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

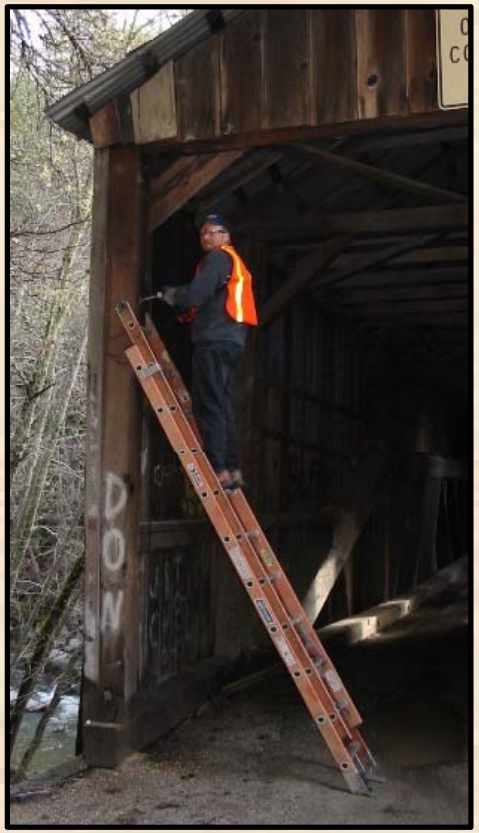
- Leaks, vandalism

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**

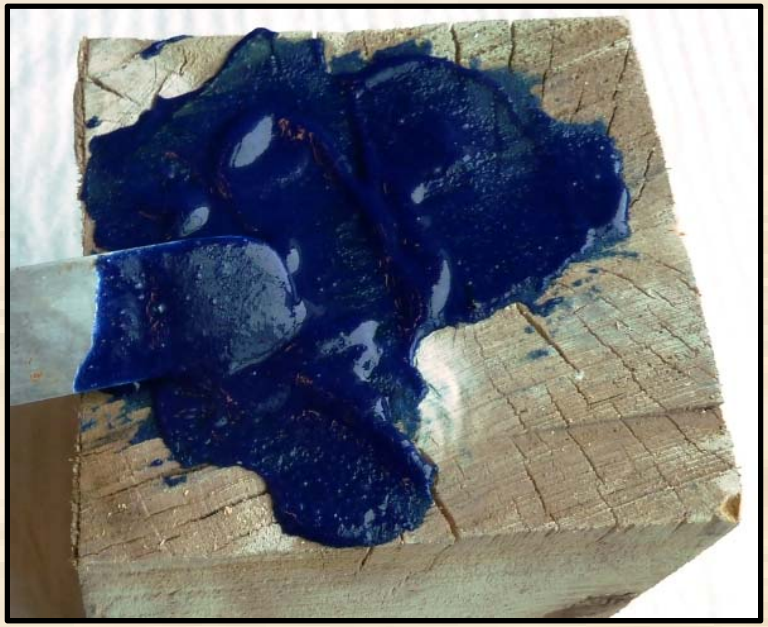
In-place Treatment Concepts

- 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

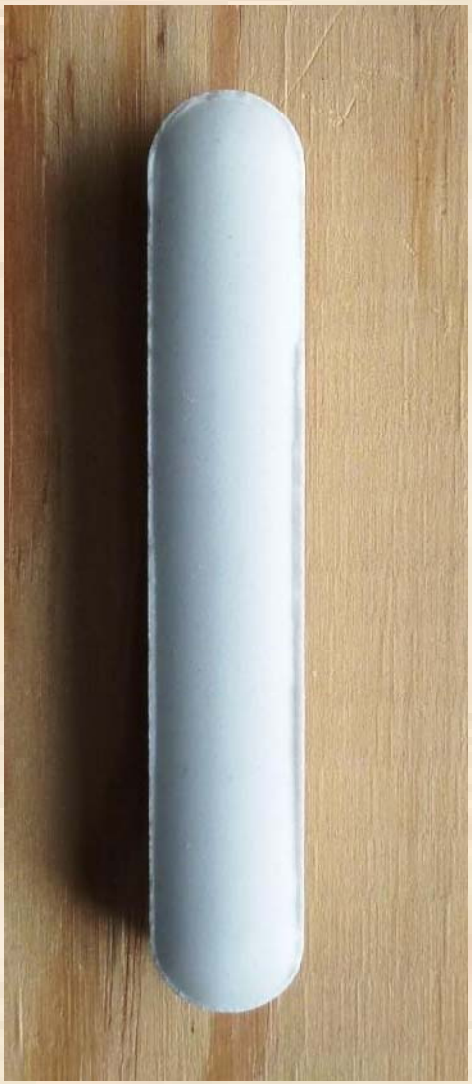
- Available as glycol-based liquids or powders to mix with water.
- Can be diluted with water and sprayed on surfaces
  - Substantial penetration in moist wood, but less useful in larger timbers
  - Useful for flooding end-grain at connections
  - Readily leached from surfaces by rain
- Can be poured 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

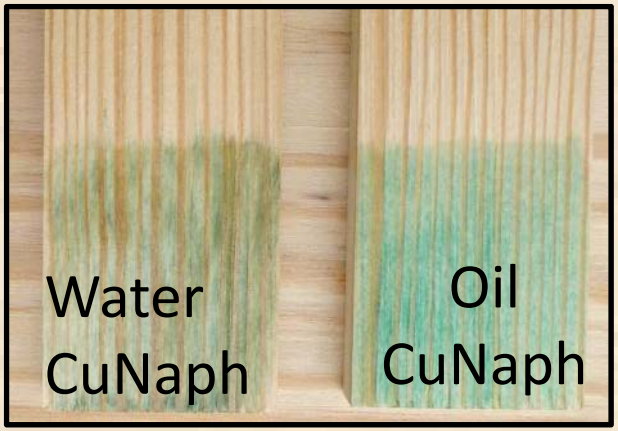
Boron

Gels and Pastes

- Borate gel
  - Applied like caulk to joints or drilled holes
  - Combine advantages of solids and liquids
  - Cost?
- Pastes (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
  - Copper naphthenate
  - Copper-8-quinolinolate
  - ~~Zinc naphthenate~~
- 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

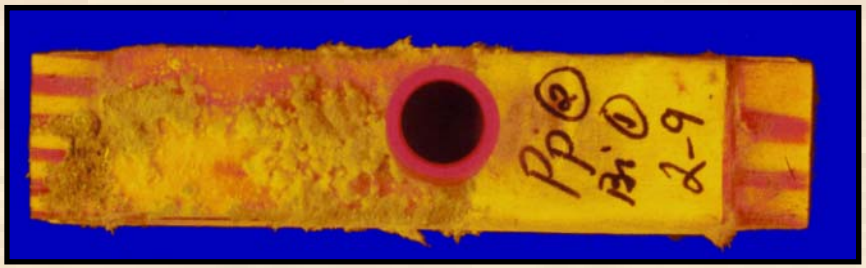
Laboratory Trial

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

Treatments	Active Ingredient(s)
Diffusibles	
Borate/Glycol liquid	Boron
Borate powder in water	boron
Borate/CuNaph paste	Boron/Copper
Boron rod	Boron
Sodium Fluoride rod	Fluoride
Boron/copper rod	Boron/Copper
Fumigants	
MITC solid	MITC
Dazomet granules	MITC
Chloropicrin liquid	Trichloronitromethane

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

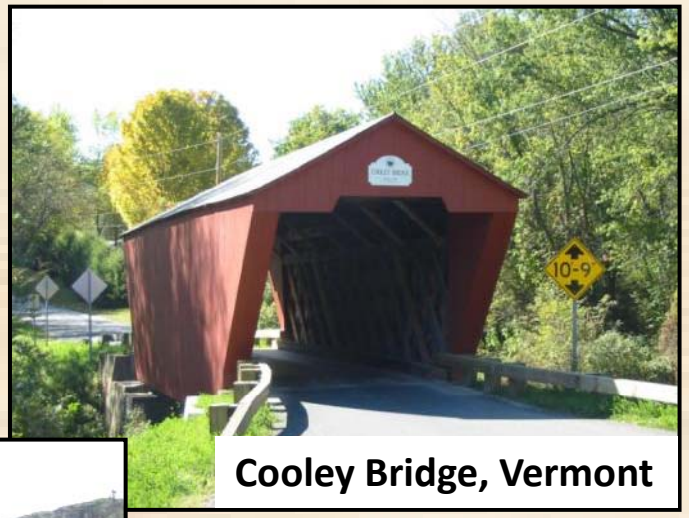
Laboratory Results: Fumigants

- 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

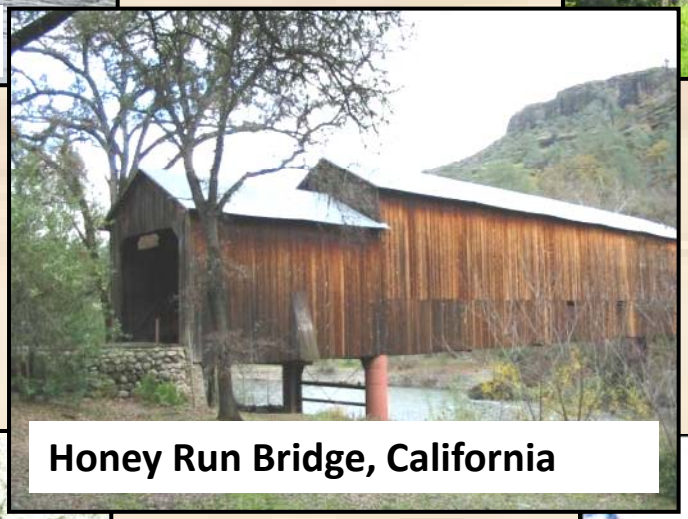
Field Methods

- 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

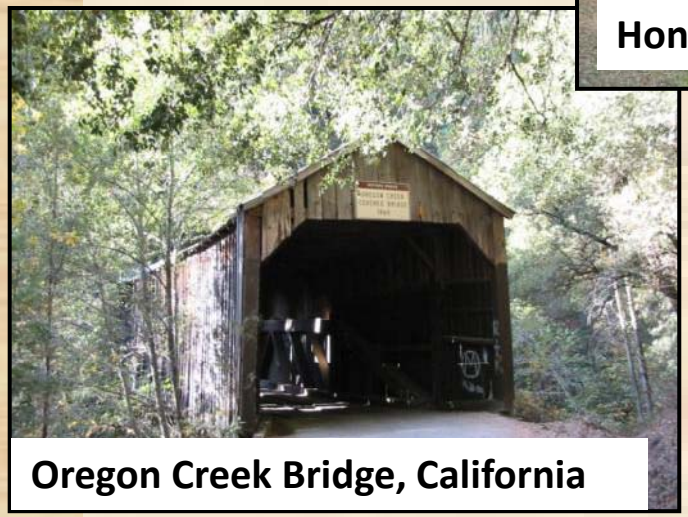
Cedarburg Bridge, Wisconsin



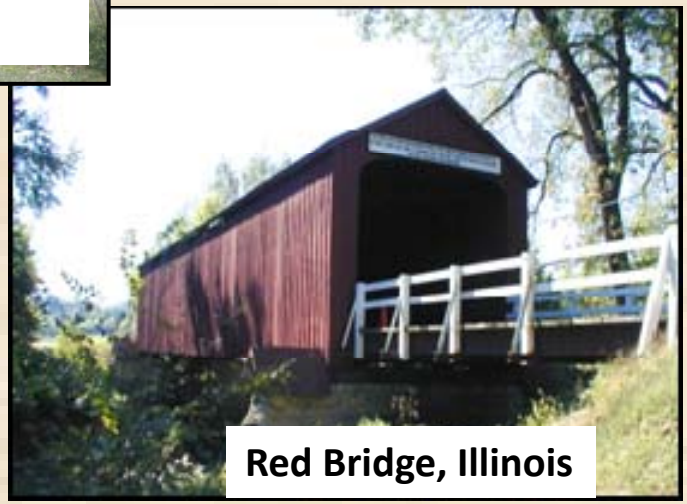
Cooley Bridge, Vermont



Honey Run Bridge, California



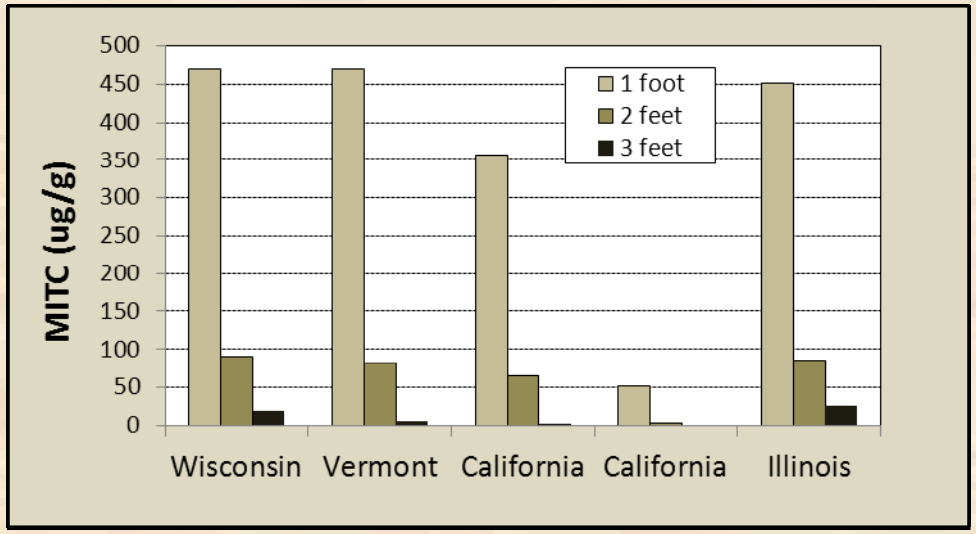
Oregon Creek Bridge, California



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

Research Conclusions

- 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)

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