

m ü n c h i n g e r



Innovation in Window Application

Our World is Wood



International Timber Trading is our Business

Adolf and Harald Münchinger



Second generation family-owned company since 1961

Headquarter in D-75443 Ötisheim



sales and administration 40 employees

Production Site in D-91578 Leutershausen



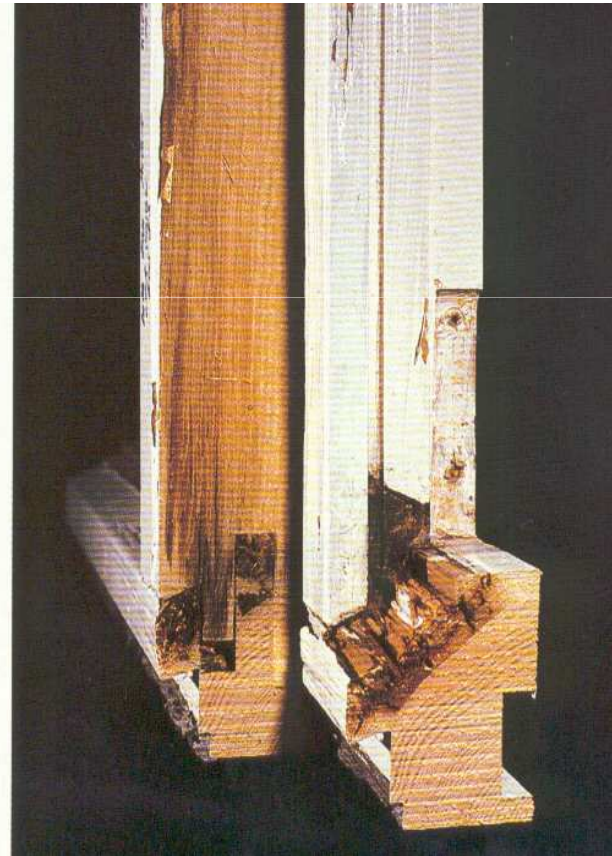
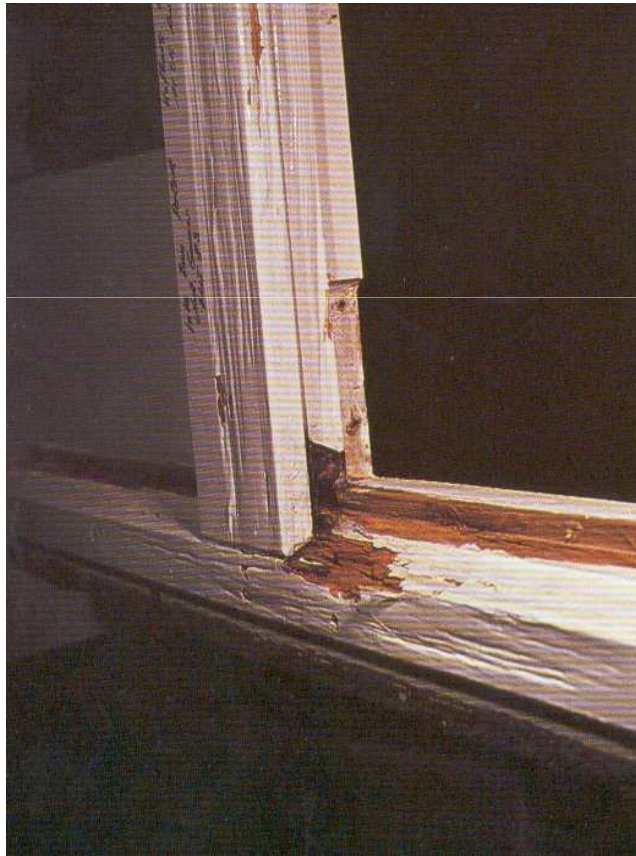
Production approx. 100 employees

„Wood is wonderful“ (strapline in the 80th)

- multifunctional
- aestetical



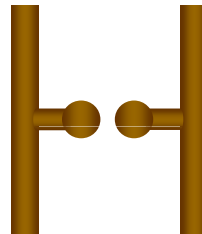
Is wood really wonderful?



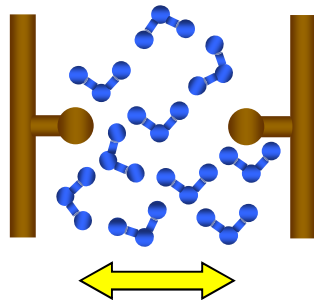
Why Wood Modification ?

- Remedy for disadvantages

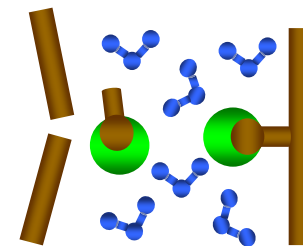
Absolute dry wood



**Wood after water
adsorption**

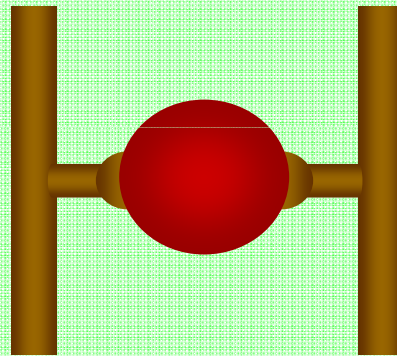


Fungi attack



Methods of Wood Modification

Cross-linking



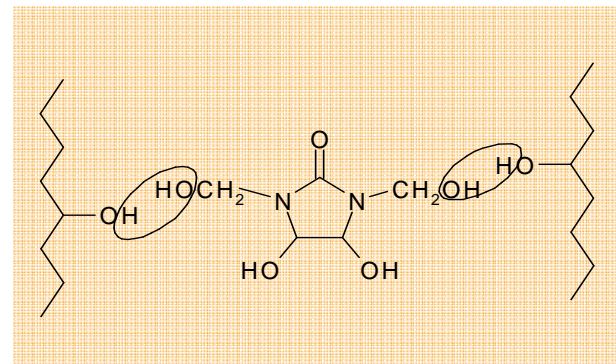
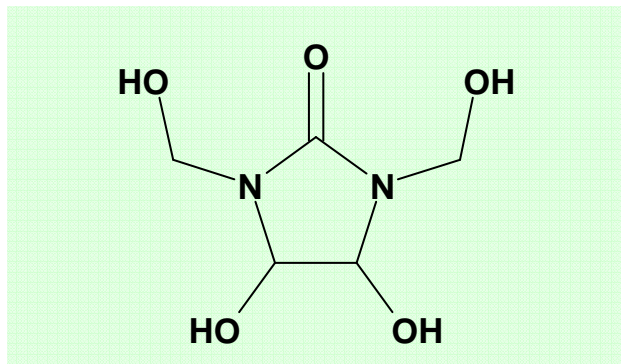
*Belmadur
Modification*

The Belmadur® Technology

- Belmadur® - an innovative Wood Modification Technology
- Property profile of wood is greatly improved
 - ➔ High resistance against micro-biological degradation
 - ➔ Reduced swelling and shrinking
 - ➔ Improved dimensional stability, and form stability for plywood
 - ➔ Many other advantages for window applications
- Not a biocide, fungicide, or insecticide
- Improvements to performance are permanent

Belmadur[®] Wood Modification Chemistry

- Cross-linking cellulose fibers is a well known process in the textile finishing (easy care / wrinkle-free treatment)
- Cross-linking with Belmadur[®] formulation containing DMDHEU
- Two step process is applied to non-durable wood species resulting in “modified” wood with tropical hardwood properties



Belmadur[®]- Safe and Sustainable Technology

Safe

- Cross-linking agent is non-toxic with well documented properties and a long history of application in the textile industry
- Not a fungicide or pesticide
- Formaldehyde emissions below the European E1 limit for engineered wood materials
- Total VOC emissions are lower than those of many softwood species

Sustainable

- Wood from domestic species becomes viable alternative to exotic hardwoods
- Technology creates new options for use of wood as a renewable resource to substitute other materials

Belmadur[®] Wood Production Technology



Step 1: Vacuum-pressure treatment with Belmadur[®] Solution (impregnation)

Step 2: Curing at temperatures above $> 100\text{ }^{\circ}\text{C}$ (cross-linking and fixation)

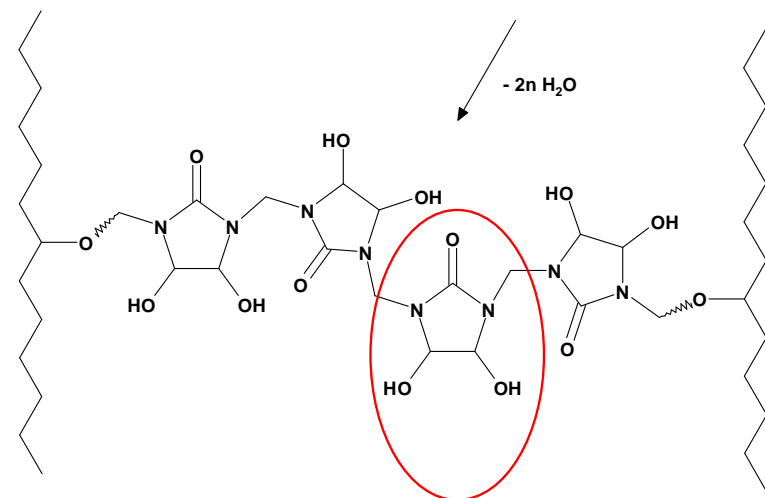
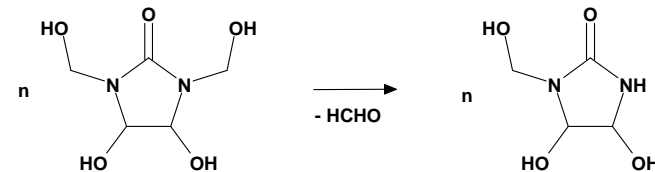
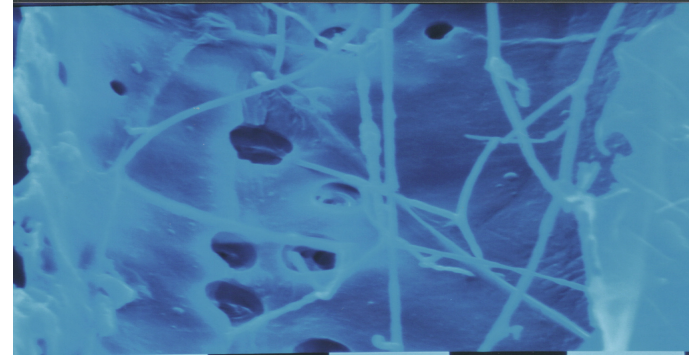
Wood Species, Wood Quality



- For window application only
Scots Pine
- Generally poor quality (knots, resin pockets, inner stresses etc.) can not be converted into high quality

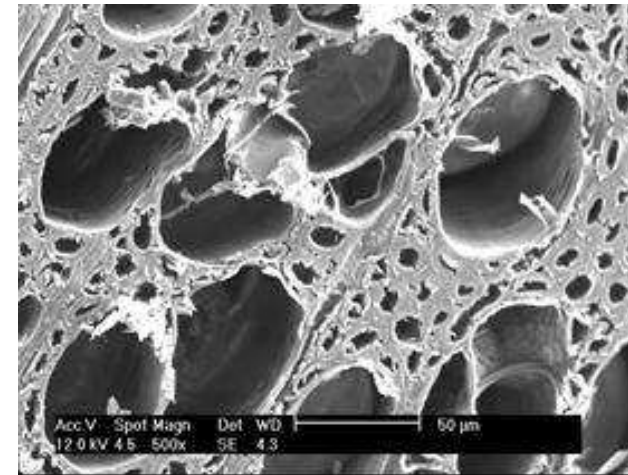
Mode of Action

- Mode of action is non-biocidal
- Crosslinking is permanent
- Modified timber no longer food source
for wood destroying organisms
- Blue stain protection is required



Changes in Structure and Color

- Cell lumina remain open
- Modification causes permanent swelling of the cell walls
- Appearance of Belmadur Pine similar to Larch



Fungal and Decay Testing

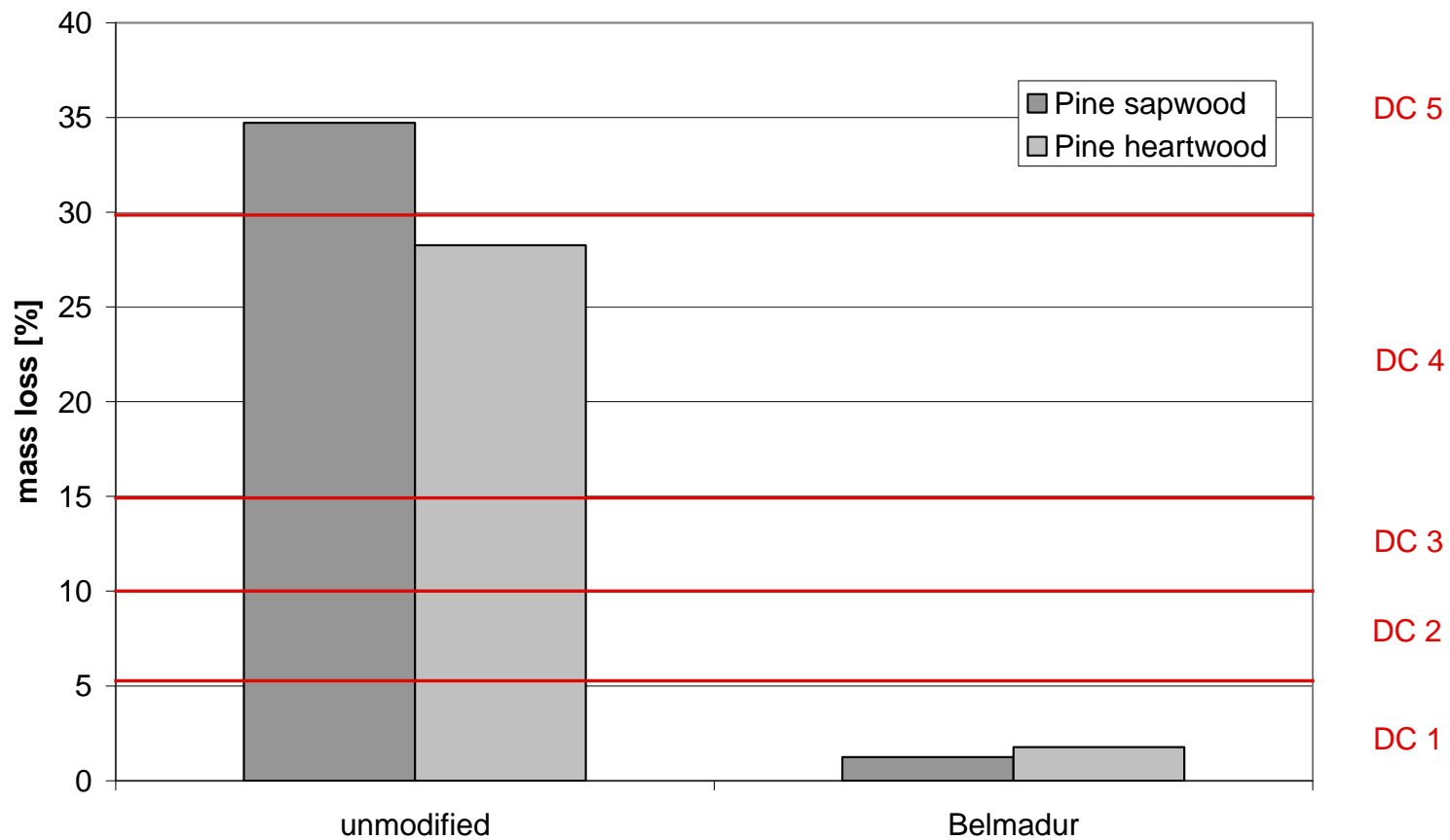
| Test Description | Method | Results / observations |
|---|--|--|
| Test of durability against brown and white rot fungi for pine and beech | According to European Standard EN 113 and prCEN/TS 15083 (comparable to WDMA Soil Block Test) | Durability class 1 reached (comparable to teak), decay less than 15% of untreated control sample |
| Test of durability in soil contact for pine and beech | <p>a) Laboratory testing according to ENV 807</p> <p>b) Field testing according to EN 252 and AWP A E7</p> | <p>a) Durability class 1 reached</p> <p>b) Tests ongoing; favorable preliminary results</p> |

Termite Testing

| Test Description | Method | Results / observations |
|--|--|---|
| Testing of durability against termite attack | <ul style="list-style-type: none"> a) Laboratory testing, choice test b) Laboratory testing, forced test c) Field testing, subterranean termites, Portugal d) Field testing, drywood termites, Australia | <ul style="list-style-type: none"> a) No decay in choice test b) Increased resistance in forced testing c) No or only slight attack in Portugal after 3 years d) Testing recently started |

Durabilty against brown rot fungi

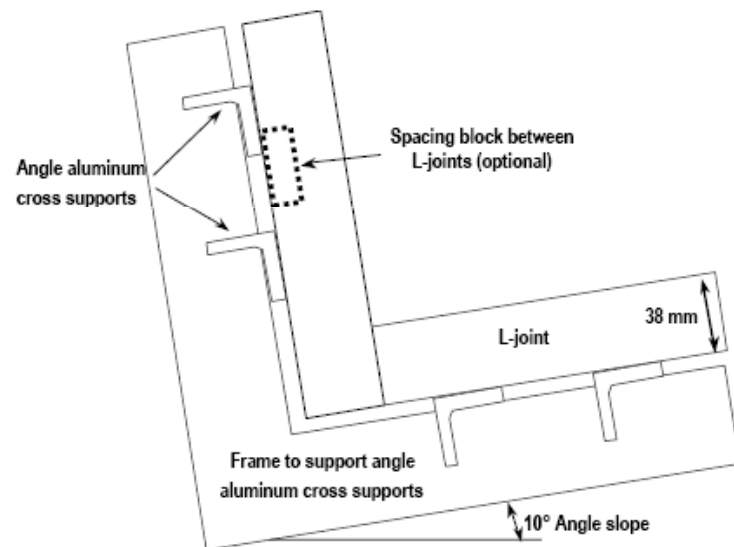
Mass loss caused by *Coniophora puteana*



Fieldtest Locations



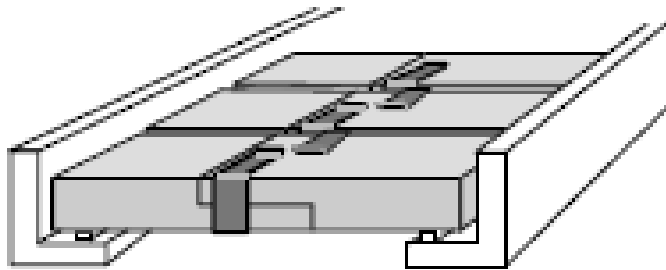
Field testing – L-joint



Results – L-joints



Field Testing Lap-Joint

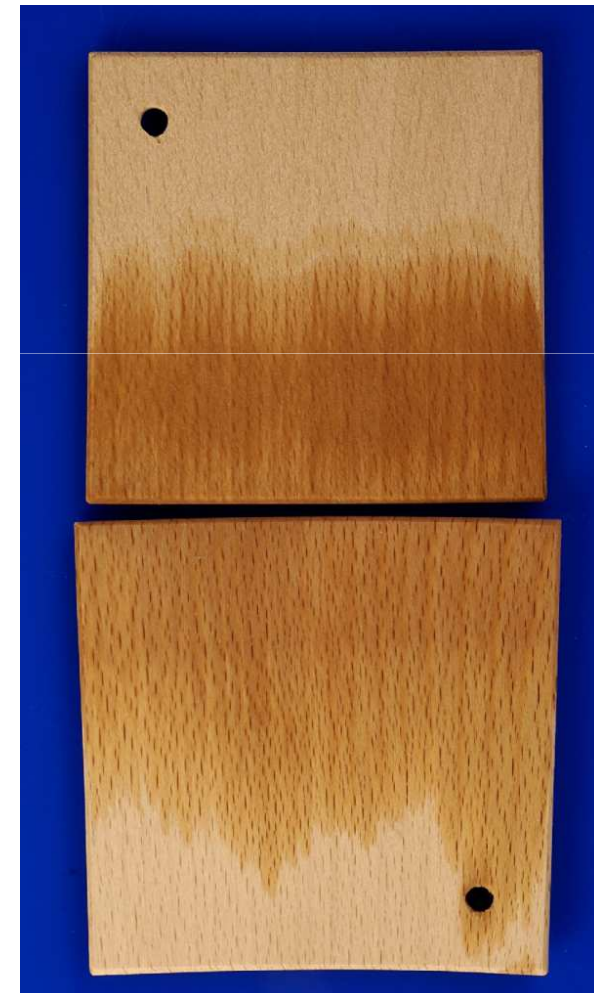


Results Lap-Joints



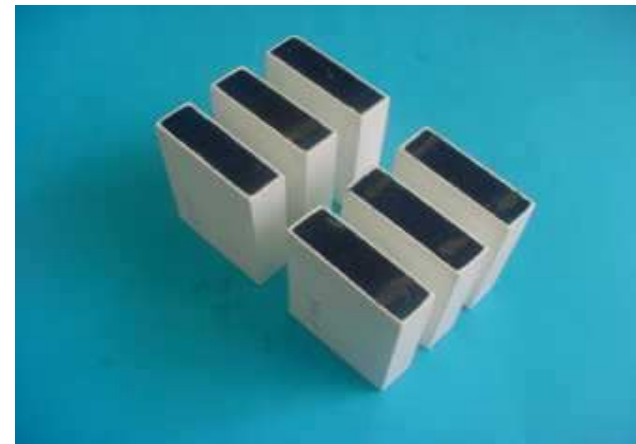
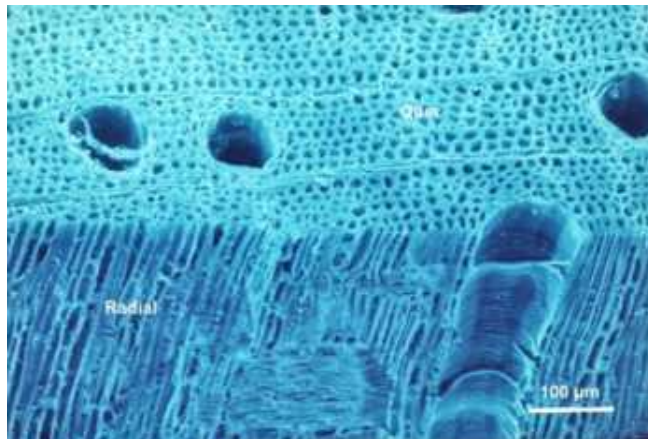
Swelling and Shrinking Behaviour

- Reduction approx. 60%
- Furthermore reduction of anisotropy
- Coefficient of swelling
 - radial 0,019
 - tangential 0,034
 - axial 0,0009



Capillary Water uptake

- Capillary water uptake is clearly reduced
- Water uptake coefficient W_w (kg/(m² x h^{0,5}))
 - Radial 0,051
 - Tangential 0,033
 - Axial 1,898

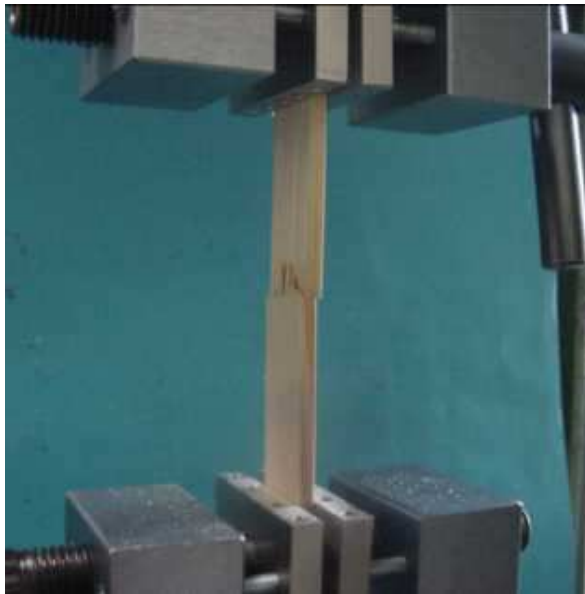


Mechanical Properties

- Bending strength is unchanged
- Modulus of elasticity unchanged
- Compression strength increased by 30 - 50%
- Impact strength is reduced
 - Embrittlement of the wood caused by the modification process
- Surface hardness increased by 35%

Glued Bar and Fingerjoints

- glue joint requirements in glued bar („Rosenheimer Kanteltest“) fulfilled



- Relevant testing procedure concerning fingerjointing, ift, Rosenheim, fulfilled

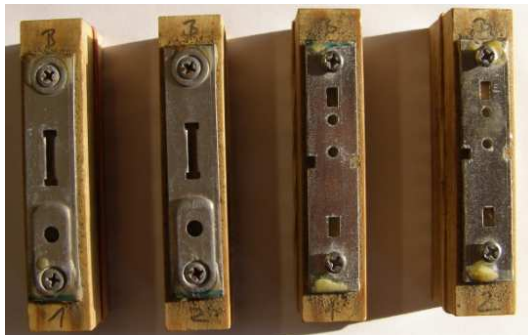
Compatibilty with sealants, sealing profiles etc.

- all standard products for Pine are suitable



Compatibilty with Fittings and Fasteners

- Commercial fasteners and fittings for natural wood with different bloomings are suitable without reservation



Distortion of Glued Bar

- Glued bars with a length of 2m with different combinations of Belmadur Pine and unmodified Pine did not show untypical distortions under changing climate conditions



Processing

- Using the same rotation speed and feed rate, tool abrasion is reduced by 50% compared to unmodified pine
- Force of infeed is decreased by the same amount



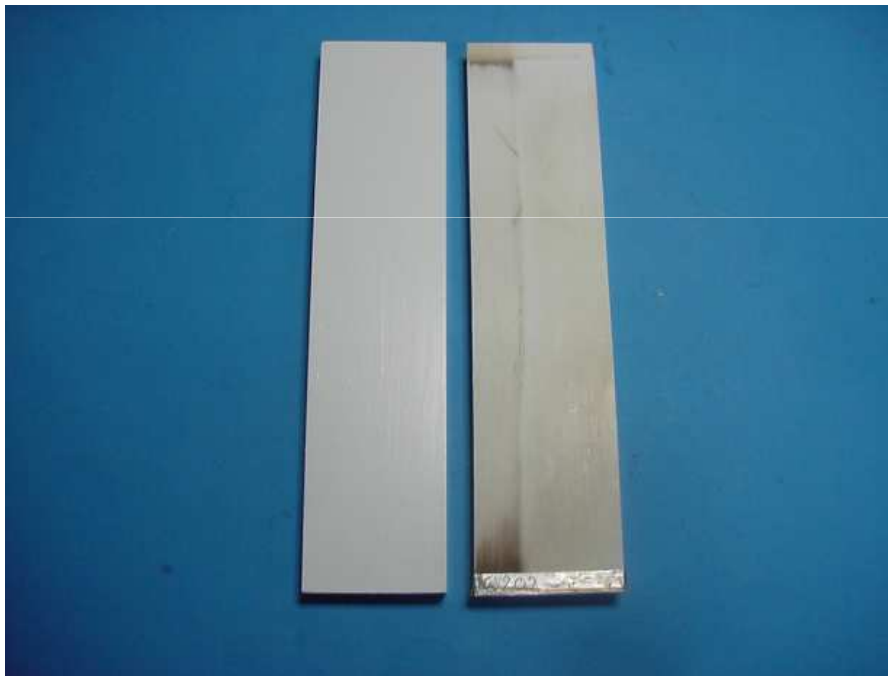
Results of Accelerated Weathering



Results of Accelerated Weathering



Results of Accelerated Weathering



The Generation Window

- Domestic Pine timber from sustainable European forestry with FSC and PEFC-Certificate
- Biological durability class1 combined with low thermal conductivity
- Outstanding dimensional stability
- All required standard materials like fasteners, fittings etc. for window manufacturing are suitable for Belmadur Pine as well
- Visibly enhanced performance of coating systems



