Environmental benign wood protection by means of electro osmotic pulsing technology (PLEOT)

Plan:
--- A new alternative to chemical wood protection.
A wood protection technology that gives an extensive protection from wood degrading fungi without having negative influence on the surrounding environment ---

PLEOT - Background

- Commercial available wood species – have often low durability
- Wood in contact with moisture leads to
  - Shrinkage and swelling
  - Good conditions for fungal degradation

- Wood protection by PLEOT
- Protect when wood is moist
- Refractory species can be used (Spruce)
Natural Durability
Constructive Protection
Chemical protection

Independent of wood specie  Very low process costs  Safe  Wood properties unaltered

WOOD INNOVATIONS 2012
"...Altogether the moisture content of wood is the most important factor for wood degradation by fungi and thus also for wood protection." - Olaf Schmidt - Wood and Tree Fungi
Wood moisture content levels for some wood destroying fungi. (Olaf Schmidt, Wood and Tree fungi)

<table>
<thead>
<tr>
<th>Species</th>
<th>Minimum</th>
<th>Optimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antrodia spp.</td>
<td>30</td>
<td>35–55</td>
<td>60–90</td>
</tr>
<tr>
<td>Coniophora puteana</td>
<td>26–30</td>
<td>30–70</td>
<td>60–80</td>
</tr>
<tr>
<td>Daedalea quercina</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gloeophyllum spp.</td>
<td>30</td>
<td>40–60</td>
<td>80–210</td>
</tr>
<tr>
<td>Heterobasidion annosum</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lentitheus lepideus</td>
<td>35–60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phlebiopsis gigantea</td>
<td>100–130</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serpula lacrymans</td>
<td>26</td>
<td>30–60</td>
<td>55–225</td>
</tr>
</tbody>
</table>

Electrical resistance of different wood species (Wood Handbook, William Simpson and Anton TenWolde)

Installation of PLEOT

- low frequency
- pulsed electrical current (40V) with off-period
- not harmful
- needs to be connected
- transport of ions and water

Electro osmosis: motion of polar liquid through membrane or porous material, when electric field is applied
PLAEOT - Installation

- Metal fasteners transport ions into the wood, advantage / disadvantage
- Metal ions from fasteners not sufficient for wood protection
- Other conductive material:

PLAEOT – Competitive advantage

The environmentally friendly advantage:
- Minimal use of energy for protection
- No transport or use of chemicals

The economical advantage:
- Can replace existing biocide based technology when/if restrictions will come
- Can be used on wood species not treatable with chemicals
- Can be implemented into cultural heritage buildings
- Low energy consumption, below 2€/year
Modified mini block trial; Pine sapwood

PLEOT - Resultater

Likestrøm

Elektropuls

AC

Forskjellige strømkilder
Results - brown rot

*Pinus sylvestris* exposed to *Coniophora puteana* after 8 weeks
EN 113 Test: Brown rot
– Coniophora puteana
Spruce, Pine sapwood

Mean mass loss (%)

EN 113 Test: White rot
– Trametes versicolor
Spruce + pine sapwood

Mean mass loss (%)

WOOD INNOVATIONS 2012
In ground durability

**Mean mass loss (%)**

<table>
<thead>
<tr>
<th></th>
<th>Beech</th>
<th>Pine</th>
<th>Beech</th>
<th>Pine</th>
<th>Untreated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Untreated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Protection against subterranean termites
Instalation in Norway
**Electromagnetic radiation**

<table>
<thead>
<tr>
<th>Målepunkt</th>
<th>Uten PLEOT</th>
<th>Med PLEOT</th>
<th>Uten PLEOT</th>
<th>Med PLEOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vegg i korridor ved system kontroller</td>
<td>10 V/m</td>
<td>&lt;0.1%</td>
<td>30 V/m</td>
<td>&lt;0.3%</td>
</tr>
<tr>
<td>Kantine, yttervegg</td>
<td>H2 24 V/m, H3 25 V/m, H4 18 V/m</td>
<td>&lt;0.25%</td>
<td>H2 24 V/m, H3 25 V/m, H4 18 V/m</td>
<td>&lt;0.25%</td>
</tr>
<tr>
<td>Garderobe, dusj, yttervegg</td>
<td>H2 38 V/m, H3 32 V/m, H4 30 V/m</td>
<td>&lt;0.4%</td>
<td>H2 38 V/m, H3 32 V/m, H4 30 V/m</td>
<td>&lt;0.4%</td>
</tr>
<tr>
<td>Garderobe, dør inn dusj</td>
<td>29 V/m</td>
<td>&lt;0.3%</td>
<td>29 V/m</td>
<td>&lt;0.3%</td>
</tr>
<tr>
<td>Garderobe, toalett</td>
<td>4 V/m</td>
<td>&lt;0.1%</td>
<td>4 V/m</td>
<td>&lt;0.1%</td>
</tr>
<tr>
<td>Arbeidsplass 1, høfthøyde</td>
<td>100 V/m</td>
<td>&lt;1%</td>
<td>100 V/m</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Utendørs, på veg, til høyre for vindu</td>
<td>H2 21 V/m, H3 18 V/m, H4 15 V/m</td>
<td>&lt;0.1%</td>
<td>H2 21 V/m, H3 18 V/m, H4 15 V/m</td>
<td>&lt;0.1%</td>
</tr>
</tbody>
</table>

**PLEOT: prevent fungal degradation in wood + ?**

- Prevent staining fungi
- Reduce moisture content in wood / biomass
- New areas of use for wood based panels?
- Longer lifetime for food?
- Stimulate growth in plants/food?
- Stop fungi from attacking living trees?
- Stop fungal growth.....
- ++
Possibilities in AU/NZ

> Higher value product from low value wood. (Pine eucalypt ++?)
> Enhance possibilities for increased use of wood
> New areas for the use of wood
> Prevent growth of staining fungi

> Any ideas?

Field trials at Innisfail

![Field trials image](image-url)
Acknowledgement

MILJØTEKNOLOGI AS
Thank you for your attention

Erik Larnøy
lae@skogoglandskap.no
0481199048
www.pleot.com