Viance

PRESERVATION INNOVATION

Opportunities and Challenges in the Development of Non-metallic wood Preservatives

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Viance?

- A joint venture between Rockwood and Rohm and Haas
- Incorporation of CSI and ROH's world wide wood protection interests (including Acima)
- Combines CSI's technology and customer orientation in wood protection with ROH technologies across a broad range of biocide and surface protection areas

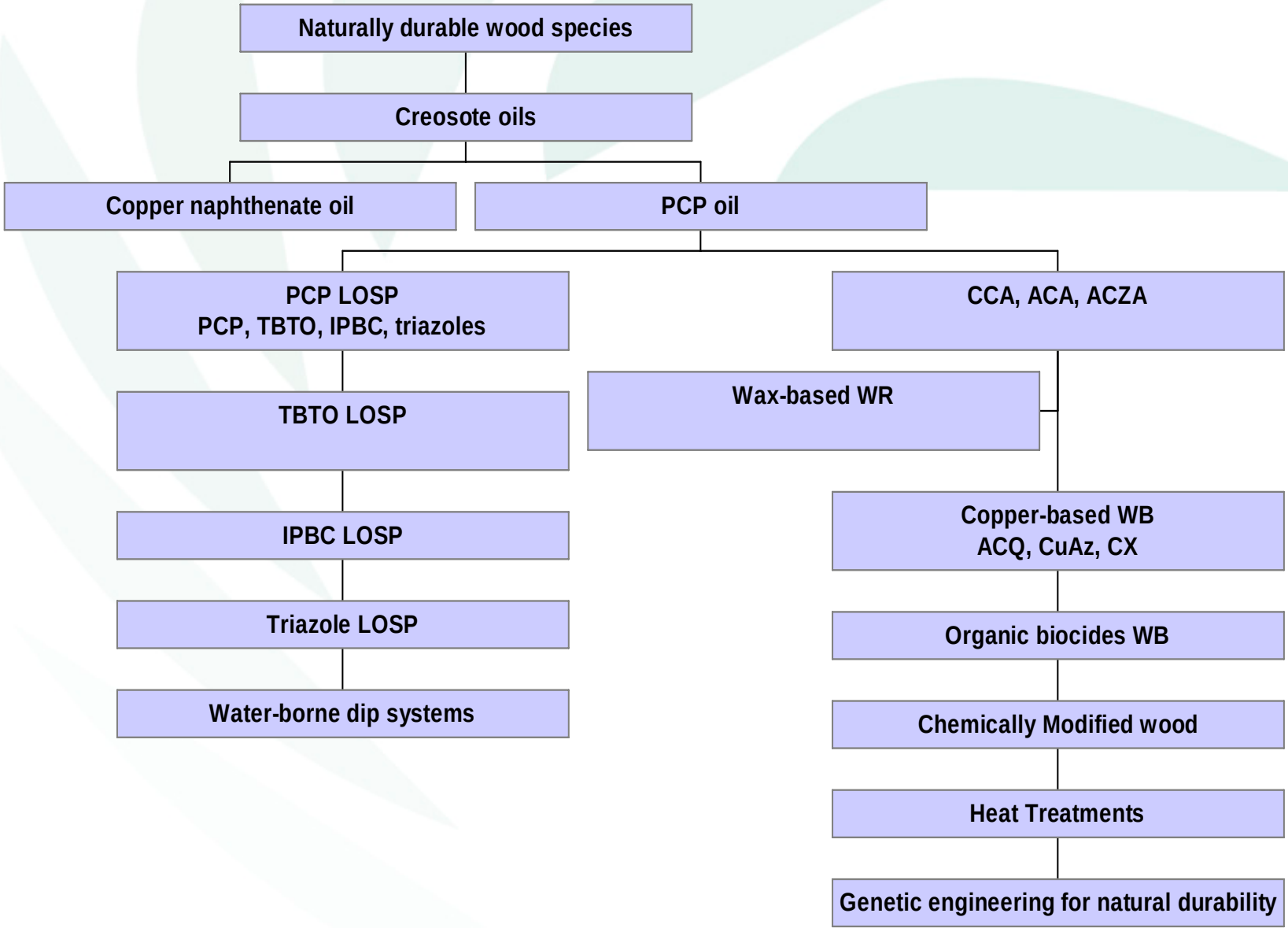
ROHM AND HAAS

CSI CHEMICAL SPECIALTIES, INC.

Viance PRESERVATION INNOVATION

Our world has changed and continues to do so

Preservation Family Tree



The world has changed

- Arsenicals gone for residential uses
- Chromium too
- Copper products predominate

Observations

- Environmental concerns and market perceptions will continue to lead to evolutionary change over time
- Sinking biocide base
- many currently used actives are disappearing because:
  - cost of new studies
  - uncertainty of the review process
  - future profitability estimations
  - products will be simply discontinued
- Improving product margins needed to sustain the industry
- Must evolve to compete with increasing challenges from non-wood products

What is an “Organic” Preservative?

- Synthetic biocide
- Non-metallic material
- Composed of C, N, O
- Other element may be S, P, X
- Usually biodegradable
- Highly varying toxicity
- Triazoles, Quats, Iodo, Isothiazolones,
- Oxathiazine,halo-aromatics, insecticides, etc

Organic?

v.

Carbon Based ?

v.

Non-metallic ?

Desirable attributes of wood preservatives

- Performance against decay and insects (termites)
- Cost effectiveness
- Operational
  - Analysis
  - Treatability
- Appearance of treated products
  - in store
  - in service
- Minimal environmental impact
  - Leaching and depletion
  - Eco-toxicity

How well do non-metallic systems meet the requirements of a good preservative system?

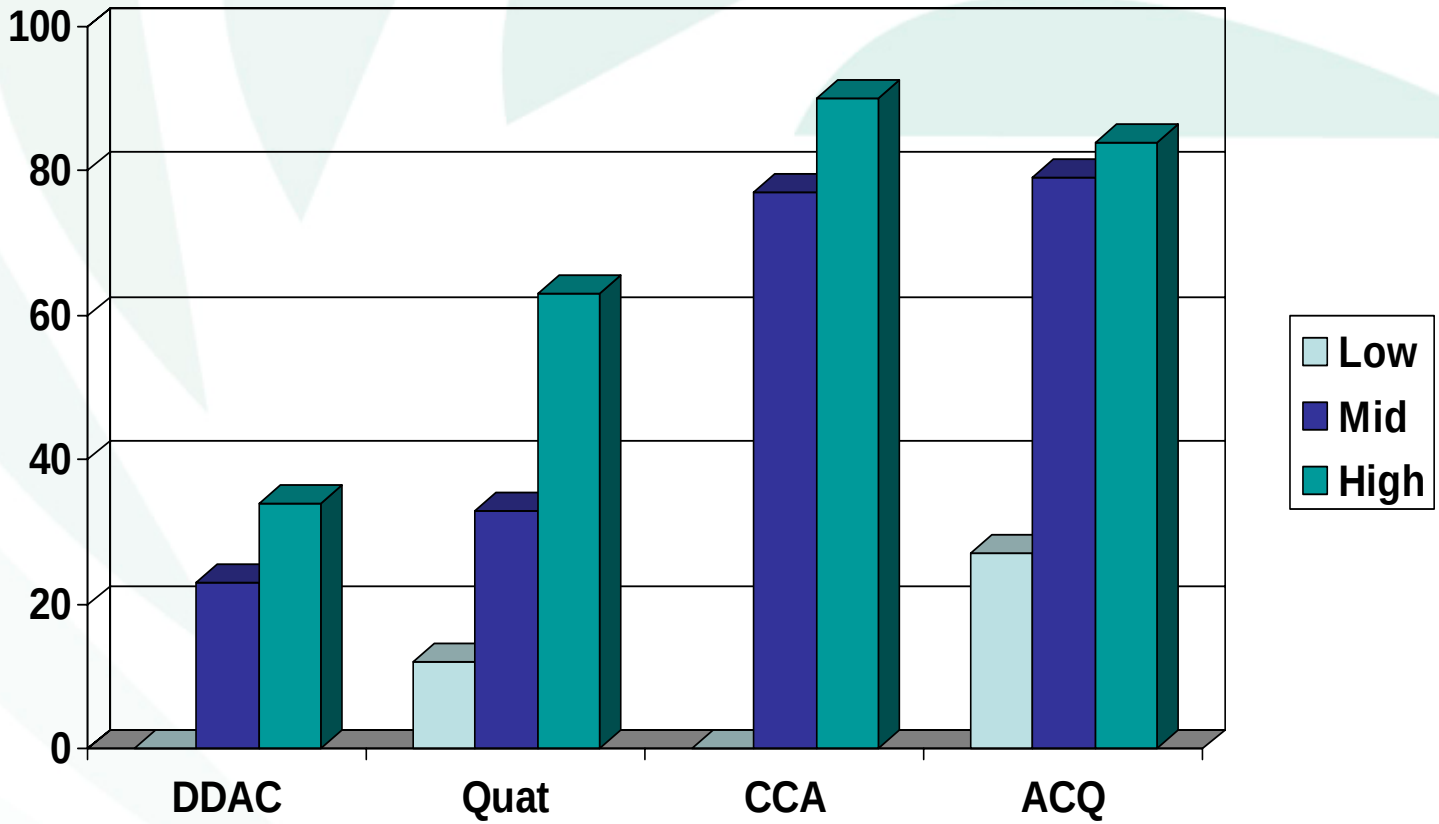
Non-metallic Preservative Systems R & D challenges

- Active ingredients can be significantly more expensive
- Activity spectrum limited
  - More complex cocktails
  - Multiple actives
  - Registration hurdles
- Insolubility in water complicates formulation
  - Emulsions
  - Treatability especially in refractory species
- Operational issues
  - Solution stability
  - Penetration and retention determination complexity
- Resistance to weathering
  - Color
  - Surface UV degradation
  - Mold
- Cost/Performance

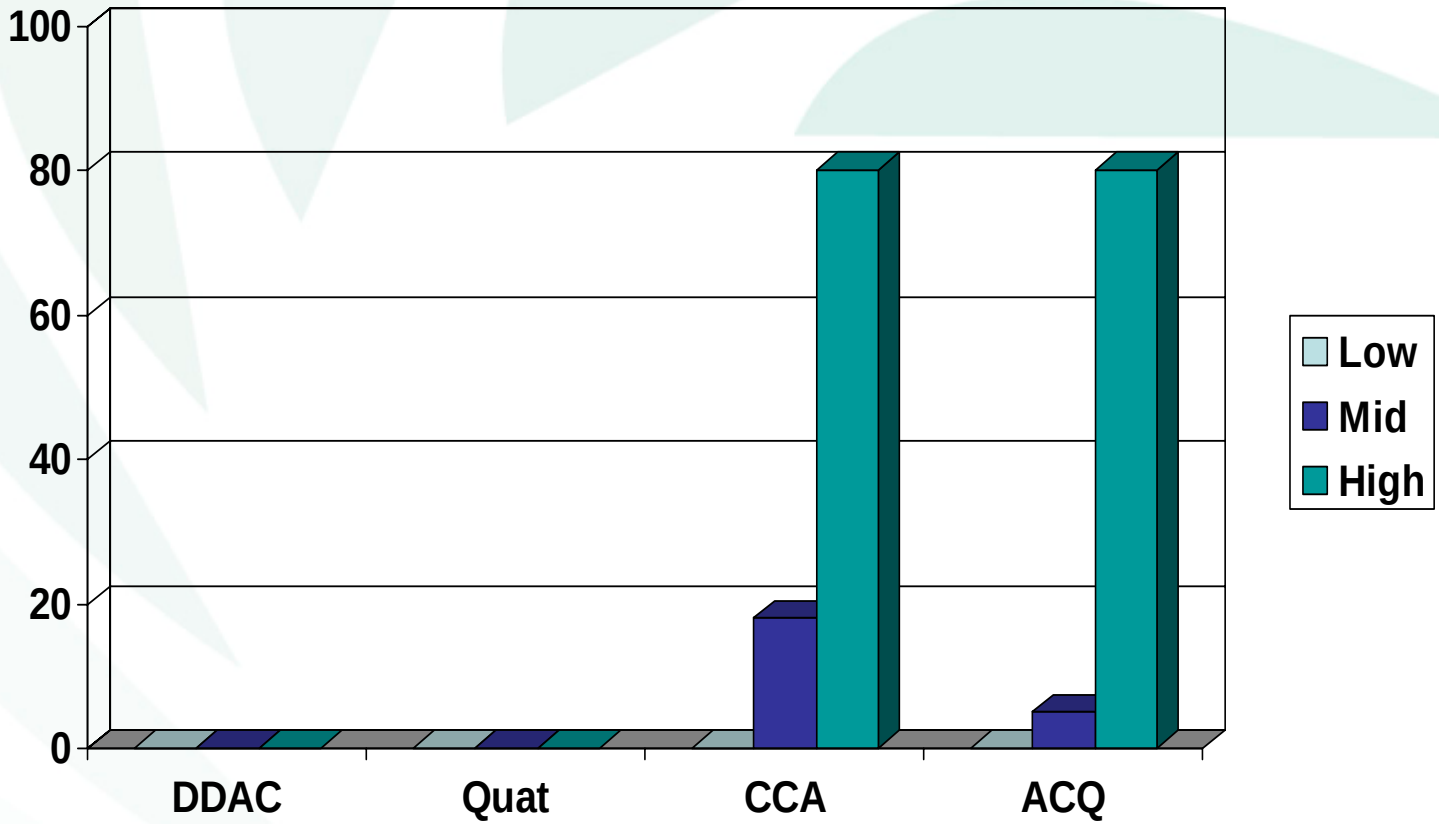
Non-metallic Wood Protection Systems Opportunities

- Performance
- Moisture control in wood in service
- Stabilization of wood from weathering exposure in service
- Depletion of preservatives and control mechanisms
- Specificity towards biodeteriogens and their impacts
- Weathering in service
- Mold control in storage
- Surface stain in service
- Treatments of refractory species
- Retention and penetration determination

Above ground test 15 years Hilo



Above ground proximity test 15 years Hilo



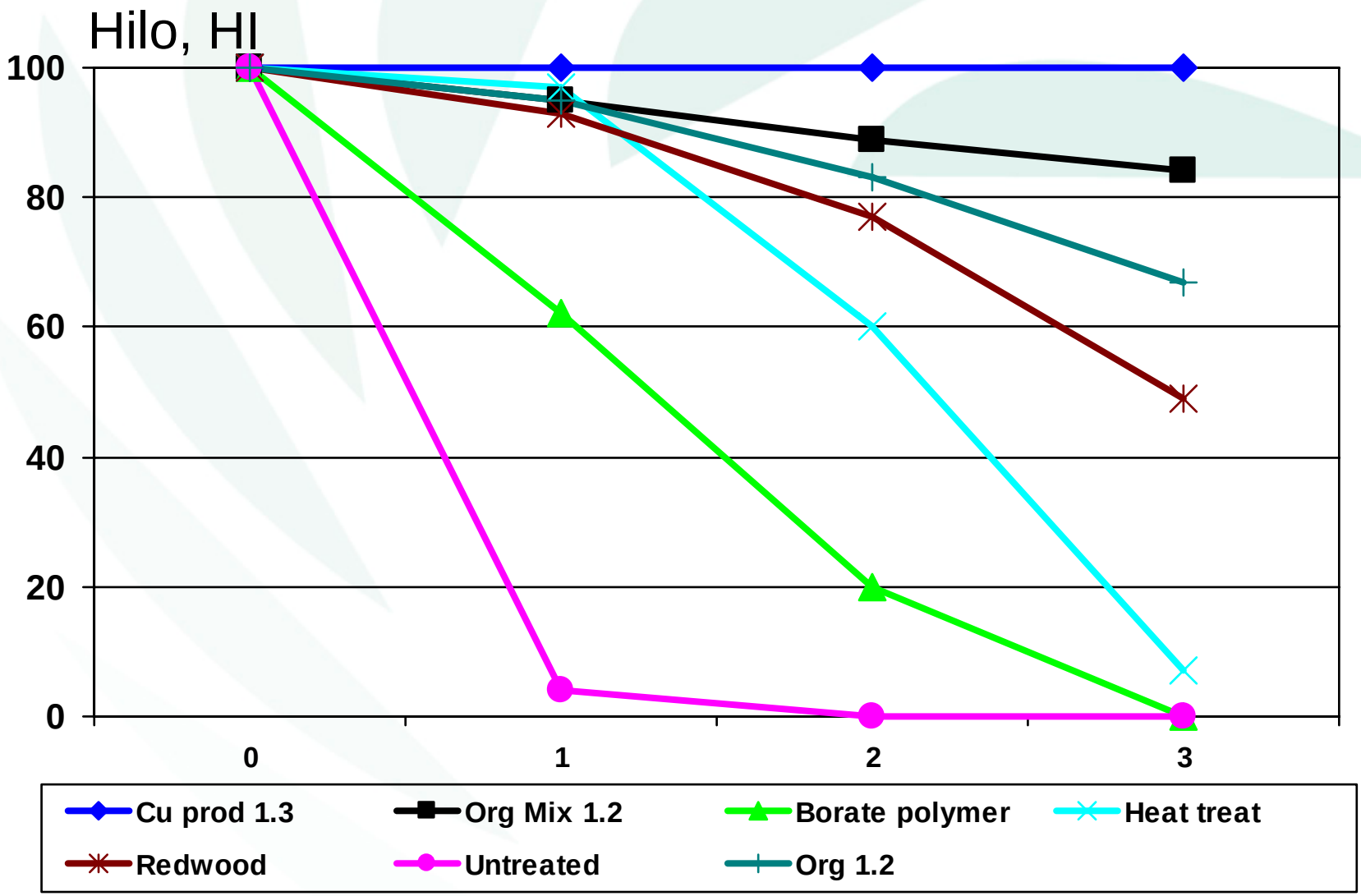
Test methods matter

- In above ground testing, the methodology used can provide quite different results
- Test site differences provide different results with different test methods
- Which one is correct?
  - Depends on how you view the hazard
  - Are you looking for best case or worst case scenarios?
  - Depends on the climate where the product will be used
  - Depends on the application envisaged

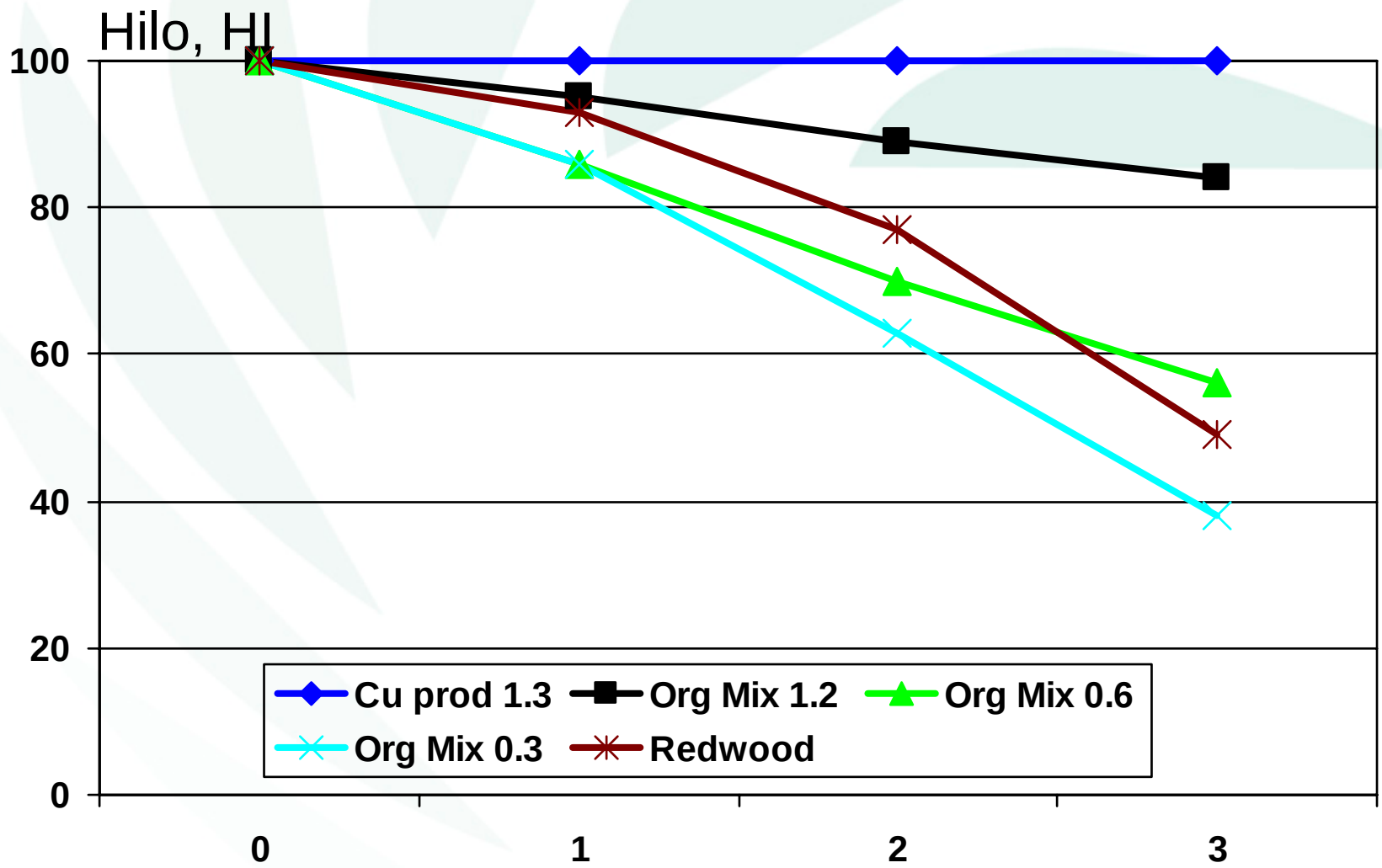
How good do our treatments need to be? Are we making relevant comparisons?

- CCA at 4.0 or 6.4 kg/m^3 was the old standard
- Old-growth heart Coast Redwood (Sequoia spp.) was the precursor to treated lumber in the US
- Is old-growth heart Redwood a realistic control and how does it compare with CCA?
- What does the data show?

Ground proximity test – 3 years



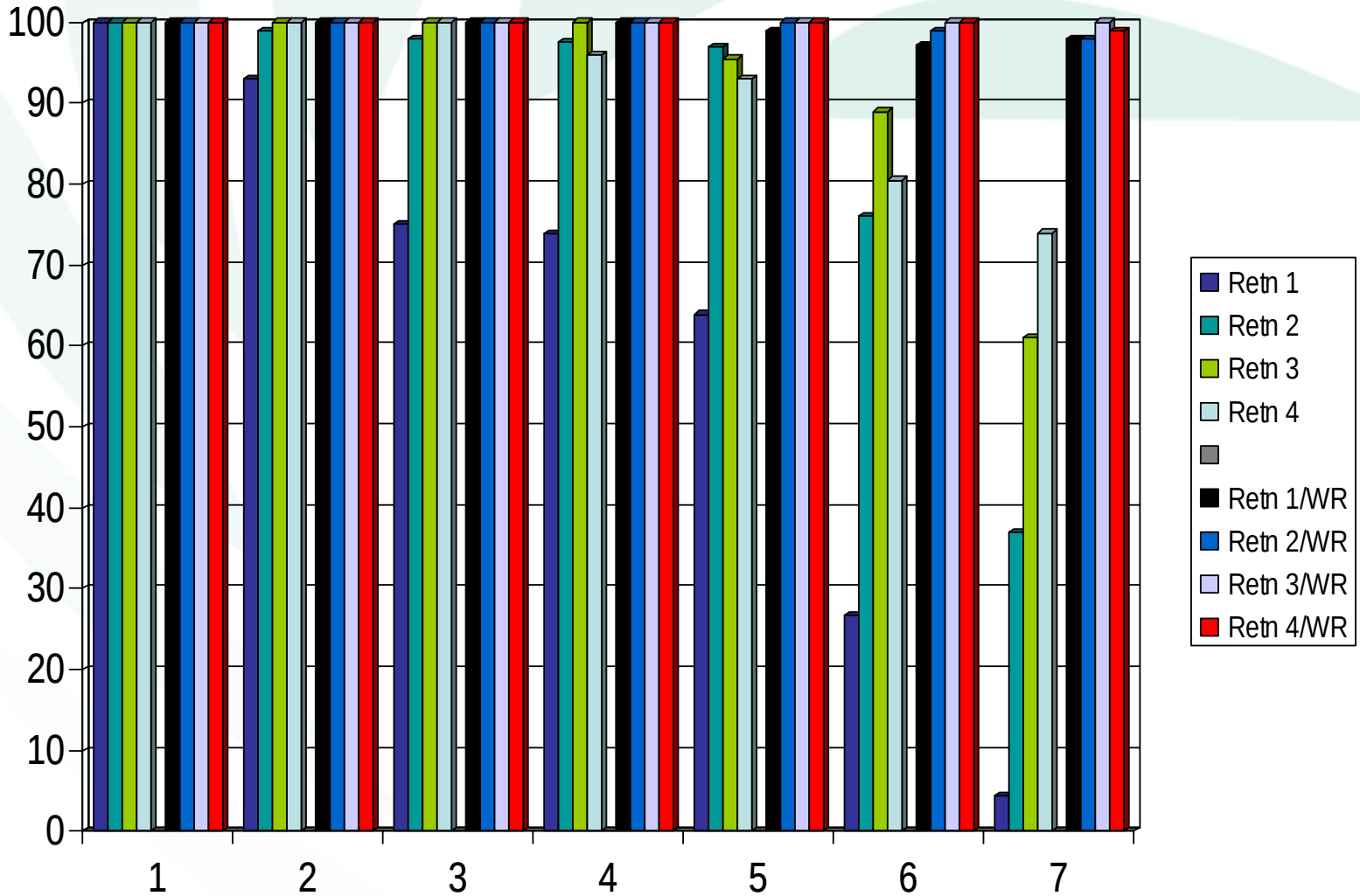
Ground Proximity test – 3 years



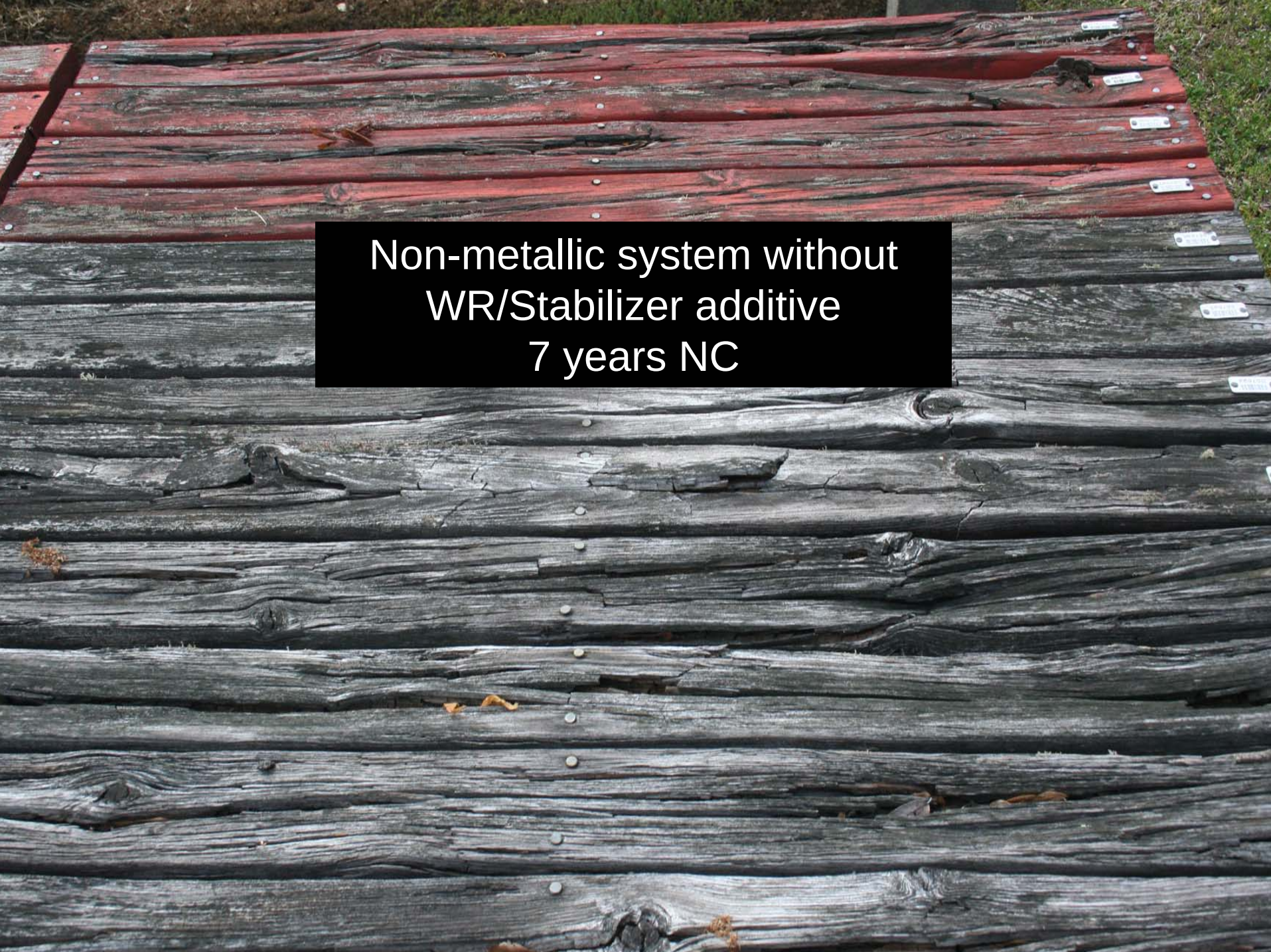
Control of moisture content and wood stability

- Improves long term performance
- Enhances appearance

Effect of MC control on the performance of a non-metallic preservative system performance
Lap-joint test, Hilo, HI – 7 years




Non-metallic system with
WR/Stabilizer additive
7 years NC


Non-metallic system without
WR/Stabilizer additive
7 years NC


CCA + WR
CCA

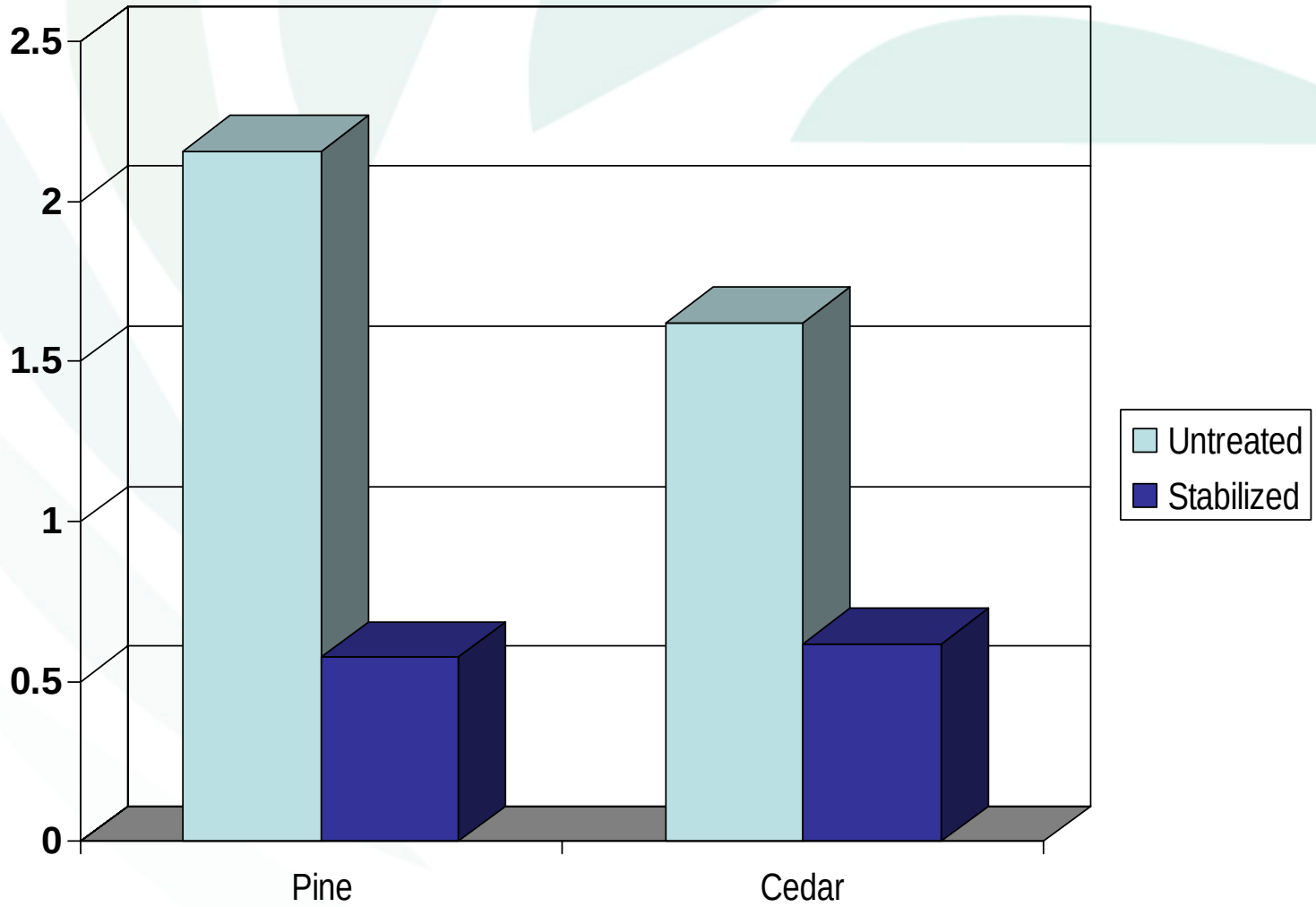
Weathering

- Surface weathering of exposed wood a key negative factor with non-metallic organic preservatives
- Species dependent, but the southern pines are particularly susceptible to deep checking in service
- Unlike metals such as copper and chromium, organic biocides provide little protection
- Some, e.g. quats can accelerate weathering due to interactions with phenolics in lignin


11 years exposure , NC


ONO SOKKI
EG-225

Cupping of Boards – 2 years exposure



Relative checking in stabilized and unstabilized non-metallic preservative treated wood

Parameter	Non stabilized	Stabilized
Total check area	146.93	15.5492
Check fraction	0.0475	0.005
Check length	206.469	37.04
# checks	13	3
Mean area	11.306	5.18
Mean Length	15.88	12.34
Mean Width	0.64	0.408

Mold control in storage

- CCA treatments are quite susceptible to surface mold in storage but molds are usually black or green
- Issue rose to significance with the widespread introduction of copper-based preservatives in 2003
- White molds more obvious on the greener wood substrate
- Overcome with isothiazolones and preservative chemistry modifications
- Now an established flashpoint for retailers in the U.S.
- Newer formulations must meet the mold prevention storage requires that now exist

Mold control versus no protection

Mold control in service


TGP14
TGP15
TGP13
TGP12
TGP11

Biodegradation of non-metallic actives

- Bacterial and fungal degradation
- May be a factor in performance
- Degradation of quats by stain/mold fungi- Ruddick
- Cocktail approach an efficient strategy to counter biodegradation
- Significance/importance not well understood
- Depletion seems to be a more pronounced effect

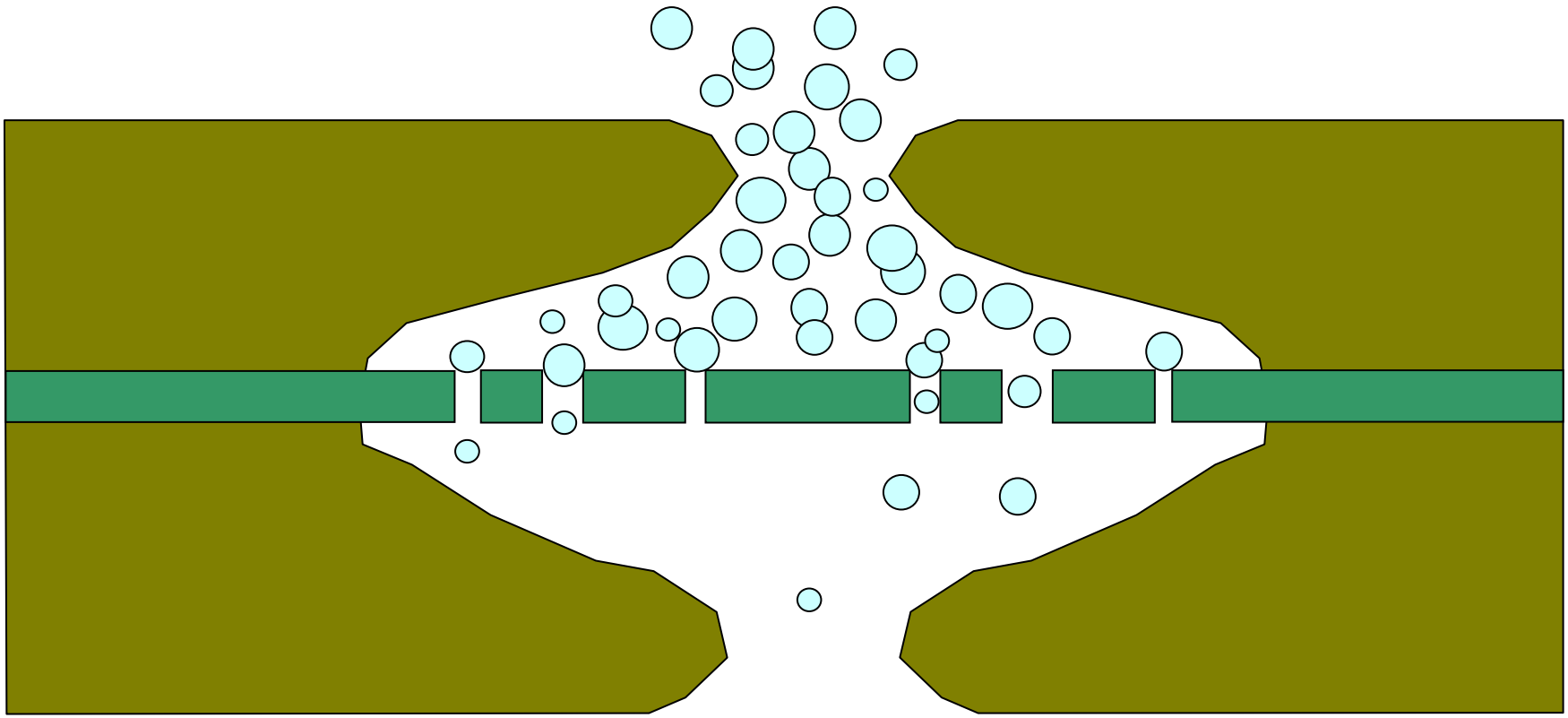
Depletion

- Longevity of effectiveness dependent on longevity in the wood
- Non-metallic biocides are generally non-polar
- Fixation by deposition or entrapment as opposed to chemical bonding with lignocellulosic components
- Low solubility in water helps resistance to depletion

Treatability of Refractory Species

- Northern pines, Hem-fir, spruces, etc. present special difficulties in treatment with non-solution formulations
- Particulate emulsions and particulate formulations create penetration issues at ambient temperatures
- Some particulate emulsions provide fluid flow allowing ready treatment when treating solutions are used at elevated temperatures
- Technology has been used commercially in the US with an organic preservative system for Northern pines since 2003

Hypothetical emulsion particle movement through pits



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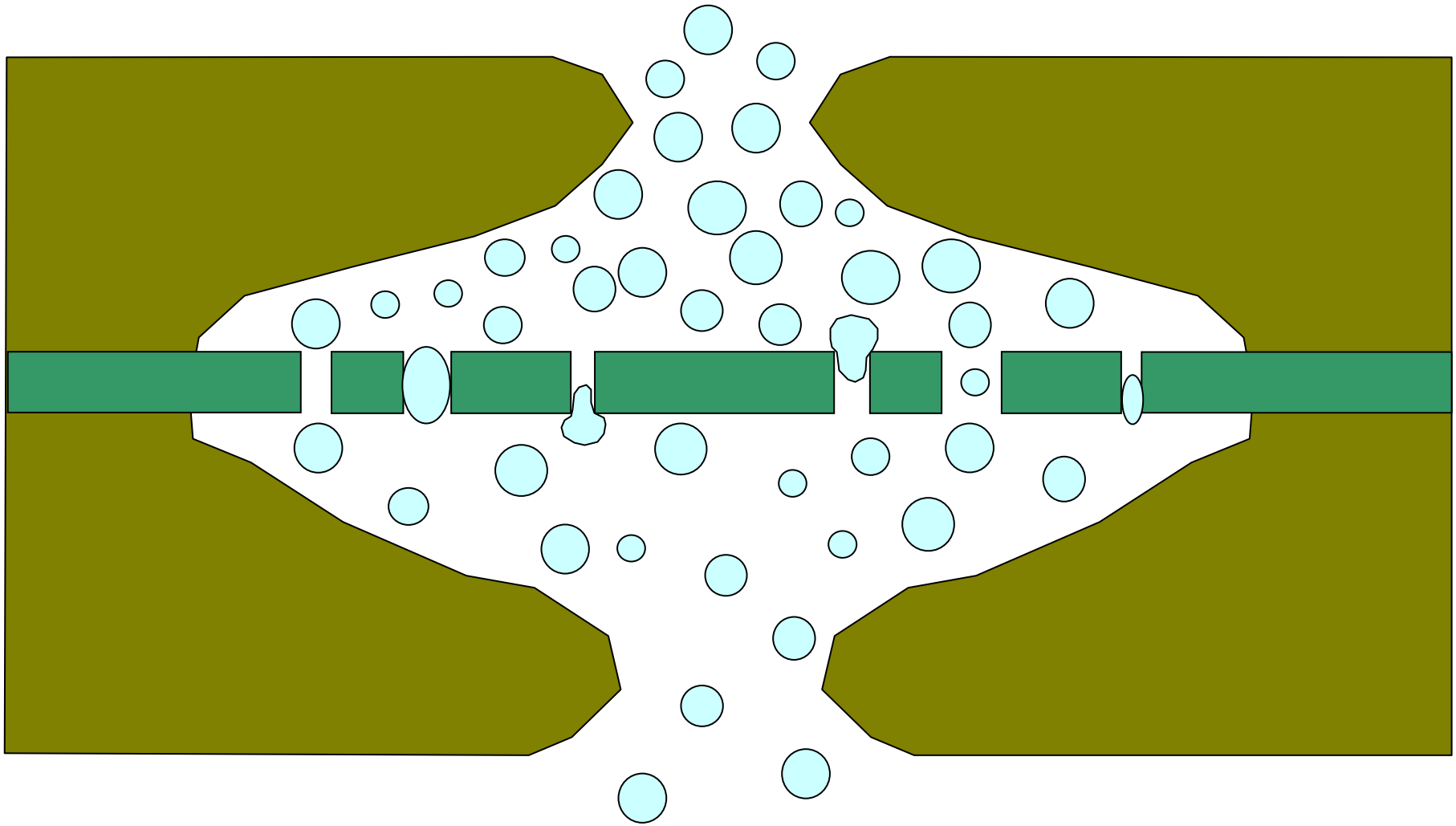
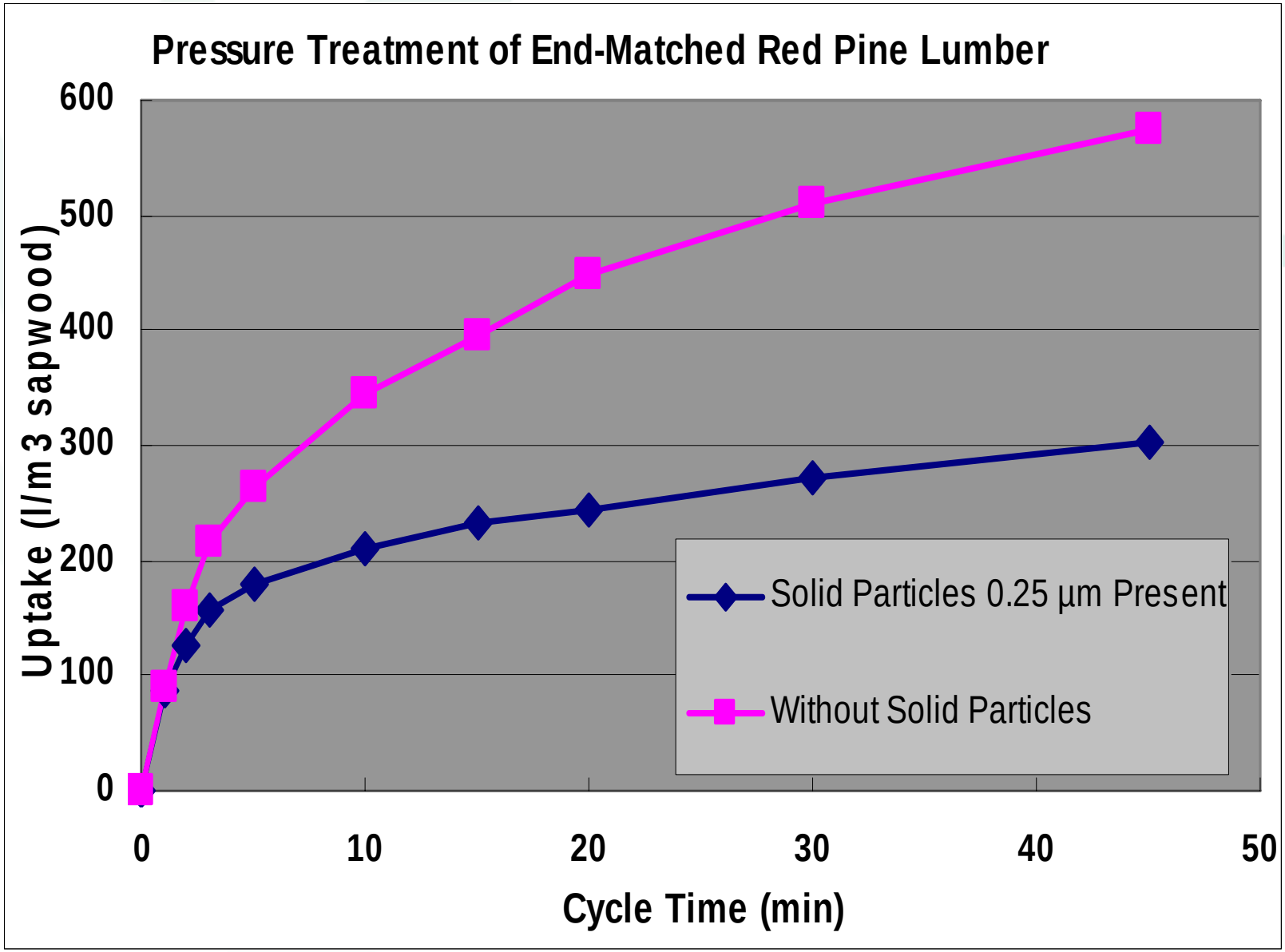


Emulsion Particle Penetration

- Particle size is important but it is not the only parameter of interest
- “Nano-technology” is not necessarily a magic bullet
- Flow in micro-porous materials
- Shear stability is very important

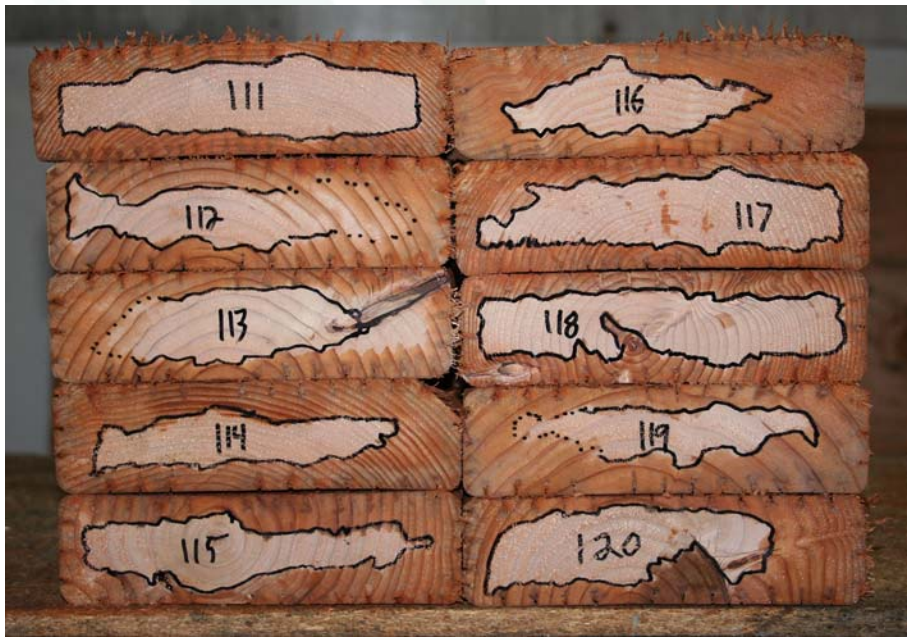

Pressure Treatment of End-Matched Red Pine Lumber
Uptake (l/m3 sapwood)
600
500
400
300
200
100
0
0
10
20
30
40
50
Cycle Time (min)
Solid Particles 0.25 µm Present
Without Solid Particles

Penetration and Retention Assessment

- Conventional in-plant and third party quality assurance procedures rely on being able to determine penetration and retention of actives in wood
- Non-metallics typically do not color wood
- Few if any reagents react with non-metallics to produce a colored complex
- Measurement of penetration is difficult
- Use of pigments
- Use of surrogates
- More complex, time consuming analytical procedures required
- Typically more expensive equipment such as HPLC needed

Preservative Penetration in Matched Samples

Non-metallic emulsion system



Copper based solution system

Use of a pigment colorant additive to delineate penetration

Conclusions

- Development of non-metallic preservative systems can be challenging
- A multi-disciplinary approach is essential
- We have a good set of tools in our tool chest but we need to be careful how we use them
- Performance expectations need to be realistic
- Focus on maintaining the long term appearance of treated wood
- Be wary of the “enemy”
- Wood is good.

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treatedwood.com