In-Place Preservative Treatments for Covered Bridges

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Presentation Overview

- Deterioration problem areas
- Characteristics of in-place treatments
- Recent research on in-place treatments for covered bridges
Problem Areas:
Its all about moisture

- Decay fungi need wood moisture content above about 25%
  - Would prefer closer to 40%
  - Can go dormant during dry periods
- Termites prefer moist wood
  - Can potentially build tubes to drier wood
- Some beetles can attack dry wood
Problem Area Example

• Contact with abutments
Problem Area Examples

- Ends of bridges
- Window openings
Problem Area Example

-Leaks, vandalism
Problem Area “Fixes”

- Most effective approach is to minimize moisture exposure!
- Replace problem components with pressure-treated or naturally durable wood
- Use in-place preservative treatment to protect vulnerable areas
In-place Treatment Concepts

- Do not restore... can only prevent damage
- Need to get preservative to the problem area
  - External or internal?
  - May need to drill holes
- Other considerations
  - Ease of use
  - Color
  - Permanence
General Types of Treatments

- Diffusibles (various forms)
- Non-diffusibles (usually liquids or pastes)
- Fumigants
Diffusible Treatments

- Borates most common, but also fluoride
- Water soluble, diffuse through moisture in wood
- Do not move far as fumigants
- Can leach-out if exposed to enough water
- Low toxicity, colorless
- Available as liquids, rods, gels and in pastes (sometimes with non-diffusibles)
Liquid Borates

• Available as glycol-based liquids or powders to mix with water.
• Can be diluted with water and sprayed on surfaces
  o Substantial penetration in moist wood, but less useful in larger timbers
  o Useful for flooding end-grain at connections
  o Readily leached from surfaces by rain
• Can be poured into drilled holes for internal treatments (but only into downward holes)
• Can be applied as foams for hard to access areas
Diffusibles as Rods

- Boron, Boron + copper, or fluoride
- Easy to handle and install
- Require a minimum hole size, but come in a range of sizes
- Can be placed into holes drilled from below
- Slower to disperse than liquids, but last longer
  - Holes can be oversized and liquid borate added with the rod
Examples of Diffusible Rods

- Fluoride
- Boron-Copper
- Boron
Gels and Pastes

- **Borate gel**
  - Applied like caulk to joints or drilled holes
  - Combine advantages of solids and liquids
  - Cost?

- **Paste (combine copper with boron or fluoride)**
  - Can be applied to joints or into holes with caulking gun
  - Noticable color (if contain copper)
  - Offer diffusion with boron and longer-term protection from copper
Non-diffusibles

• Copper-based liquids
  o Copper naphthenenate
  o Copper-8-quinolinolinate
  o Zinc naphthenenate
• Limited movement across the grain
• Typically surface treatment but can be poured into holes
• Noticable color change
• Leach resistant
Fumigants

- Applied to treatment holes
- Release gas that moves through wood
- Solids or liquids
- Can spread several feet along the grain
- Do not need moisture to move
- More care in handling, applying
Examples of Solid Fumigants

Granular Dazomet

MITC Tube
Research Overview

• Covered bridges have unique challenges
• Evaluated internal treatments on species used for covered bridges under controlled conditions
• Conducted field trials of a subset of treatments
Laboratory Trial

• Dosages of 100, 250 or 500 mg
• Moistures Contents of 30%, 60% or 100%
• Colonized by two types of decay fungi

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Active Ingredient(s)</th>
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<tbody>
<tr>
<td><strong>Diffusibles</strong></td>
<td></td>
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<tr>
<td>Borate/Glycol liquid</td>
<td>Boron</td>
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<tr>
<td>Borate powder in water</td>
<td>boron</td>
</tr>
<tr>
<td>Borate/CuNaph paste</td>
<td>Boron/Copper</td>
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<tr>
<td>Boron rod</td>
<td>Boron</td>
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<tr>
<td>Sodium Fluoride rod</td>
<td>Fluoride</td>
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<tr>
<td>Boron/copper rod</td>
<td>Boron/Copper</td>
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<tr>
<td><strong>Fumigants</strong></td>
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<tr>
<td>MITC solid</td>
<td>MITC</td>
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<tr>
<td>Dazomet granules</td>
<td>MITC</td>
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<tr>
<td>Chloropicrin liquid</td>
<td>Trichloronitromethane</td>
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</tbody>
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Laboratory Trial

• Species: Douglas-fir, southern pine, eastern white pine, eastern hemlock, red oak, white oak

• Process:
  1. Condition to moisture content
  2. Inoculate with fungus/incubate until colonized
  3. Add treatment to hole drilled in block
  4. Cut thin sections and evaluate for chemical & fungus
Laboratory Results: Diffusibles

• Concentrations increased over time, but:
  – Limited movement at 30% moisture content
• Higher concentrations made a difference
  – Glycol borate yielded most boron
  – Fluoride concentrations lower
• Boron levels usually highest in pine species
  – Often above fungal threshold
  – Little movement in white oak
• Copper movement limited
Laboratory Results: Fumigants

• Concentrations highest at one week for MITC-tube and chloropicrin
• Concentrations much lower for dazomet but also persisted longer
• Higher concentrations in less permeable wood species... apparently moved out of southern pine quickly
Field Methods

• Placed treatments into timbers of 5 bridges
• Wood species: Eastern spruce, Douglas-fir, sugar pine, ponderosa pine, red pine
• Evaluated solid internal treatments:
  – Fluoride rod (diffusible)
  – Boron rod (diffusible)
  – MITC tube (fumigant)
  – Dazomet granules (fumigant)
• Wood samples removed after 1 and 2 years
Cedarburg Bridge, Wisconsin

Honey Run Bridge, California

Cooley Bridge, Vermont

Oregon Creek Bridge, California

Red Bridge, Illinois
Field Treatment Results

- Solid MITC tubes consistently yielded chemical in bridge timbers
  - Detected up to 3 feet from treatment site
  - Wood species had no obvious effect
  - Highest levels after 2 years
More Field Results

• No fumigant movement detected from dazomet granules... moisture?
• Low moisture content limited diffusion of boron and fluoride
• Moisture content limits use of solid diffusibles to known wet areas
• Diffusibles may be less mobile in refractory species such as white oak, even with sufficient moisture
• Fumigants move readily from MITC tubes and chloropicrin... dazomet decomposition slow and probably affected by moisture levels
Summary

• First try to solve moisture problems
• Diffusibles easy to use but require careful placement in moist pockets
• Non-diffusibles only protect surfaces but last longer than diffusibles
• Fumigants can treat large members but have more handling concerns.
Thank you!

Questions?

(More details in conference paper)

or

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