Termite resistance of pure & mixed heartwood/sapwood Cypress plywood

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The beginning of the story

- European Project PLYBIOTEST QLK5-CT-2002-01270
  “Biological performance testing methodology to evaluate the durability of plywood as a quality indicator for exterior construction purposes”
- Influence of the top-veneer ?
- Top-veneer made of durable timber ?
The beginning of the story

- Farshid Faraji, Gonbad University, Iran
- Shortage of wood and wood products
- Plywood industry
- Large range of timbers available in the Caspian forest
The scenario

- Cypress = *Cupressus sempervirens*
- Cypress heartwood = high durability
  Presence of tropolones
- Plywood
  Top veneers = Cypress heartwood
  Other veneers = Cypress sapwood
- Different plywoods with different models of integration of the plies
2 Cypress trees
Avignon - South of France
45 years old

- Sapwood
- Outer heartwood
- Inner heartwood
- Core of peeling

120 cm for peeling
150 cm for massive samples
120 cm for peeling
13/10 mm plies
26/10 mm plies
Natural durability

boards for natural durability samples

central board for density and modulus of elasticity

boards for natural durability samples
Natural durability

- Evaluated according to the guidelines of EN 350-1 / EN 118 (6 samples) visual quotation

- Guidelines of EN 117 (3 samples) visual quotation + mass loss

- Use of other timbers:
  Scotch pine sapwood, poplar, beech

Termites *Reticulitermes santonensis*
## Natural durability

<table>
<thead>
<tr>
<th>Timber</th>
<th>Mass loss %</th>
<th>Standard deviation</th>
<th>Associated durability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pine (sapwood)</td>
<td>6.98</td>
<td>1.05</td>
<td>Sensible</td>
</tr>
<tr>
<td>Beech</td>
<td>6.49</td>
<td>2.23</td>
<td>Sensible</td>
</tr>
<tr>
<td>Poplar</td>
<td>7.27</td>
<td>1.98</td>
<td>Sensible</td>
</tr>
<tr>
<td>Cypress (sapwood)</td>
<td>6.09</td>
<td>1.12</td>
<td>Sensible</td>
</tr>
<tr>
<td>Cypress (heartwood)</td>
<td>0.41</td>
<td>0.17</td>
<td>Durable</td>
</tr>
<tr>
<td>Cypress (sapwood)</td>
<td>-</td>
<td>-</td>
<td>Sensible</td>
</tr>
<tr>
<td>Cypress (heartwood)</td>
<td>-</td>
<td>-</td>
<td>Durable</td>
</tr>
<tr>
<td>Scotch Pine (sapwood)</td>
<td>-</td>
<td>-</td>
<td>Sensible</td>
</tr>
</tbody>
</table>

Mass loss = % of initial mass
Scot pine sapwood

Poplar

Beech

Cypress sapwood

Cypress heartwood
Plywoods

- 1.3mm or 2.6mm
- 5 or 9 plies
- 240 g/m² MUF glue, on the 2 sides of the inner plies
- Pressing 30°C, 2 hours
- Final thickness 13 ± 0.5 mm
Plywood models

Sapwood

Pure plywoods

Heartwood

40% heartwood
Exterior plies

60% heartwood
Exterior plies

Mixed plywoods

Cypress sapwood/Cypress heartwood/Poplar/Beech

40% heartwood
Interior plies

60% heartwood
Interior plies

Cypress Sapwood/heartwood

Pure plywoods

Heartwood

Sapwood

Mixed plywoods

Cypress sapwood/Cypress heartwood/Poplar/Beech

40% heartwood
Exterior plies

60% heartwood
Exterior plies

Cypress Sapwood/heartwood

Pure plywoods

Heartwood

Sapwood
3 months pre-conditioning
1 month conditioning
65% RH, 20°C

Sample dimensions
50 x 50 x thickness (mm)
EN 117
Visual quotation
Mass loss
## Plywoods durability

### Pure panels

<table>
<thead>
<tr>
<th>Type of pure panel</th>
<th>Mass loss %</th>
<th>Standard deviation</th>
<th>Associated durability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poplar 5 plies</td>
<td>8.53</td>
<td>0.35</td>
<td>Sensible</td>
</tr>
<tr>
<td>Poplar 9 plies</td>
<td>4.27</td>
<td>0.92</td>
<td>Sensible</td>
</tr>
<tr>
<td>Beech 5 plies</td>
<td>6.27</td>
<td>1.24</td>
<td>Sensible</td>
</tr>
<tr>
<td>Beech 9 plies</td>
<td>4.04</td>
<td>0.11</td>
<td>Sensible</td>
</tr>
<tr>
<td>Cypress-sapwood 5 plies</td>
<td>5.47</td>
<td>0.62</td>
<td>Sensible</td>
</tr>
<tr>
<td>Cypress-sapwood 9 plies</td>
<td>1.76</td>
<td>0.51</td>
<td>Sensible</td>
</tr>
<tr>
<td>Cypress-heartwood 5 plies</td>
<td>0.39</td>
<td>0.19</td>
<td>Durable</td>
</tr>
<tr>
<td>Cypress-heartwood 9 plies</td>
<td>0.34</td>
<td>0.08</td>
<td>Durable</td>
</tr>
</tbody>
</table>
5 plies – Sensible
Attack on any ply

No termite penetration through the glue line

9 plies – Sensible
Attack preferentially on top layers
+ in the thick core layer
# Plywoods durability

## Mixed panels

<table>
<thead>
<tr>
<th>Type of panel</th>
<th>Mass loss %</th>
<th>Standard deviation</th>
<th>Associated durability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mix 1</td>
<td>0.27</td>
<td>0.2</td>
<td>Durable</td>
</tr>
<tr>
<td>Mix 2</td>
<td>2.45</td>
<td>0.43</td>
<td>Sensible</td>
</tr>
<tr>
<td>Mix 3</td>
<td>0.21</td>
<td>0.17</td>
<td>Durable</td>
</tr>
<tr>
<td>Mix 4</td>
<td>1.56</td>
<td>0.65</td>
<td>Sensible</td>
</tr>
<tr>
<td>Mix 5</td>
<td>0.58</td>
<td>0.1</td>
<td>Moderately durable</td>
</tr>
<tr>
<td>Mix 6</td>
<td>1.53</td>
<td>0.76</td>
<td>Sensible</td>
</tr>
<tr>
<td>Mix 7</td>
<td>0.56</td>
<td>0.27</td>
<td>Moderately durable</td>
</tr>
<tr>
<td>Mix 8</td>
<td>2.67</td>
<td>0.51</td>
<td>Sensible</td>
</tr>
<tr>
<td>Mix 9</td>
<td>0.25</td>
<td>0.29</td>
<td>Durable</td>
</tr>
<tr>
<td>Mix 10</td>
<td>0.32</td>
<td>0.27</td>
<td>Durable</td>
</tr>
<tr>
<td>Mix 11</td>
<td>1.19</td>
<td>0.09</td>
<td>Sensible</td>
</tr>
</tbody>
</table>
Mixed panels
Cypress sapwood/heartwood

Sensible

Moderately durable

Durable

40% Cypress heartwood
60%
Top veneers - Cypress heartwood
Conclusion

- Importance of the integration of the plies (durable/non-durable, top veneer) to obtain plywood durable against termites

- A different use (better use?) of biodiversity to obtain products with enhanced natural durability

- To think about:
  - Larger panels with edge seal?
  - In « real » conditions (field tests)?
  - For how long (tropolones from cypress are volatile)?

Acknowledgement
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