Modified wood: processes, products and markets

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Wood Biology and Wood Technology
Georg-August-University Göttingen
GERMANY
content

• Why modification?
• How (principles)
  • Processes
• Products
• Markets
Wood: material of the future

• Ecological
• Sustainable
• Renewable
• Esthetical
• Technologically diverse
• Modern
Wood: material of the future

- Energy efficient
- End-of-life: energy
Wood: material of the future?

Weak points:

• Moisture sensitive
• UV-stability
• Dimensional unstable
• Resistance against fungi
• Soft surface
Wood: material of the future?
How to solve these problems?

• Use wood with high natural quality (as many tropical hardwoods)
  • Availability (mid term, long term)
  • Sustainability

• Use of wood preservatives
  • Toxicity issues
  • New biocides with low impact
  • Only durability item solved

• Use of new technologies for wood treatment!!
What is „wood modification“?
Principles of wood modification

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<th>Lumen filling</th>
<th>Cell wall filling</th>
<th>Reaction with wood polymers</th>
<th>Cross linking</th>
<th>Degradation of cell wall</th>
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Bilder: Sandermann (1963)
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<th>Modification method</th>
<th>Commercial</th>
<th>Principle</th>
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<td>Acetylation (Accoya)</td>
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<td>Melamine resin</td>
<td>(X)</td>
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<td>DMDHEU (Belmadur)</td>
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<td>Furfurylation(Kebony)</td>
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<td>Silicone/Silane</td>
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<tr>
<td>oil / wax/ parafins</td>
<td>X</td>
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<tr>
<td>Chitosan</td>
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Treatment steps

- liquid, catalyst
- vacuum-pressure impregnation
- drying and reaction
- drying temp: above 100 C
Thermo treatment (TMT, Thermowood)

Process:
- no chemicals
- temperature 180°C to 220°C
- many wood species used
- difference between producers: technology used
Producers (Europe)

- Finland
- The Netherlands
- France
- Austria
- Germany
- Russia
- ...

Production (2007): approx. 100,000 m³
Acetylation

Process:
- impregnation with acetic anhydride
- reaction at elevated temperatures
- post treatment (acetic acid)
Production site „Accoya“

Quelle: www.titanwood.com

Accsys Chemicals PLC (UK)
Production since 2007
Furfurylation

Wood Polymer Technologies
www.wpt.no
silicon based compounds

Hydrophilic and potentially reactive

Protection of masonry

Clothes (dyeing agents fixation)

Coupling agents (electrical circuit)

Hydrophobic

Hydrophobation of glass

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Silanes, silicones

“water shade effects”

www.holz.uni-goettingen.de
cmai@gwdg.de
Wrinkle free wood?

- Dimensionally stable
- Crease resistant
- “Easy care” “Non-iron”
Polymerisable chemicals
First application in Germany: 
Fa. Becker/ Brakel
Fa. Becker: Furnierformholz
Solid wood-veneers-fibres
Water uptake

(Tingaut et al., 2005)
Shrinkage and swelling

**Holzarten**

- Buche
- Lärche
- Meranti
- Buche / 30%
- Kiefer
- Kiefer / 30%
- Teak
- Buche / 60%

**Volumetrische Quellung von 0% Holzfeuchtigkeit zur Fasersättigung**

- Buche: 18%
- Lärche: 14%
- Meranti: 12%
- Buche / 30%: 10%
- Kiefer: 12%
- Kiefer / 30%: 10%
- Teak: 8%
- Buche / 60%: 6%
Resistance against fungi
ENv 807

Weight gain after reaction

mass loss

Klasse V
Klasse IV
Klasse III
Klasse II
Klasse I

DMDHEU
mDMDHEU
mDMDHEU + DEG

weight gain after reaction

0% 5% 10% 15% 20% 25% 30% 35% 40%

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Brinell hardness (parket flooring)

![Graph showing hardness of different species and concentrations of DMDHEU]

- **Species**:
  - Pinus sylvestris
  - Tectona grandis
  - Fagus sylvatica

- **Concentration of DMDHEU**:
  - untreated
  - 10%
  - 30%
  - 50%
  - 80%

**Hardness (N/mm²)**

- The graph illustrates the increase in hardness as the concentration of DMDHEU increases for each species.

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Production and markets
* Production heat treated wood in Europe: approx. 100,000 m³

* Production other wood modification treatments: approx. 50,000 m³
• Biocide treated wood
  – Costs!!
  – Special products

• Markets of tropical hardwoods
  – Hazard classes 1-5
  – „high quality“

• Special products
esthetics

Foto Parkett: Hamberger, Ro
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)
Products/ markets: use class 3
(Photos by Thermowood Association, Finland)
products: hazard classes 1-5
Potential applications for Belmadur® Wood
Basis materials for wood modification

- Fast growing
- Easy „treatable“
- Large quantities
Basis materials for wood modification

- Pines
- Poplars
- Beech?
- Eucalypts
- Other fast growing wood species!
Outlook „modified wood“

1. New methods will get to market
2. Will get larger market share
3. Will be introduced in high quality/ special products
4. Must be marketed as „new material“
5. New type of industry will develop („wood modifiers“) between chemical industry and wood industry

get involved in this new business!
Thank you for your attention!