Micronised Copper Preservatives

Terry Smith
Osmose New Zealand
Prepared for Wood Preservation 2009
Rotorua NZ 15-16 April

Micronised Wood
Preservatives: Topics
- Technology
- Use in Plant
- Benefits
- Current Approvals and Use

www.osmose.co.nz
The Need for New Preservatives

- CCA change in 2004
- Developed by Osmose US
- Product of over 8 years R&D
- Replacement for solubilised copper systems such as ACQ and Copper Azole
- Environmental and consumer benefits

Traditional method for Wood Treatments

- The current method for getting copper into wood is to "dissolve" the copper in an organic solvent
- Alkaline copper and copper azole products use solvents (MEA or ammonia) to dissolve the copper
- Organic solvent copper-based preservatives can lead to problems concerning
  - preservative leaching
  - metal product corrosion
  - paintability and staining
  - mould
Benefits of Micronised Product Technology

- Micronised preservatives do not need or use organic solvents
- Osmose micronised preservatives are manufactured using patent pending micronizing technology to grind copper particles so small that they can penetrate into wood in “solid form”

Dimension Scale Comparisons in Microns

- Micronized Copper “MicroPro” particles – “Sub-Micron”
  - Sheet Paper Thickness - 100
  - Human Red Blood Cell – 1.0
  - Human Hair – 80
Micronized Copper

Copper distribution in tracheids around bordered pits

Copper distribution on cell wall of wood tracheids

1800x Magnification

2300x Magnification

The Micronizing Process

Large Copper Particles

Micronizing Mill

“Sub-Micron” Size Copper Particles
Benefits of Micronised Product Technology

- Reduced leaching

Percent Copper Metal Leaching (AWPA E-11 Test)
Benefits of Micronised Product Technology

- Reduced leaching
- Reduced corrosivity
Benefits of Micronised Product Technology

- Reduced leaching
- Reduced corrosivity
- Lighter colour

www.osmose.co.nz
Benefits of Micronised Product Technology

- Reduced leaching
- Reduced corrosivity
- Lighter colour
- Reduced risk of mould growth
- Environmental benefits

Environmentally Preferred Product (EPP)

- MicroPro was the first wood preservative technology in the world to receive EPP certification from Scientific Certifications
  - Largely eliminates copper releases
  - Reduces air emissions
  - Reduced energy requirements
  - Reduced greenhouse gas emissions
Micronised Formulations:
Use in plant
- 2-part concentrate (copper and co-biocide)
- Mixing requirement
- Processes
- Penetration

MicroPro Copper Penetration
Southern Pine
Indicated Penetration for 6x6 Timber 0.60 pcf Treatment

MicroPro: Use

- Introduced to US in 2006
- 5 billion board feet = 11.8 million cubic metres
- 3 million decks or 150,000 miles of fence
- More than 10 million 4x4 posts in service
- On sale at more than 4000 home centres and lumberyards
- Micronised preservatives account for more than 50% of treated lumber sold in the US
- In commercial use in US, England, Ireland, Turkey, Israel, Taiwan, Korea

www.osmose.co.nz
MicroPro Approvals

- NES/ICC approval
- ERMA approval
- NZS3640 application in place
- APVMA (pending)
- AS1604 approval pending
- TUMA and TMA granted

Overall, the 7 field stake tests show good efficacy of the micronized formulations. In every case, the performance of the micronized system was similar to or better than its soluble counterpart at equivalent retentions. The tests are being conducted in well-known, high hazard sites in Australia, Florida, Hawaii and Mississippi.

MicroPro Independent testing

- Forest Products Journal article
- 6 years testing
- More than 1000 stakes in test
- 17 independent field sites
- “Overall, the 7 field stake tests show good efficacy of the micronized formulations. In every case, the performance of the micronized system was similar to or better than its soluble counterpart at equivalent retentions. The tests are being conducted in well-known, high hazard sites in Australia, Florida, Hawaii and Mississippi.”
Summary of Review
(Freeman and Barnes)

- Micronized copper preservatives perform as well or better than soluble copper based wood preservatives.
- Laboratory and field tests demonstrate that micronized copper treated wood products provide protection against fungal decay, such as brown rot, white rot, and soft rot, as well as termite resistance in both above ground and ground contact applications.
- Micronized systems leach less copper and have improved corrosion resistant properties when also compared to soluble copper based wood preservatives.

www.osmose.co.nz

Australian trials on the efficacy of Micronized copper

Laurie Cookson
Group Leader, Bioproduct Assessment, CSIRO
Preservatives tested

- CCA oxide
- ACQ (alkaline copper quat)
  - Amine solubilised copper
  - 2:1 copper oxide/quat ratio
  - DDAC as the quat in termite trial
  - Carboquat as the quat in fungal bioassay and stake trial
- MCQ (micronized copper quat)
  - Micronized (particulate) copper
  - 2:1 copper oxide/quat ratio
  - Carboquat as the quat
- MCQ advantages
  - Micronized copper less corrosive to metal
  - Reduced solubility and leaching of micronized copper
  - Carbonate quat less corrosive to metal
  - But, is it still effective against termites and fungi??

Trials in Australia by CSIRO

- Fungal bioassay
  - Six basidiomycetes
  - Soil block decay method
  - Trial at Melbourne laboratory
- H3 termite field trial
  - Above-ground near Darwin (dry tropical Australia)
- Stake trial
  - In-ground stakes at Innisfail (wet tropical Australia)
Fungal bioassay

- Soil block method
  - 4 brown rotting fungi
    - *Pinus radiata* sapwood
    - 20 x 20 x 10 mm
  - 2 white rotting fungi
    - *Eucalyptus delegatensis* sapwood
    - 20 x 20 x 10 mm
- Artificial weathering
  - 5 days leaching at 35°C, change water daily
  - 5 days vacuum oven drying at 40°C
- Sterilised by gamma irradiation
- Duration
  - 12 weeks incubation at 25°C, but 20°C for *Serpula lacrymans*

Brown rots percent mean mass losses after 12 weeks incubation

<table>
<thead>
<tr>
<th>Fungi</th>
<th>Retention % m/m oven dried wood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coniphora olivacea</td>
<td>Water 0.27</td>
</tr>
<tr>
<td>Fomitopsis lilacino-gilva</td>
<td>ACQ 0.41</td>
</tr>
<tr>
<td>Gloeophyllum abietinum</td>
<td>MCQ 0.20</td>
</tr>
<tr>
<td>Serpula lacrymans</td>
<td>ACQ 0.43</td>
</tr>
<tr>
<td></td>
<td>MCQ 0.43</td>
</tr>
</tbody>
</table>

Retentions as % m/m oven dried wood

www.osmose.co.nz
White rots percent mean mass losses after 12 weeks incubation

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Perenniporia tephropora</th>
<th>Lopharia crassa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>5.0%</td>
<td>10.0%</td>
</tr>
<tr>
<td>ACQ 0.25</td>
<td>15.0%</td>
<td>20.0%</td>
</tr>
<tr>
<td>MCQ 0.19</td>
<td>20.0%</td>
<td>25.0%</td>
</tr>
<tr>
<td>ACQ 0.48</td>
<td>25.0%</td>
<td>30.0%</td>
</tr>
<tr>
<td>MCQ 0.32</td>
<td>30.0%</td>
<td>35.0%</td>
</tr>
</tbody>
</table>

Retentions as % m/m oven dried wood

H3 termite field trial
- Outdoors, above ground test
- 2 subterranean termite species
  - Coptotermes acinaciformis
  - Mastotermes darwiensis
- Test timbers
  - Pinus radiata sapwood
  - Corymbia maculata sapwood
  - 100 x 25 x 25 mm
- Artificial weathering
  - 5 days leaching at 35°C, change water daily
  - 5 days vacuum oven drying at 40°C
- Duration
  - 12 months for C. acinaciformis
  - 8 months for M. darwiensis

C. acinaciformis – most widespread, economically important species
M. darwiensis – most voracious sp., restricted to northern Australia
H3 Coptotermes termite trial

Insert pipe in infested tree

Termites attracted into steel container with test specimens and timber baits

12 months exposure with *C. acinaciformis*

H3 Coptotermes termite trial
**Coptotermes acinaciformis**

Percent mean mass losses

![Diagram showing mass losses for Coptotermes acinaciformis](image1)

- Water
- ACQ 0.18
- MCQ 0.18
- CCA 0.19
- ACQ 0.35
- MCQ 0.35
- CCA 0.38

Retentions as % m/m oven dried wood

**Pinus radiata (SW) & Corymbia maculata (HW)**

---

**Mastotermes darwiniensis**

Percent mean mass losses

![Diagram showing mass losses for Mastotermes darwiniensis](image2)

- Water
- ACQ 0.18
- MCQ 0.18
- CCA 0.19
- ACQ 0.35
- MCQ 0.35
- CCA 0.38

Retentions as % m/m oven dried wood

**Pinus radiata (SW) & Corymbia maculata (HW)**
Innisfail H4 in-ground stake trial

- Wet tropics of Australia
- Mean annual rainfall of 3600 mm
- Mean maximum annual temperature of 28.1°C
- Test timbers
  - Pinus radiata sapwood
  - Corymbia maculata sapwood
    - Particularly soft rot susceptible timber
  - 500 x 20 x 20 mm
- No artificial weathering before installation
- First inspection after 1.4 years
- Trial is on-going
Failed CCA hardwood or softwood
- Inspect by probing with a knife
- Failure to decay
  - Soft rot
  - White rot
- Failure to termites
  - Amitermes herbertensis
  - Heterotermes paradoxus
- After 1.4 years
- Shows fraction of H4 requirement
  - (half, quarter or eighth)

Innisfail Corymbia maculata (hardwood) 2.3 yrs
mean ratings, 8 = sound, 0 = fully destroyed

Retentions as % m/m oven dried wood
Innisfail *Pinus radiata* after 2.3 years. mean ratings, 8 = sound, 0 = fully destroyed

![Graph showing retention in % m/m oven dried wood for different treatments over 2.3 years.](image)

- **Innisfail**
- Vigorous test site
- Partly affected by Cyclone Larry in 2006?
- Fallen logs encourage Termites/fungi?
Laurie’s Conclusion

“Results to date show that MCQ is as effective as ACQ”

Summary

- Micronised copper preservatives offer many product benefits compared to soluble copper formulations
  - Corrosion, leaching, colour, mould
- Micronised copper-treated wood has been accredited as an environmentally preferred product
- Extensive testing has shown them to be at least as effective as soluble copper wood preservatives