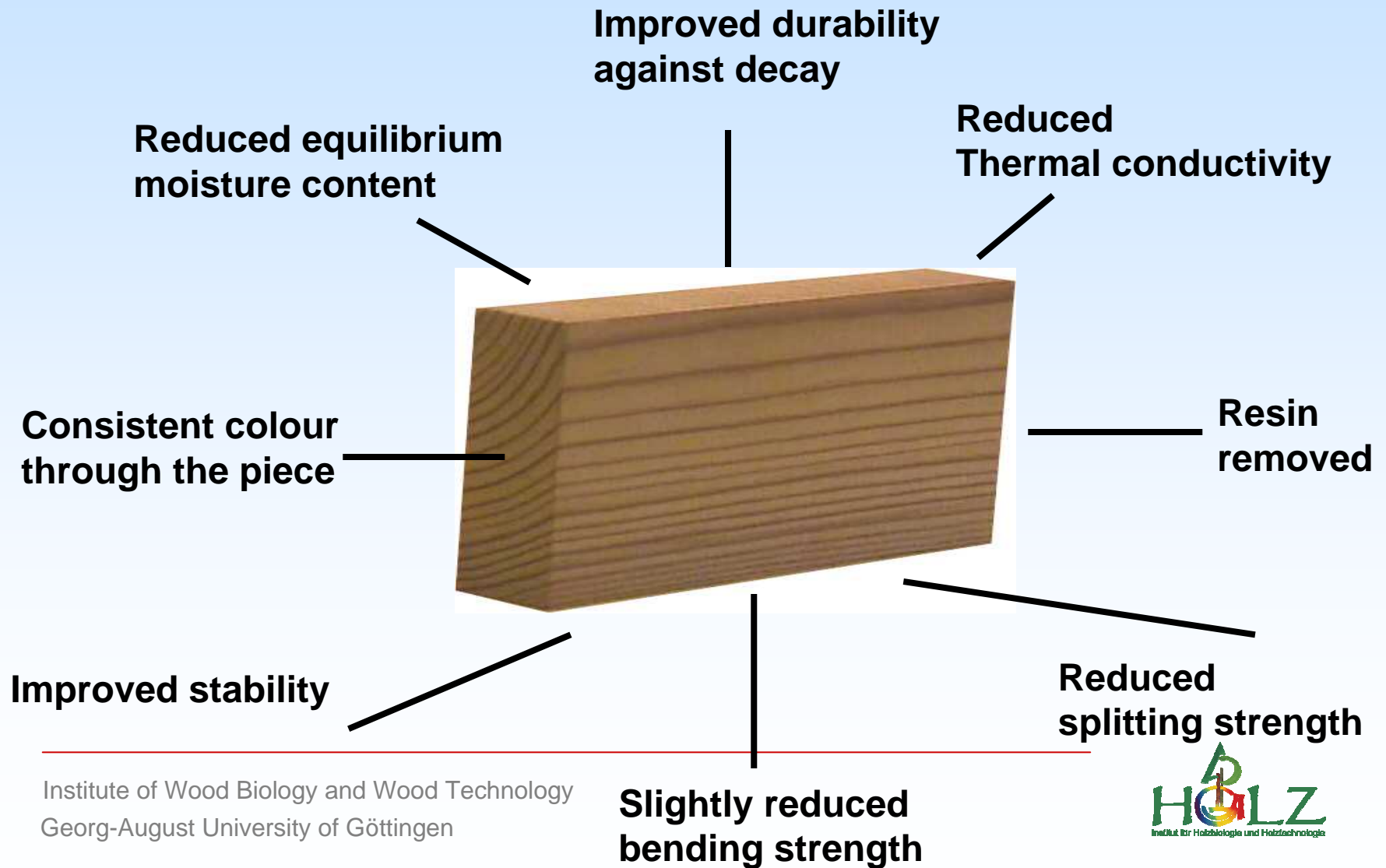


Institute of Wood Biology and Wood Technology
Georg-August University of Göttingen

Heat Treatment Processes in Europe

- PLATO (Netherlands): Platowood
 - NOW (New Option Wood - France): retified wood
 - Finnforest etc. (Finland): Thermowood
 - Menzholz (Germany): oil-heat
 - Stellac (Finland)
 - Balz (Switzerland)
 - Mühlböck/ Mitteramskogler (Austria)
 - Barkett (Russia/ Germany)
 - Bitus (Sweden)
-

Heat treatment processes

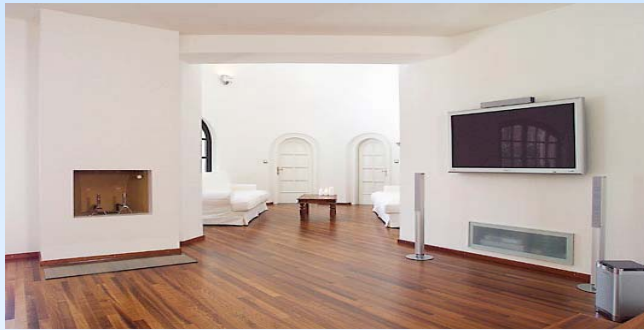


Technology behind processes

- Differences between processes:
 - general process conditions more or less comparable (170 - 240 C)
 - process steering (oxygen-nitrogen, oil, steam)
 - equipment (large, small)
 - steps within process (one or several steps)
 - conditioning before and after

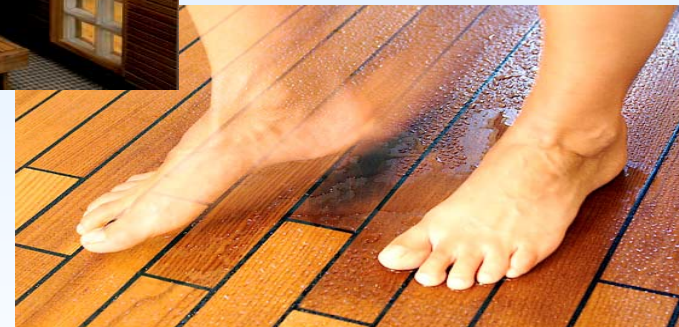
Products/ markets: use class 1

(Photos by Mitteramskogler/ Austria)



Products/ markets: use class 2

(Photos by Mitteramskogler/ Austria)



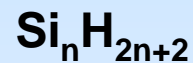
Products/ markets: use class 3

(Photos by Mitteramskogler/ Austria)



Silicon Treatment of Wood

Silicon and Silicon Compounds



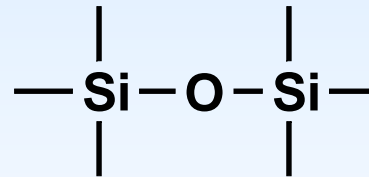
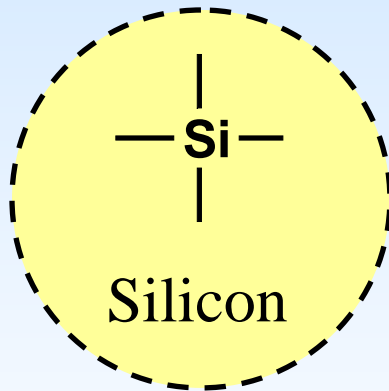
Silanes



Silicic Acid

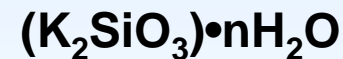
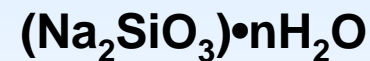


Silica



Siloxane

- Silicone Oil
- Silicone Rubber

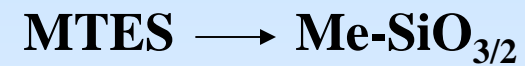
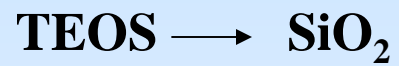


Silicates,

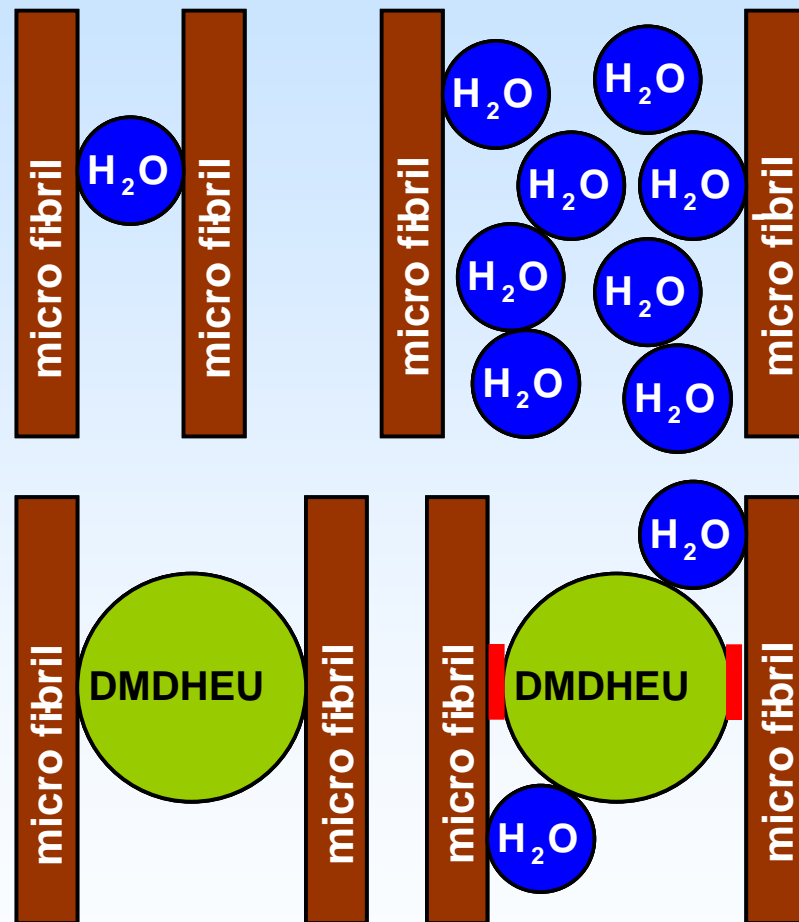
e.g. Water Glass

Silicon Treatment of Wood

The Sol-Gel-Process

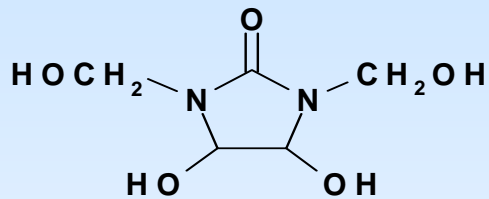


Wood modification with aqueous resins (DMDHEU)

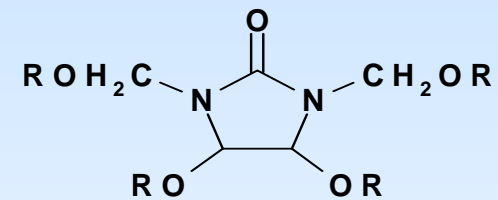


- Agent fixes the cell wall in a permanent swollen state (bulking)
- Agent react with wood (cross-linking)

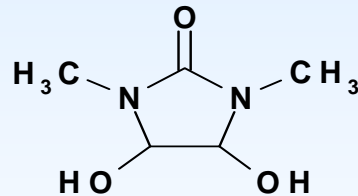
Chemical Agents



DMDHEU
(dimethyloldihydroxyethyleneurea)



mDMDHEU(a); mDMDHEU(b)
(modified DMDHEU)
R= H or CH₃

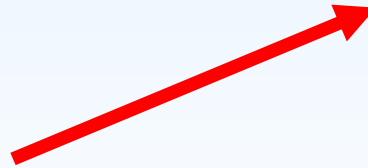


DHDMI
(dihydroxydimethylimidazolidinone)

- Produced for textile industry
- “Easy care” properties
- Bulk product
- Low formaldehyde release

Treatments

- ◆ aqueous solutions
- ◆ vacuum/pressure impregnation
- ◆ optional pre-drying
- ◆ curing in steam dryer (higher than 100° C)



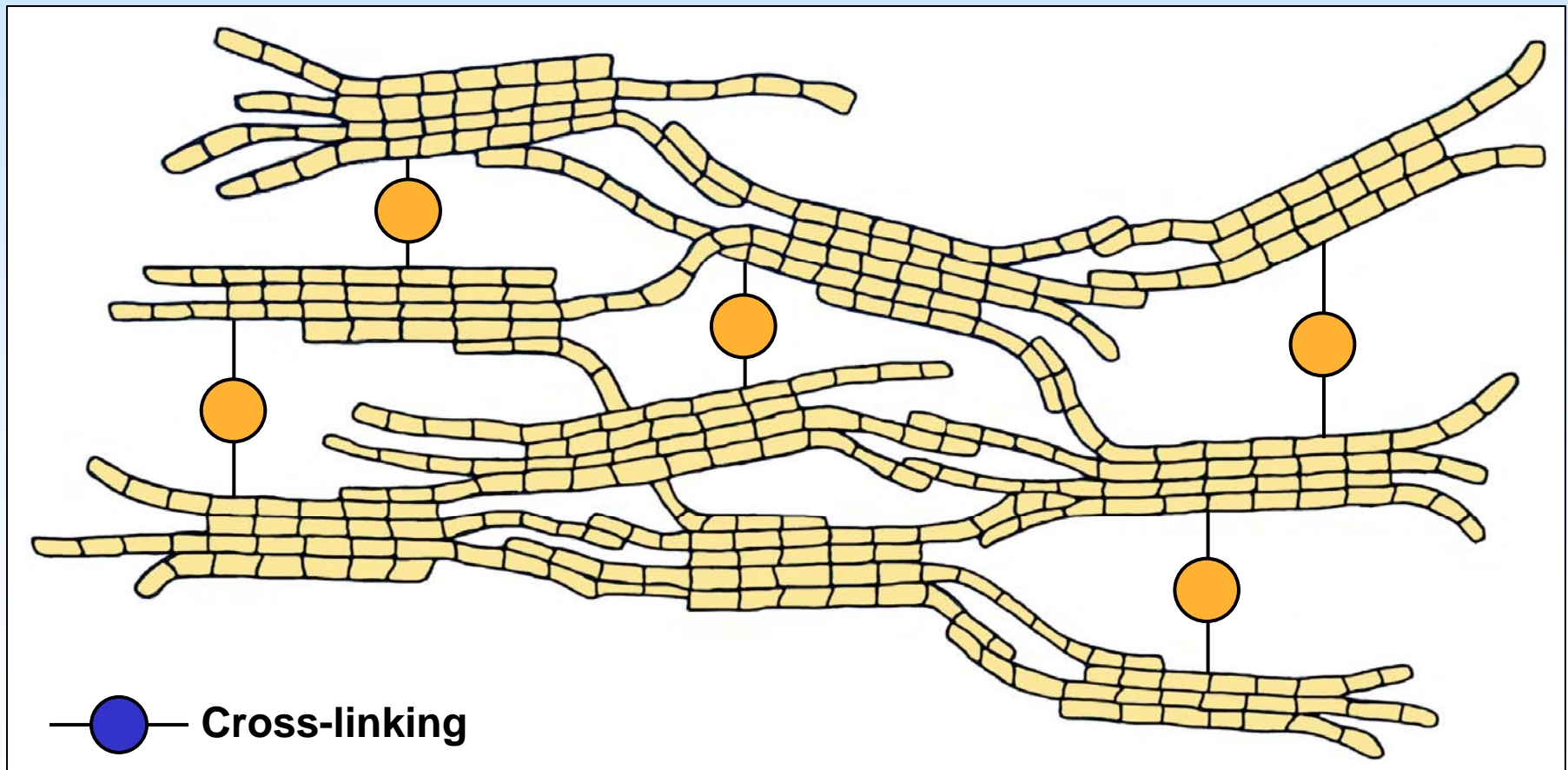
Cross-linking of cellulose fibres

Cross-linked cellulosic fibres in cotton:



- ⇒ Dimensionally stable
- ⇒ Crease resistant
- ⇒ “Easy care”
“Non-iron”

Cross-linking cellulose molecules

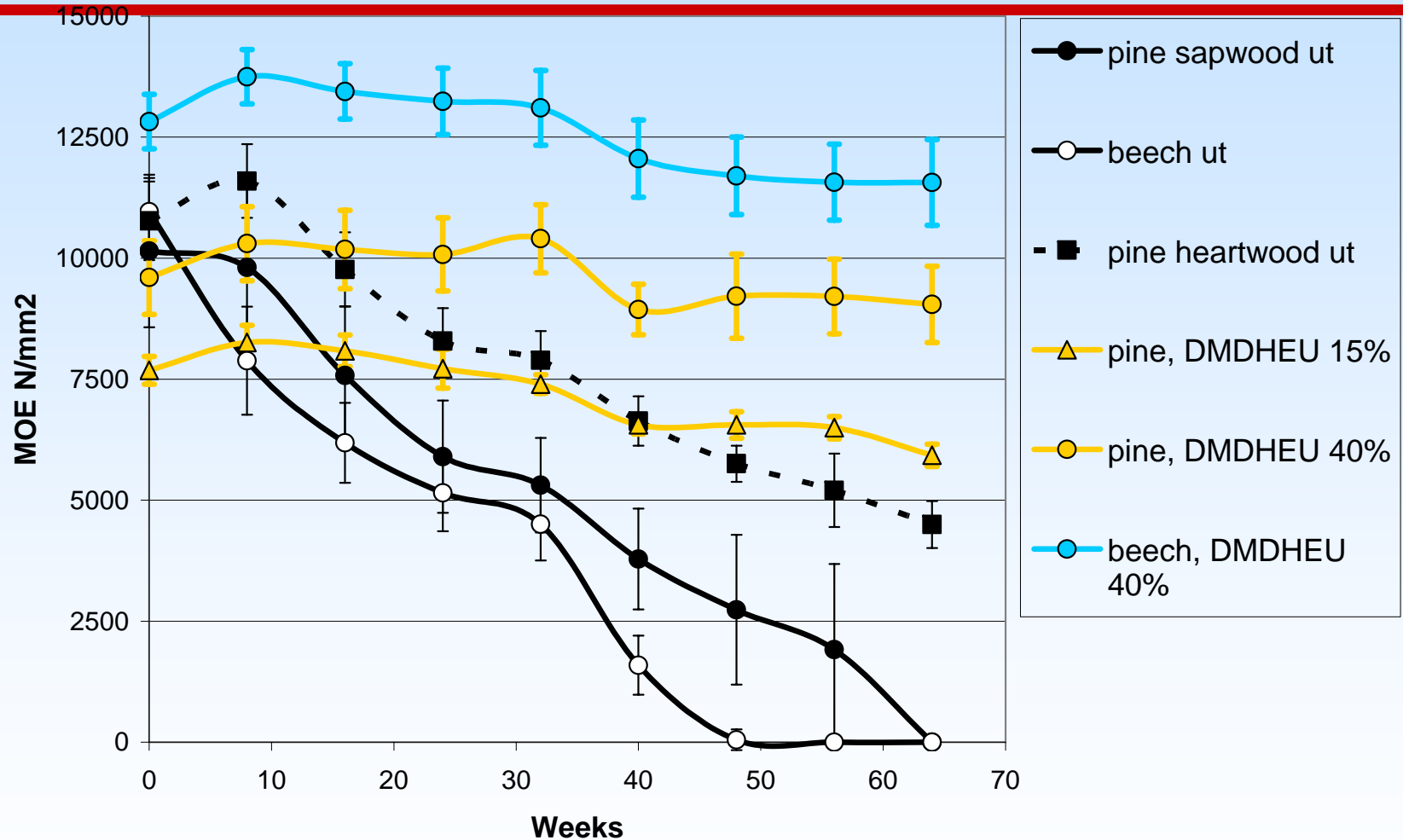


Treatments

- ◆ aqueous solutions containing: agents
- ◆ vacuum/pressure impregnation
- ◆ optional pre-drying
- ◆ curing in steam dryer (higher than 100° C)

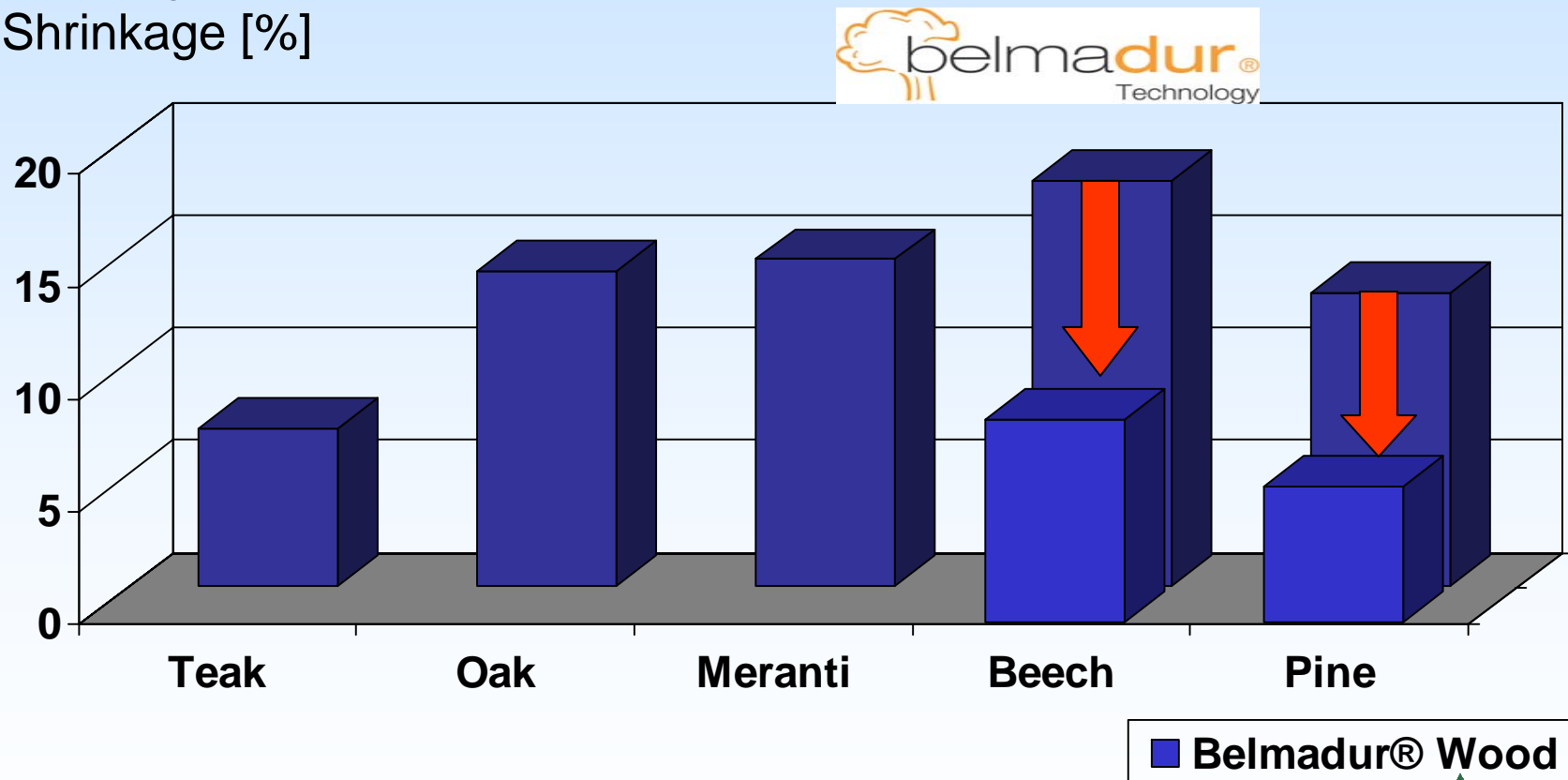


Durability against soft rot (ENv807)



Advantage # 1: High dimensional stability, reduced swelling and shrinkage

Swelling/
Shrinkage [%]



BASF Belmadur[®] Technology



® = patent and registered trademark of BASF

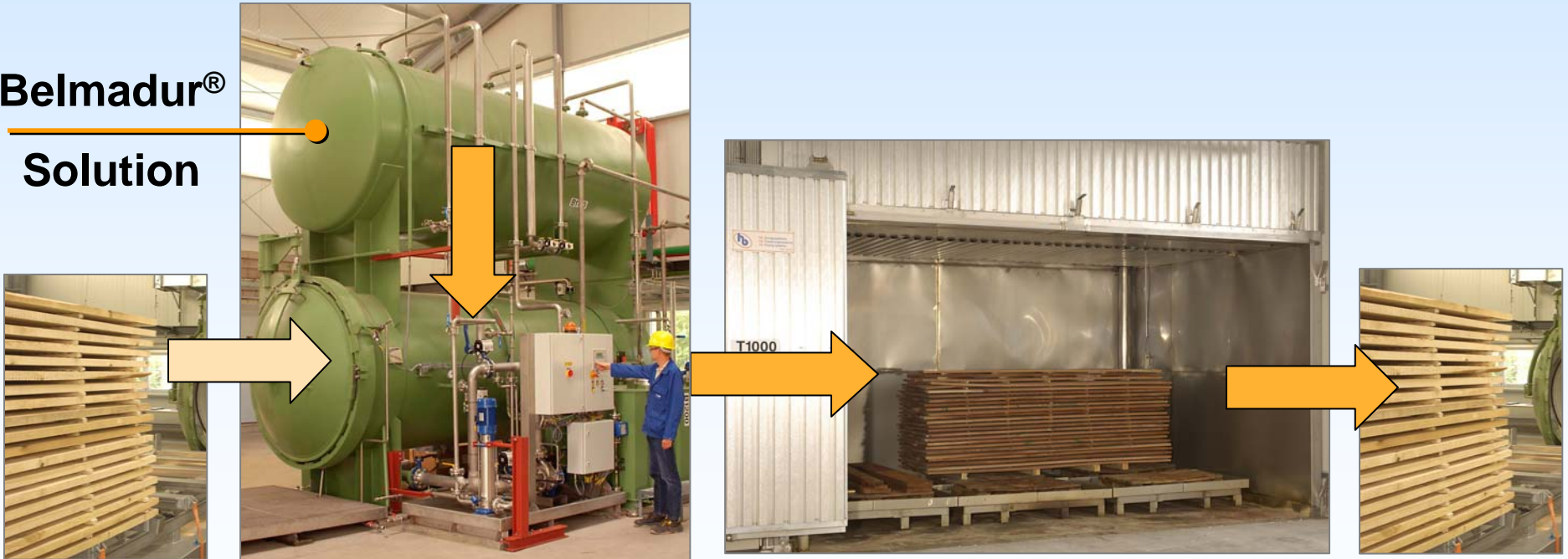
Wood

Treatment

Curing

Belmadur[®]
Wood

Belmadur[®]
Solution



Room temperature

Temperature > 100°C

Institute of Wood Biology and Wood Technology
Georg-August University of Göttingen



Thank you very much for your attention!