Wood Preservation Options for Transportation Applications

William B. Smith, Ph.D.
Professor, SUNY ESF
Syracuse, NY

Let’s take a quiz.

1. The Syracuse University 2003 ball team are national champions.

- True
- False

2. The use of **Dihydrogen Monoxide**, a chemical responsible for thousands of deaths every year, should be more vigorously regulated and restricted by the EPA and DEC.

- True
- False

3. Pressure-treated preserved wood products have been responsible for serious illness and health problems.

- True
- False

o.k., the answers

1. The Syracuse University 2003 ball team are national champions.

- football?

1. The Syracuse University 2003 ball team are national champions.

- True, (basketball)

1. The Syracuse University 2003 ball team are national champions.

- True, (basketball)
- False, (football)

2. The use of **Dihydrogen Monoxide**, a chemical responsible for thousands of deaths every year, should be more vigorously regulated and restricted by the EPA and DEC.

- True
- False

The use of **Dihydrogen Monoxide**, a chemical responsible for thousands of deaths every year, should be more vigorously regulated and restricted by the EPA and DEC.

- Dihydrogen Monoxide, H_2O
- see http://www.dhmo.org

- Dihydrogen Monoxide, H_2O
- see http://www.dhmo.org

- Now we get it, …….. obviously.
- Do we drink gasoline, or breath the fumes?

Pressure-treated preserved wood products have been responsible for serious illness and health problems.

- True
- False

Pressure-treated preserved wood products have been responsible for serious illness and health problems.

- False
  - when used in accordance with common sense and good hygiene, following reasonable use instructions.
    - Do not burn.
    - Do not eat.
    - Do not breath sawdust.

What are wood preservatives, and why do we use them?

What are wood preservatives, and why do we use them?

- Wood is GOOD!
  - It is strong and stiff, particularly for its weight.
  - It is easy to manufacture, work, fabricate, and build with.
  - It is attractive.
  - It has good thermal characteristics.
  - It is economical.
- These are all very important characteristics and qualities for Transportation Applications!

  - However, ……..

- Wood, being a natural material, is susceptible to deterioration and degradation by fungi and insects if …….
  - it is wet (above 25% moisture content)
  - it is warm (above 50^{o}F)
  - if there is air.
  - if it is a food source (not naturally durable or preservative treated)

Wood Preservation

- Wood used outdoors must be Treated with Preservatives, or be naturally durable (and then, heartwood only)
- Uses can be:
  - Industrial / Structural
  - Residential / Decking
- Creosote and oil-borne preservatives have been successfully used for protection of poles, piling, ties, timbers, etc. for over 100 years!

- Waterborne wood preservatives have been in use for about 50 years.
- It was not until the mid 1970's, however, that use of CCA-treated wood expanded beyond industrial and agricultural applications.
- For the past 30 years retail lumberyards, homeowners, and DIY's have recognized "pressure-treated wood" as the product to use outdoors. Now, for "residential" uses, ACQ and Copper Azole (CA) have replaced CCA.

Typical Treated Lumber Attributes

- No decay or insect attack
- Durable, long lasting
- Attractive
- Strong
- Economical
- Known product, easily worked with hand tools

Typical Treated Lumber Problems

- Shrinkage
- Warping
- Cracks, splintering
- Weathering degradation
- Chemistry questions?
- Disposal?

In Transportation Applications, it is important to distinguish between "Biological" and "Physical" performance concerns!

Wood Preservative Treatments

Waterborne and Oil-borne

"Oil-borne" Preservatives

- **Creosote**
  - distillate of coal tar
- **Pentachlorophenol (PCP) (in oil)**
- **Copper Naphthenate (in oil)**

- these are typically "industrial-use" preservatives, for poles, piling, timbers, R.R. ties, etc.

"Waterborne" Preservatives

- Chromated Copper Arsenate (CCA)
  Type C (47% CrO_3 , 19% CuO, 34% As_2O_5) most common
- Alkaline Copper Quat (ACQ)
- Copper Azole (CA)
- Ammoniacal Copper Zinc Arsenate (ACZA) (primarily for western species)
- Borates
  - borates have low toxicity, however th
    remain water soluble and susceptible t
    leaching.

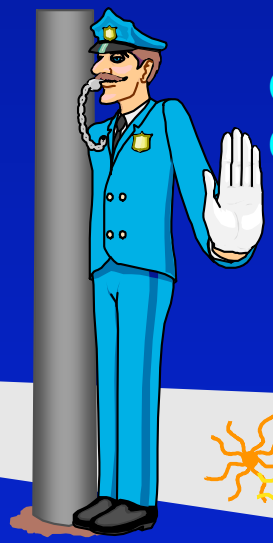
Waterborne (historically, CCA and ACZA) treatment of wood

- After treatment wood is typically quite wet.
- This wood will subsequently shrink.
- Shrinkage in use can result in cracks and splits.
- Though strength and durability are not effected, attractiveness and usability may suffer.
- Moisture moves more readily, drying and absorption.
- However, surfaces are “drier” and “cleaner”.

Creosote and Oilborne treatment of wood

- Moisture moves less readily, slower drying and absorption.
- Moisture is generally repelled.
- This typically results in improved weathering characteristics and better physical performance.
- However, surfaces may not be perceived as as “dry” and “clean”.
- Treatment processes and handling procedures can improve surface properties.

Ideal Wood Preservative Behavior



Good Fungi, Insect and borer Control

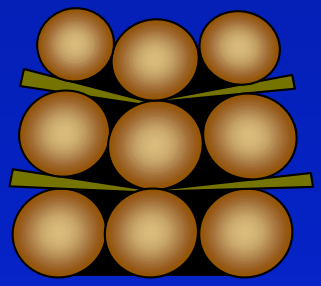
Deep Penetration

Effective for Long Periods of Time

NIAGARA MOHAWK

Pole Conditioning - Removal of Moisture from Wood

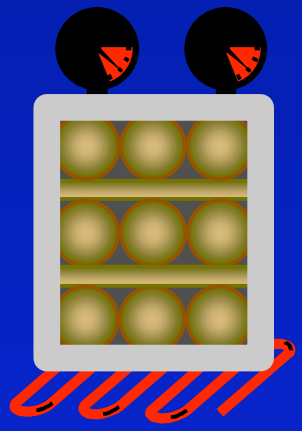
Air Seasoning



Air Seasoning

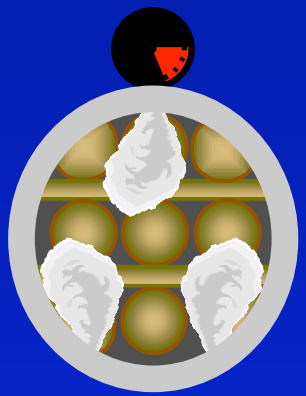
- Southern pine
- Douglas--fir

Controlled Drying



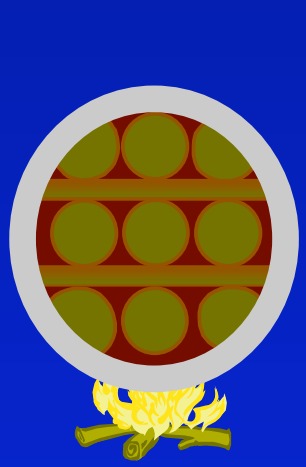
Kiln Drying

- Southern pine
- Douglas-fir



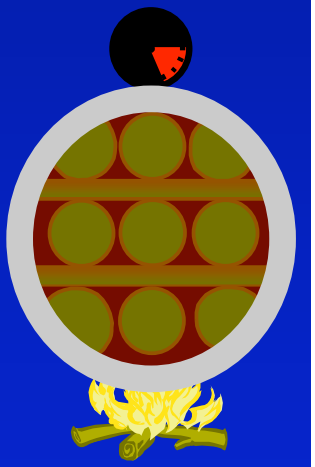
Steaming followed by Vacuum then Drainage

- Southern pine



Heating in Presence of Oil-Borne Preservative at Ambient Pressure

- Southern pine
- Douglas-fir



Boulton Drying in Heated Oil under Vacuum

- Douglas-fir coastal

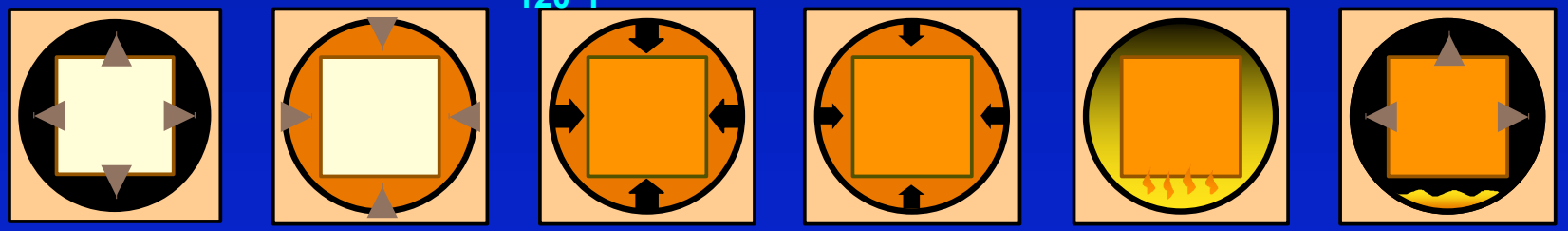
NIAGARA MOHAWK

Pressurized Pole Treatment With Water-Borne Preservative

FULL CELL OR BETHELL PROCESS

Maximum Temperature = 120° F

220° F Maximum



Vacuum

Minimum = 22 in Hg

> 30 minutes

Flood

Maximum Pressure 150 psig

Pressure

Fixation

For Southern pine, "Sufficient Pressure to Prevent Kick Back"

6 Hours Maximum

Drain

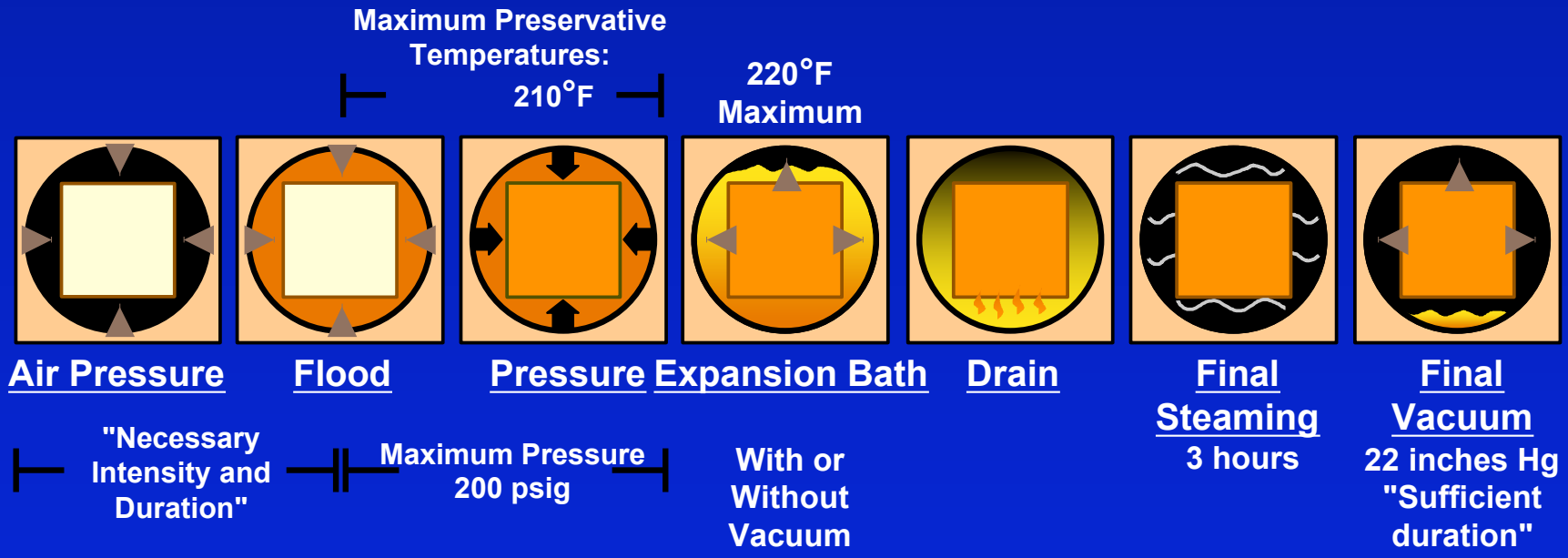
Final Vacuum

(Optional) Minimum = 22 in Hg

NIAGARA MOHAWK

Pressurized AWPA Treatment Steps - Class 3, 40 Foot Southern Pine, Penta

EMPTY CELL OR RUEPING PROCESS



NIAGARA MOHAWK

Preservative Treatment at Cellular Level

Penta Preservative impregnates the pole via pits, tracheids and rays at the cellular level

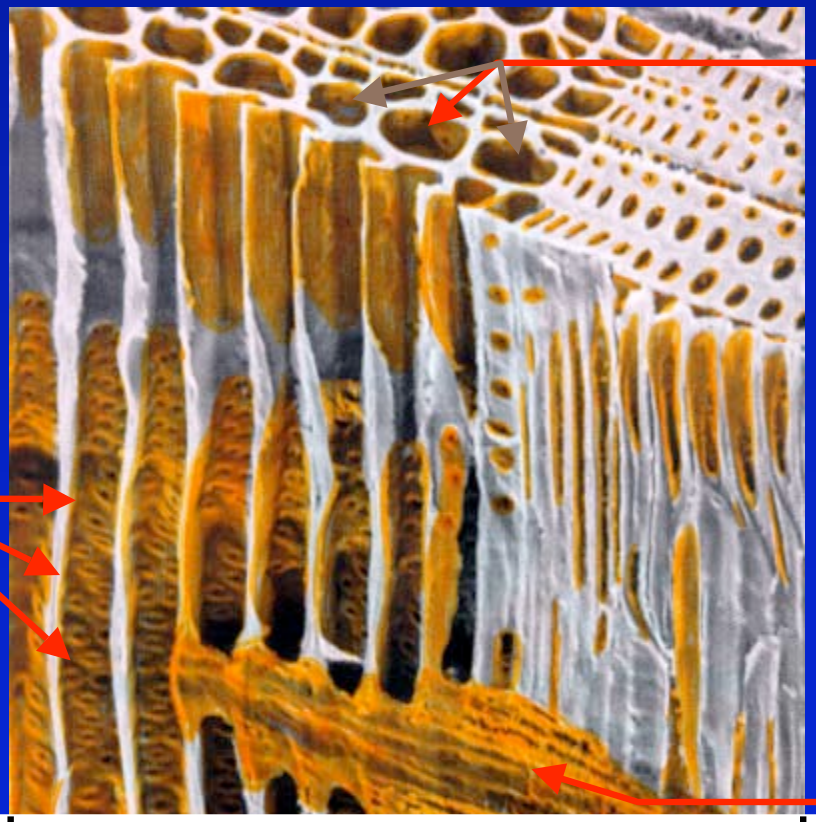


Photo courtesy of College of Environmental Science and Forestry, State University of New York, Syracuse

NIAGARA MOHAWK

Preservative Treated Wood Should be *Specified in Accordance to AWPA Standards*

American Wood-Preservers' Association Standards

- Wood species, preparation, treatment
- Preservative, retention, penetration
- Inspection and analysis
  - Treatment and Chemical

AWPA Standards, examples

- P2 - Creosote
- P5 - Water-Borne Preservatives
- P8 - Oil-Borne Preservatives
- P9 - Organic Solvents
- C14 - Wood for Highway Construction
- C2 - Lumber, Timber, Bridge and Mine Ties
- C3 - Piles (until next year!!)
- M3 - Quality Control
- M4 - Care of Products

AWPA Standards, the Use Category System (UCS)

- The UCS designates what preservative systems and treatment have been determined to be effective in protecting wood products under specified exposure conditions.
- Transportation Applications are likely to be in UC4 or UC5
- UC4 (A, B or C)
- UC5 (A, B or C)

- UC4A - Wood used in contact with the ground, fresh water or other conditions favorable to deterioration
  - fence, deck and guardrail posts, structural lumber, timbers and poles in regions of low natural potential for wood decay and insect attack.

- UC4B - Wood used in contact with the ground either in severe environments, climates with high deterioration potential, in critically important components such as utility and building poles and wood foundations, and in wood used in salt water splash areas.

- UC4C - Wood used in contact with the ground either in very severe environments, climates with extremely high deterioration potential, in critical structural components such as land and fresh water piling and foundation piling, and utility poles in semi- to tropical environments.

- UC5A - Wood used in salt and brackish water to the north of New Jersey and San Francisco. Specific marine borer presence is important.

- UC5B - Wood used in salt and brackish water between New Jersey and Georgia. Specific marine borer presence is important.

- UC5C - Wood used in salt and brackish water south of Georgia and along the gulf coasts as well as Hawaii and Puerto Rico. Specific marine borer presence is important.

Several examples ……

Covered Bridge, keep wood dry

Covered Bridge, inside is dry

Creosote highway bridge over stream

Creosote highway bridge over stream

Creosote highway bridge over stream

Creosote highway bridge over stream

Penta arch bridge

Penta bridge deck

Under penta bridge deck

Under bridge

Wood bridge / culvert

Wood bridge

CCA bridge deck

Creosote piles under CCA deck

CCA piles and bulkhead

CCA
pile driving

Creosote pile driving, note cutoffs

Creosote ferry dock pilings

Stress laminated deck bridge

Sound barrier wall

Wood Preservatives: Today's Situation

- By agreement between the preserved wood industry and the EPA several "New Generation" wood preservatives are to be substituted for CCA in certain applications.
- Alkaline Copper Quat (ACQ)
  - ACQ Preserve
  - NatureWood
- Copper Azole
  - Wolmanized Natural Select

Wood Preservatives: Today's Situation

- Transitioning through 12/31/03, the new generation water-borne preservatives will be used for non-industrial products.
- Industrial use products will continue to be treated with CCA (and the other traditional wood preservatives such as creosote, and pentachlorophenol and copper naphthenate in oil.

Wood Preservatives: Today's Situation

- Industrial use products include such items as: piling, poles, structural timbers, highway construction, certain marine and agricultural uses, shakes and shingles.
- Non-industrial use products include such items as decking, railings, playgrounds.

Does this mean that CCA is Unsafe? NO!!

- The EPA was pressured "politically" to act by parties who did not like the idea of having arsenical compounds in treated wood near people.
- Concerns focused on disposal of treated wood, arsenic in soil, and people touching the treated wood.
- Over the past several decades, however, there have been no documented cases of harm when proper use and handling recommendations are followed.

Safe Handling Information for CCA Preserved Wood

CAUTION : ARSENIC IS IN THE PESTICIDE APPLIED TO THIS WO

- NEVER BURN TREATED WOOD
- WEAR DUST MASK & GOGGLES WHEN CUTTING OR SANDING WOOD
- WEAR GLOVES WHEN WORKING WITH WOOD

Ask for the Consumer Safety Information Sheet or call 1-800-282-0600. www.ccasafetyinfo.com


animal bedding or structures or containers for storing
do not use where treated wood may come into
except for uses involving incidental
trash collection.
boilers
CAUTION : ARSENIC IS IN THE PESTICIDE APPLIED TO THIS WOOD • NEVER BURN TREATED WOOD • WEAR DUST MASK & GOGGLES WHEN CUTTING OR SANDING WOOD • WEAR GLOVES WHEN WORKING WITH WOOD
Ask for the consumer safety information sheet
Or call 1-800-282-0600. www.ccasafetyinfo.com
OPEN TAG FOR ADDITIONAL INFORMATION

What should you do with CCA Preserved Wood?

- The EPA has not concluded that CCA-treated wood poses unreasonable risks to the public, and is not recommending that existing structures or surroundin soils be removed or replaced.
- A panel of physicians, appointed by the Florida Department of Health, found no data demonstrating any clinical disease, including skin diseases and cancer, associated with arsenic exposure, including t children, from use of CCA-treated wood at playgrounds and recreational facilities.

What should you do with CCA Preserved Wood?

- The Consumer Product Safety Commission (CPSC) professional staff, after more than two years of scientific assessment, has recently recommended tha no further action be taken to regulate wood treated with Chromated Copper Arsenate (CCA).
- They concluded that over a lifetime, normal and casual exposure to arsenic in foods such as rice, othe grains and meat, drinking water and other sources could be much larger than exposure from playgroun equipment during childhood.

What should you do with CCA Preserved Wood?

- Follow recommended use practices and procedures.
- Normal maintenance.

What about creosote?
NO, it has not been banned.

- Creosote has NOT been banned!
- For about 20 years its use has been limited to industr applications. No "over-the-counter" sales.
- Creosote has, until recently, been available for brush on over exposed field cuts.
- Now Copper Napthenate, or comparable treatment, should be used for treating field cuts (see AWPA M4

What about plastic and composite "lumber"?

- It is more expensive.
- It is not as strong.
- It is not as stiff.
- It is heavy.
- It can be excessively hot or cold, due to thermal conductivity.
- It can be slippery.
- It is not particularly attractive (ugly).
- It requires substantial energy to manufacture.
- It is often from recycled plastic.
- Maintenance might be reduced. No checks or splinte

Plastic timber bulkhead; however, CCA piles and timbers

Wood is GOOD!

- Properly preserved wood can be used in many highway applications.
- It is economical.
- It is aesthetically pleasing.
- It is easily worked.
- It is readily available.
- It is long lasting.

When using and building with preserved wood, be smart:

- If using treated wood in aquatic environment communicate that to the treater!
- When cutting and fabricating in sensitive environments, collect sawdust and all cutoffs
- Have workers wear gloves, longsleeve shirts and pants, and follow OSHA guidelines!
- Do not allow cutoffs and other scrap treated wood to be burned!
- Use appropriate treatments!

Award winning bridge!

Further Information:

- www.woodpreservativescience.org
- www.epa.gov/pesticides
- www.ccasafetyinfo.com
- www.naturalselect.com
- www.osmose.com/wood/usa/preserved/naturewood
- www.treatedwood.com/products/preserve/
- www.sfpa.org
- www.timberpilingcouncil.org

Thank you!

- Questions?
- Comments?
  - Bill Smith
  - wbsmith@esf.edu
  - 315/470-6832