Wood Preservation

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Durable Wood Products

- Naturally Durable Wood
  - Extractives
- Treated Wood
  - Biocides
- Modified Wood
  - Altered wood chemistry

Use Category System

Use Category	Service Conditions	Hazards	Example
1	Interior, dry	Insects	Millwork
2	Interior, damp	Insects, Decay	Sill plates
3	Exterior, above ground	Insects, Decay	Decking
4	Exterior, ground contact	Insects, Decay	Posts
5	Marine exposure	Insects, Decay, Marine borers	Piling

Naturally Durable Wood

- All sapwood is non-durable
- Heartwood durability variable
- Durability caused by presence of extractives
- Major naturally durable species in Canada:
  - Western redcedar
  - Yellow-cedar
  - Eastern white cedar



- Some tropical hardwoods have very high natural durability
  - Common names may describe several species

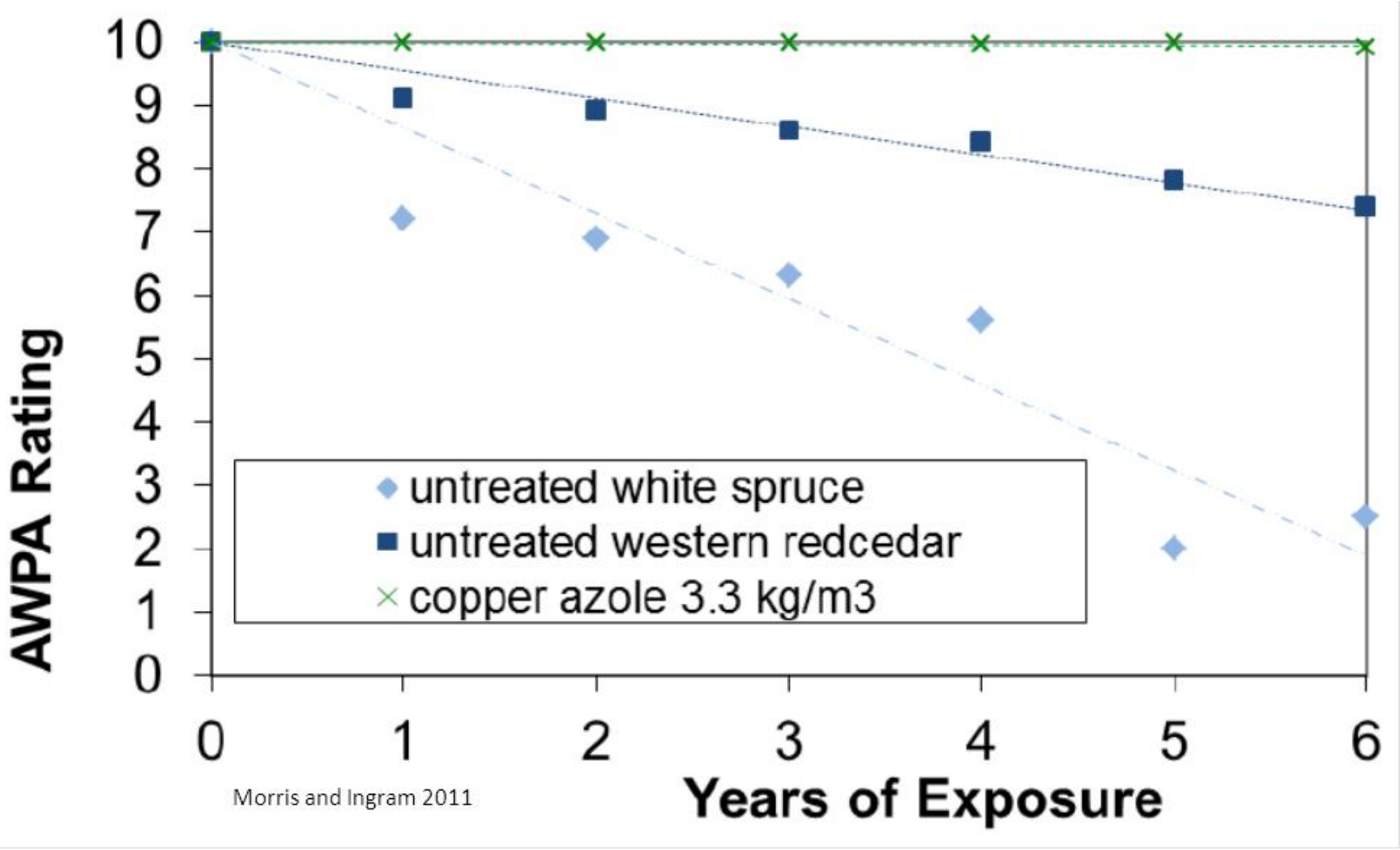
Western Redcedar Extractives

- Extractives increase from pith to bark and from crown to base
  - Lower, outer heartwood generally most durable
- Second growth has similar durability to old growth
- Major extractives groups in WRC heartwood
  - Thujaplicins
    - Highly toxic to decay fungi *in vitro*
    - Rapid depletion in wood products
    - Poor correlation with durability in lab and field tests
  - Lignans
    - Moderately toxic to decay fungi *in vitro*
    - Slow depletion in wood products
    - Moderate correlation to durability in field tests
  - Terpenes
    - No known toxicity or relationship to durability

Western Redcedar Uses

- Valued for durability, dimensional stability and appearance
- Often used in above-ground, exterior exposures
  - Decking
  - Fencing
  - Siding
  - Shingles

Western Redcedar Performance



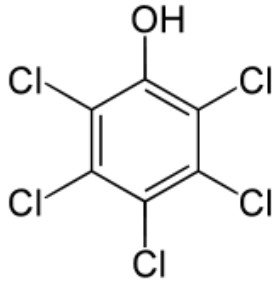
Wood Preservatives

- Industrial Preservatives
  - Creosote
  - Pentachlorophenol
  - Arsenicals (CCA, ACZA)
- Residential Preservatives
  - Copper amine preservatives
  - Micronized copper preservatives
  - Carbon-based preservatives (above ground only)
  - Borates (interior only)
  - CCA (restricted uses)

Industrial Preservatives - Creosote

- Byproduct of coke production for steel making
- Used neat or in heavy oil solution
- Contains hundreds of chemicals
  - Including polycyclic aromatic hydrocarbons
  - Some are known carcinogens
- Restricted to industrial uses
  - Mostly used for railway ties, poles and piling

Industrial Preservatives - Pentachlorophenol



- Synthetic chlorinated phenol
- Oil-based preservative
- Environmental concerns from dioxins and furans present as contaminants
- Restricted to industrial uses
  - Mostly used for poles and large timbers

Industrial Preservatives - Arsenicals

- ACZA: Ammoniacal Copper Zinc Arsenate
- CCA: Chromated Copper Arsenate
  - Highly effective, waterborne preservative
  - Use in residential construction restricted in 2003 due to concerns about use in playground equipment
  - Largely used poles and timbers
  - Permitted for shingles, plywood and preserved wood foundations in residential construction

Residential Preservatives – Copper Amine Systems

- ACQ: Alkaline copper quaternary
  - Copper ethanolamine + quaternary ammonium compound
- CA: Copper azole
  - Copper ethanolamine + tebuconazole
- Effective against fungi and insects
- Dominant in Canada
- Corrosive

Residential Preservatives – Micronized Copper Systems

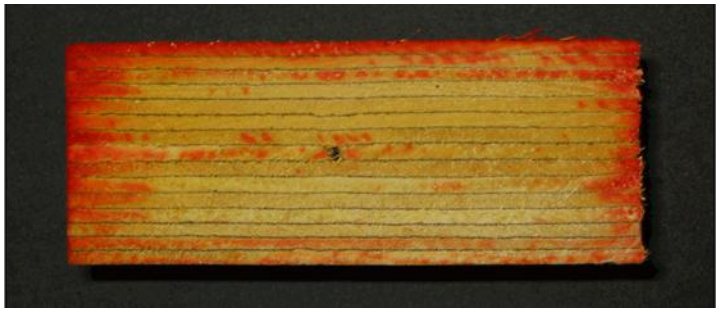
- Copper present as small “micronized” particles of basic copper carbonate
- MCQ: Micronized Copper Quat
- MCA: Micronized Copper Azole
- Dominant in US
- Introduced to Canada in 2012

Residential Preservatives – Carbon-Based Preservative Systems

- Metal-free, “organic” in chemical sense
- In Canada:
  - FIM-1
    - Quaternary ammonium compounds
  - Wolman AG
    - Tebuconazole, Propiconazole, Quaternary ammonium compounds
- Effective against basidiomycetes
- US formulations add insecticides to control termites
- Presently restricted to above-ground uses

Residential Preservatives - Borates

- Controls fungi and insects
- Diffuse into wood
- Highly leachable
  - Not suitable for wet exposures
  - UC1 and UC2 only
- Used in remedial treatments
  - Borate glycols
  - Borate rods
- Zinc borate used to treat OSB



Wood Treatability

- Sapwood generally treatable
- Heartwood more difficult to treat

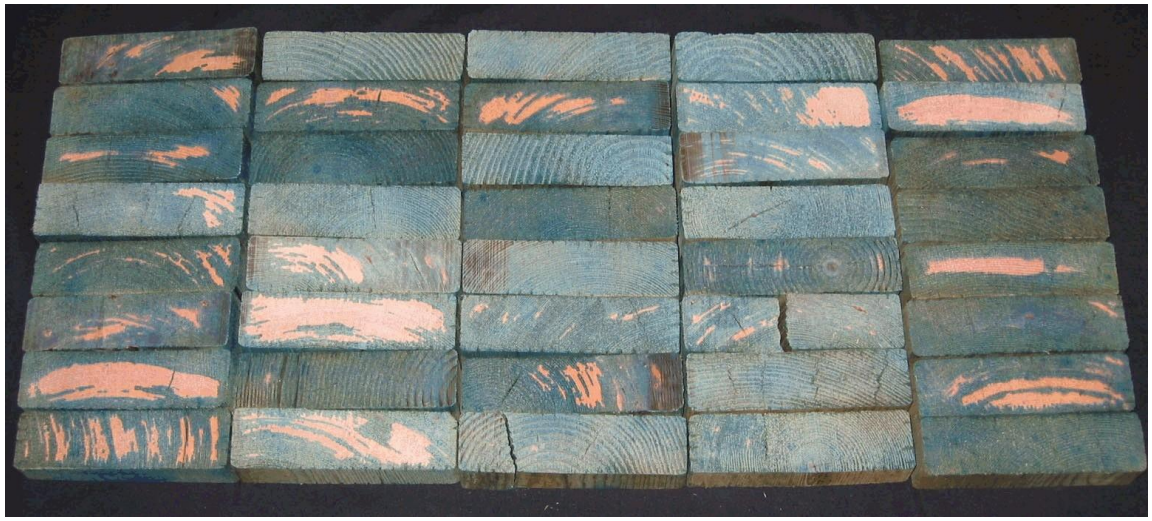
Species	Treatability
Douglas-fir (coastal)	Moderately Difficult
Western hemlock	Moderately Difficult
Lodgepole pine	Difficult
White spruce	Difficult
Western redcedar	Very Difficult
Southern pine, Radiata pine	*Least difficult*

Incising

- Improves preservative penetration
- Necessary for many Canadian species to meet standards for penetration

Treatment Quality

- Retention
  - Gauge
  - Assay
- Penetration
  - Total distance
  - % of sapwood



Pressure Treatment Processes

- Full cell
  - Initial vacuum, add preservative, pressure, final vacuum
  - Leaves preservative in wood cell
  - Maximum uptake
  - Used primarily for water-based preservatives

Demo video

- Empty cell
  - Add preservative, pressure, final vacuum
  - Pulls preservative out of cell lumen
  - Limits uptake
  - Used primarily for oil-based preservatives

Non-Pressure Processes

- Generally limited penetration
- Dip/diffusion treatments can work for borates which diffuse into wood
- Tru-core® is a patented process that uses buffered amine oxides to drive preservatives into wood
  - Not yet available in Canada

End Cut Preservatives

- Untreated wood exposure during cutting or drilling needs protection
- Brush on end cut preservatives available
  - Copper naphthenate (exterior, green)
  - Zinc naphthenate (exterior, colourless)
  - Borates (interior)

Regulation

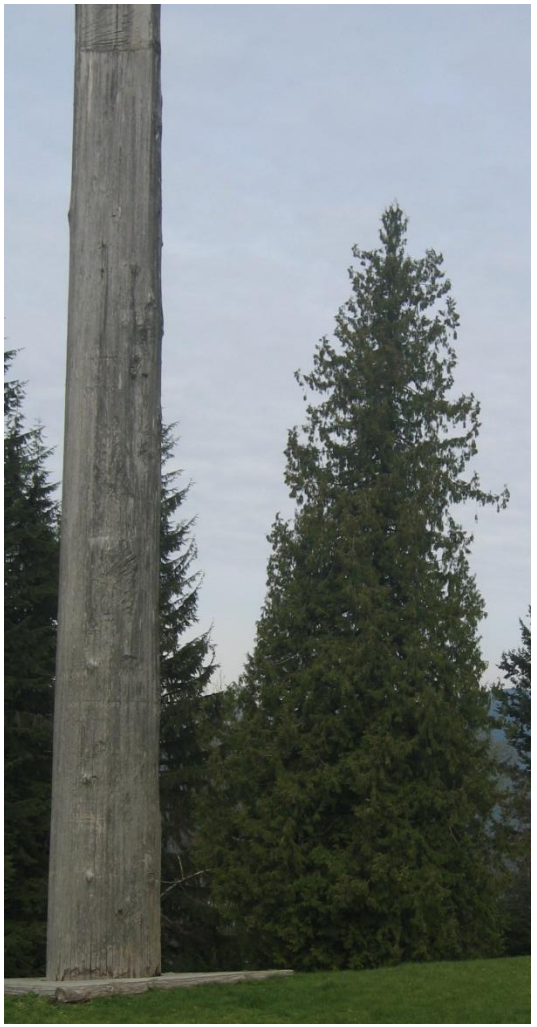
- Must be registered with Health Canada's Pest Management Regulatory Agency (PMRA)
  - Reviews comprehensive data package and publishes label that describes legal uses of wood preservatives
  - PMRA Label Search

Standardization

- Canadian Standards Association (CSA)
  - CSA O80 Standard on Wood Preservation
- American Wood Protection Association (AWPA)
  - Annual Book of Standards

Environmental Performance

- Wood should last long enough to grow replacement fibre
  - e.g. pole produced from 60 year old tree should last 60 years
  - Preservation required
- LCAs published on performance of treated wood relative to competitive products



Life Cycle Assessments for Treated Wood

PT Wood	Alternative	GHG	Fossil fuel	Water usage	Acid rain	Smog	Eutroph -ication	Ecol. Impact
ACQ lumber	WPC							
CCA piling	Steel, concrete, plastic							
CCA guard rail post	Steel							
Borate lumber	Steel							
Penta pole	Steel, concrete, composite							

Caveats

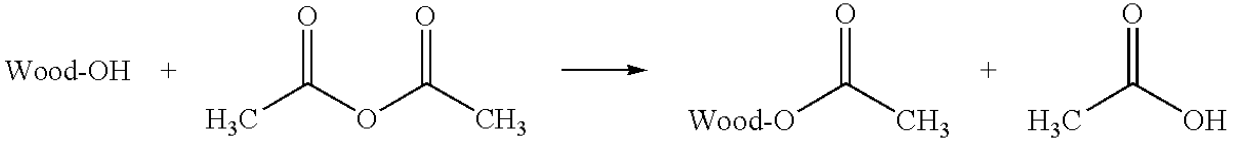
- Treated wood has a very positive environmental story IF:
  - The wood comes from sustainably managed forests
  - It meets service life expectations
    - Preservatives are applied properly
    - Used wisely
  - There are options of end of service life disposal

Thermal Wood Modification

- Thermal modification
  - Conditioned in kilns around 200°C
  - Anoxic heating (e.g. steam, nitrogen, oil)
- Thermally modified wood
  - Increased durability
  - Increased stability
  - Darker colour
  - Through-treated

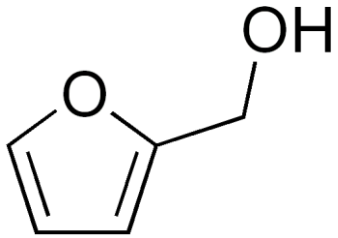
Acetylation

- Wood reacted with acetic anhydride



- Improved dimensional stability
- Increased durability
- Requires full penetration
- Marketed as Accoya®, Perennial Wood®

Furfurylation



- Wood reacted with furfuryl alcohol
- Crosslinking
- Increased durability, hardness
- Dark colour
- Requires full penetration
- Marketed as Kebony®

Chemically Modified Wood

- Pros
  - No biocides
  - Enhanced durability
  - Improvements in other properties (e.g. stability, hardness)
- Cons
  - Expensive
  - Requires full penetration
  - Limited availability in Canada

Activity

- Scenario 1: Decking in Vancouver
- Scenario 2: Resource road bridge in Prince George
- Scenario 3: Marine piling off Vancouver Island
- Scenario 4: Framing lumber in Louisiana

- What is the hazard?
- What is the Use Category?
- What preservative(s) would you recommend?