PROS AND CONS OF CURRENT AND FUTURE WOOD PRESERVATIVES

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Wood Preservatives

- Creosote (1831)
- Cu naphthenate (1899)
- ACA, ACC, CCA, FCP, PENTA ('30s & '40s)
- ACZA, Borates ('80s)
- ACQ, CA ('90s)
- CuNap-W, PXTS, CX-A ('00s)
- New ('10s)

What about today?

- Residential vs. Industrial
- Processes
- Preservatives

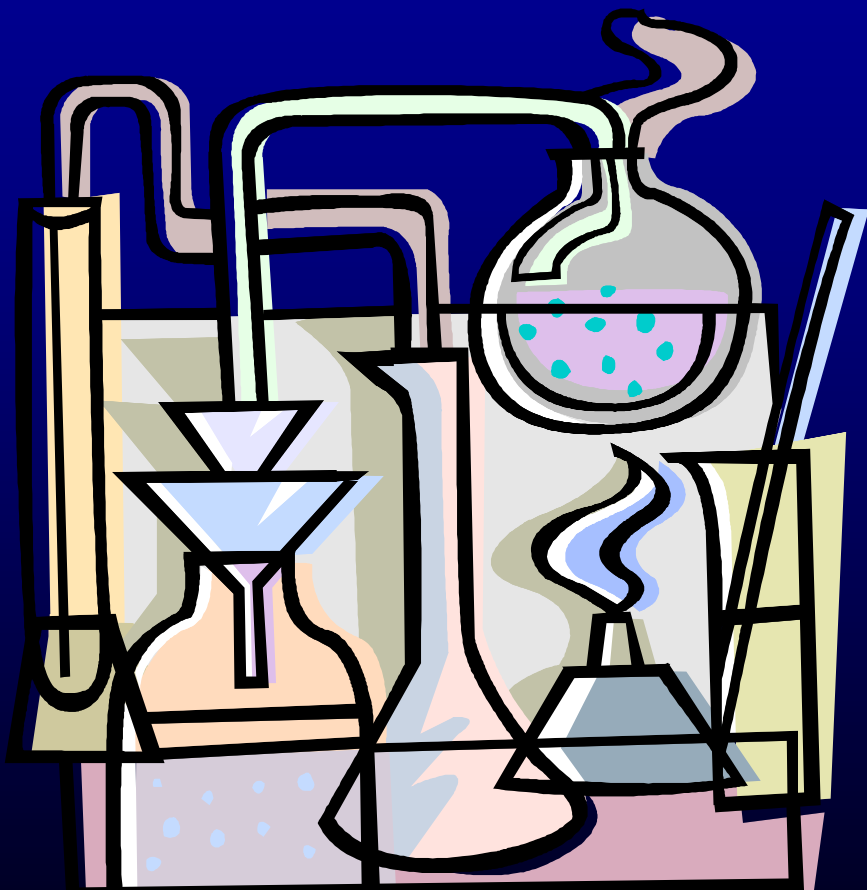
Residential vs. Industrial

- Outdoor & Indoor exposures
  - Waterborne (95% = CCA)
  - Label Change in '04
  - Public perception vs science
- SYP =
  - 70% of all treated
  - 86% of lumber & timbers
  - 44% of production is treated [7.63 Bbfm]

Residential vs. *Industrial*

- Mostly exterior exposure
- The big 3—creosote, penta, CCA/ACZA
- Restrictions threatened

Residential CCA Replacements



- Copper-organic systems
  - Ammoniacal copper quat (ACQ)
  - Copper Azole (CA)
  - Copper Xyligen (CX)
- Borates (non-ground contact)

Background

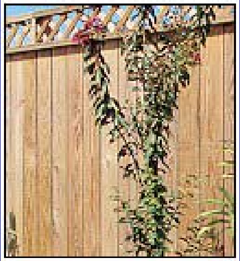
- CCA introduced in 1933
- Solid science behind CCA & its safety known for decades
- Faced opposition for decades
- Recent headlines: arsenic exposure
- Proposed state legislation banning CCA
- Class-action lawsuits
- Effect of negative publicity

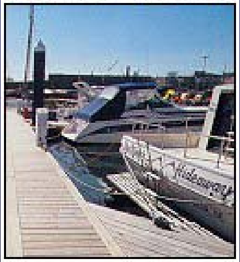
Leading wood preservative mfg.'s amend CCA registrations with EPA leading to voluntary withdrawal of chromated copper arsenate (CCA)

- Feb. 12, 2002, leading wood preservative mfg.'s entered into agreement with EPA
- Withdrawal of CCA from <u>**residential**</u> applications only

- Where are we now?

Waterborne Wood Preservatives [AWPA Book of Standards P5]



- CCA
- Ammoniacal Copper Quat [ACQ]
- Copper Azole [CBA-A and CA-B]
- Copper Xyligen [CX-A]
- Borates [SBX]
- ACZA
- Others
  - Cu *bis*(dimethyldithiocarbamate) [CDDC]
  - DDAC
  - Copper *bis*-(N-cyclohexyldiazeniumdioxy) (Cu-HDO or Cu Xyligen)

Oil Systems

Creosote [P1/P13, P2, P3, P4]

Ban in ME and

possible in other states?

- Rereg Elig Doc to be issued 1 August
  - No butt or thermal treatment
  - No remedial treatment

Carrier solvents [P9]

Oilborne Systems [P8]

Pentachlorophenol

Restrictions on butt, thermal, remedial treatments

- Favored because it is organic
- ????

Copper naphthenate

- low mammalian toxicity
- not as copper rich
- low leaching [≈ 4 ppm]

Oxine copper (*bis* Copper-8-quinolinolate)

- FDA food contact approved
- Ni could be a problem

Chlorpyrifos [CPF]

- Insect protection only

Isothiazolinone

- Usually added as a moldicide

IPBC

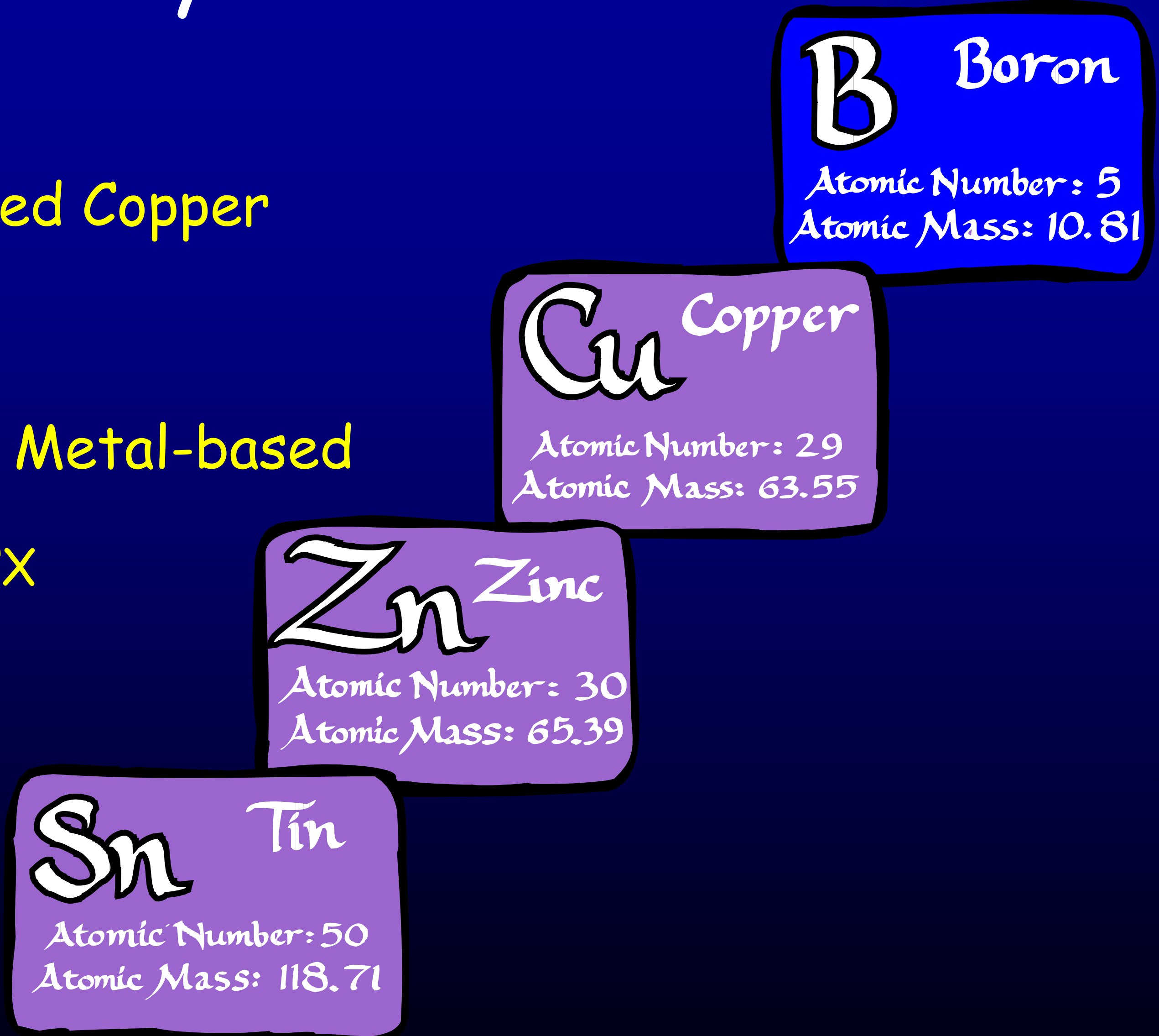
- Millwork

Chlorothalonil

- Good efficacy but solubility problems
- Used with CPF

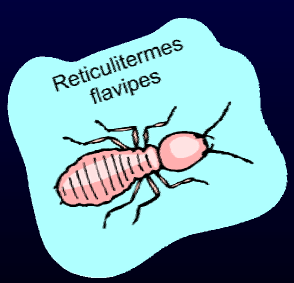
Inorganic Systems

- Borates
- Uncomplexed Copper Systems
  - ACQ
  - CA/CBA
- Complexed Metal-based Systems
  - CuHDO/CX
  - Cu8
  - CuN
  - ZnN
  - CDDC
  - TBTO

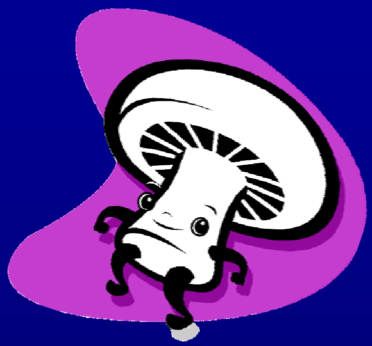


Organic Biocides/Preservatives

- Azoles
  - Cyproconazole
  - Propiconazole
  - Tebuconazole
- Quaternary Ammonium Compounds
  - DDAC
  - ABAC
  - BAC
  - ADBAC
- IPBC
- Synthetic Pyrethroids
  - Permethrin
  - Bifenthrin
  - Cypermethrin
  - Cyfluthrin
  - Deltamethrin



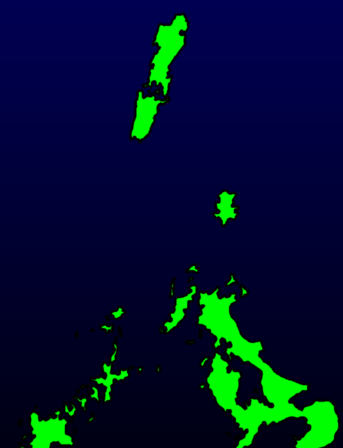
- Organic Agrochemicals
  - TCMTB
  - Chlorothalonil
  - Dichlofluanid
  - Isothiazolone
  - Fipronil
  - Imidachloprid
  - Methylene bis-thiocyanate



- Oligomeric Alkylphenol Polysulfide [PXTS]
- Polymeric Betaine
  [alternating quat, borate ether units]
- Copper Betaine

Ammoniacal Copper Quats (ACQ)

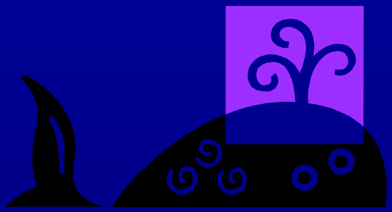
- Introduced ~1990 in the U.S.
- Used for 15 years in Europe, Japan, Australia, New Zealand, and Asia.
- Approved for full exposure to above ground, ground contact, and freshwater uses.
- Fixed preservative



ACQ

- Combines copper (II) and one of the quaternary compounds (quats)
- Usually in CuO:quat ratio of 2:1
- 3 types of ACQ available in North America:
  - ACQ-Type B (Ammoniacal based with Cu and DDAC as quat)
  - ACQ-Type D (Amine based with Cu and DDAC as quat)
  - ACQ-Type C (Alkaline based with Cu and BAC as quat)

Quat Properties



- Low mammalian toxicity
- Relatively inexpensive
- Broad activity against decay fungi and insects
- Excellent stability and leach resistance
- Surfactant-exposed wood wets easier
- Moderate efficacy
- Most often combined with other biocides
- Now mostly used as Carbonate ion instead of Chloride

Copper Azoles: History / Uses

- Copper azole treated wood products used worldwide since 1992.
- Copper azole is approved for full exposure to above ground, ground contact, and freshwater applications
- Fixed Preservative

Azoles

- Triazoles (cyproconazole*, propiconazole, tebuconazole)

- Copper azole with boron (CBA)
  - Cu:boric acid:tebuconazole ratio of 49:49:2

- Copper azole without boron (CA)
  - Cu:tebuconazole ratio of 96.1:3.9

Azole Properties

- Highly active against wood decay fungi
- Soluble in hydrocarbon solvents
- Good stability and leach resistance
- Expensive, although cost effective
- Little activity against sapstains, molds, and insects/termites
- Usually combined with other fungicides or termiticides

Borates: History

- Recorded use as early as 1913

- Borate treated wood products established in New Zealand in 1950

- Widely used i ... utheast Asia before U.S.

- Introduced to U.S. 25 years ago.

Types of Borates

- Sodium octaborate, sodium tetraborate, boric acid, sodium pentaborate [SBX]
- Calcium borate
- Zinc borate
- Trimethyl borate

Borates

- Usually formulated as a mixture of borax and boric acid
- Extremely low mammalian toxicity
- Broad range of activity against decay fungi and insects
- Limited to uses with minimal or no leaching exposure

Concerns with 2nd Generation Systems

- Cost increase 2-4x
- Disposal
- Not as forgiving
  - formulating tricky
- Ammoniacal/amine
- Corrosion to treating plants and fasteners
- Grow mold

Corrosion

- Increased rate by dissolving Zn, further attack Fe at the O_2-wood interface

Leaching of Cu

- > CCA because Cu rich
- Aquatic toxicity causing hard look

Mold, algae growth

- N = more growth

Current Processes

- Same basic processes
- Modified full-cell
- Best Management Practices

Where are we going?
Concerns & Challenges

- How long will the current 'new' systems be with us?
- What will 3rd generation systems look like?
- Will processing change?
- Competitive materials?

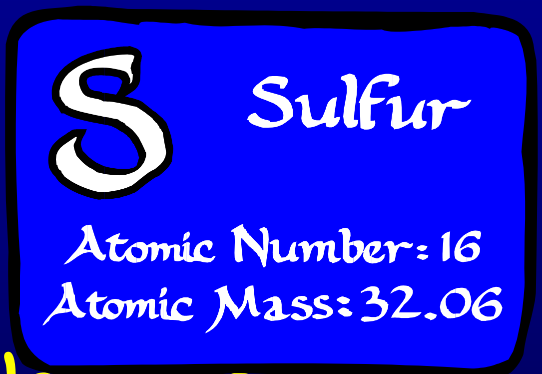
How Long?

- Probably 10 years
- Pressure on heavy metals
- Some European countries are eliminating Cu [Denmark, Norway, Holland]
- Lawyers are salivating
- 'Real vs. Imagined'

Improved 2nd or 3rd Generation Systems

- Organic systems (in Europe now)
  - expensive
  - oilborne
  - limited activity
  - appearance
  - leaching of non-fixed systems
  - New “ micronized Sytems”

- Polymeric xylenol tetrasulfide



- Non-leachable borate systems???

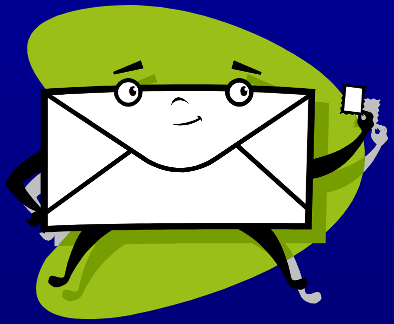
- Aqueous copper naphthenate

- Antioxidant, metal chelator, water repellent additives

- <u>**Cu Xyligen**</u>
- Chlorothalonil (revisited)
- CuBorate systems
- <u>**Solublized Cu8 systems**</u>
- <u>**Acetylated wood**</u>
- ***Polymer/furfurlated wood***
- Polymeric Betaine
- Copper Betaine
- Vacsol Azure (teb:prop:imida-chlorprid)
- <u>**Isothiazolinones**</u>
- <u>**Nano-particle systems/micronzed**</u>
- Non-amine dispersion systems
- Barrier systems

- Less will be more
- Niche systems
- Micro-emulsions

- Envelope treatments



- Multi-component systems

- Maybe shorter service life

- Life cycle analysis

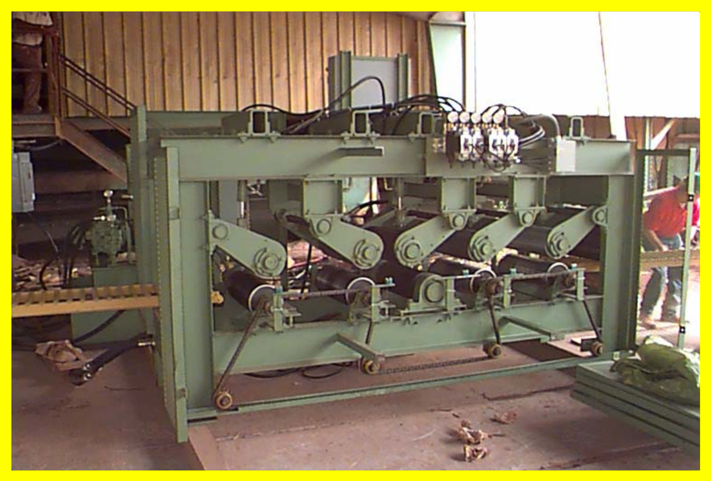
CHEMICALS

- Chemo phobia
  - biocide free; heat treatments
  - antagonistic microbes
  - Modification
  - Barrier wraps

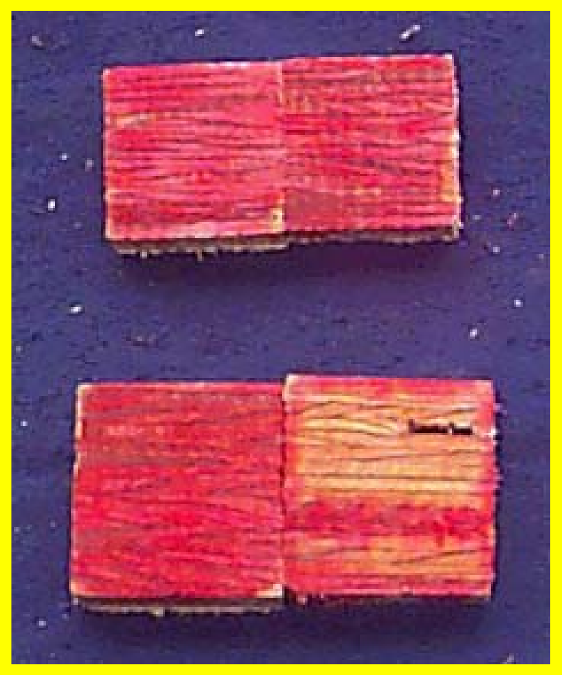
Barrier Wraps

Processing Changes

- Gas-phase treatments
- Supercritical CO_2
- Improvements in refractory wood treatment



- Mechanical stressing has been shown to improve treatability



- Vapor boron has been successful with a wide range of composites including plywood, OSB, LVL, MDF

Challenges

- Mold issues
- Formosan termite
- Engineered composites
- Public education

Mold Issues

- Emotional—no scientific proof that *Stachybotrys* caused health problems (CDC)

- "The mold issue has only become a problem because the public now perceives it as a health threat and . .

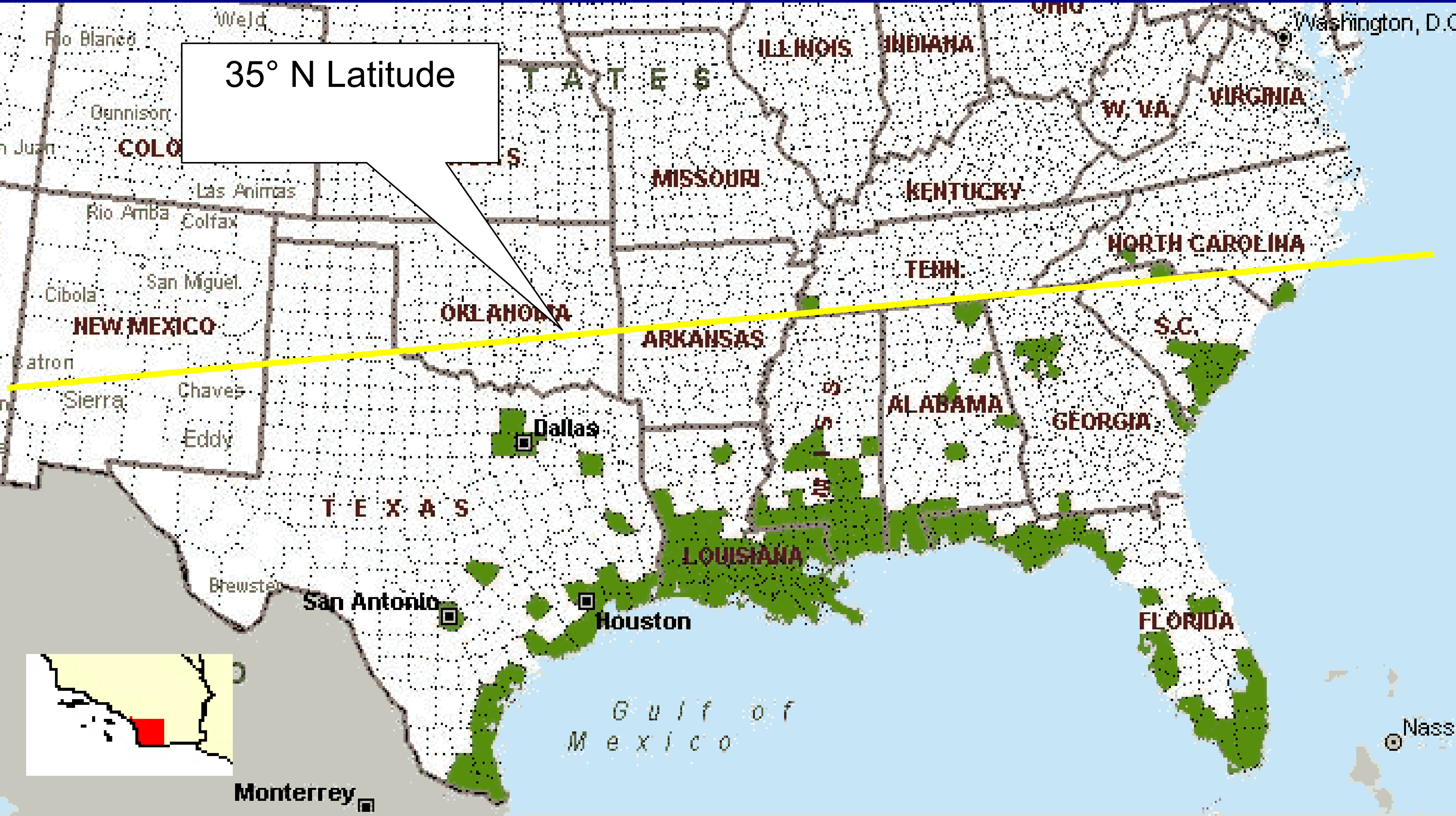
  attorneys are bringing the issue before juries to seek large judgments."

- Cure the moisture problem!

Formosan Termite

- In affected areas, high demand for treated wood
- $2+ billion problem
- Borate-treated lumber would seem to offer a solution

C. formosanus known infestations and projected northern migration



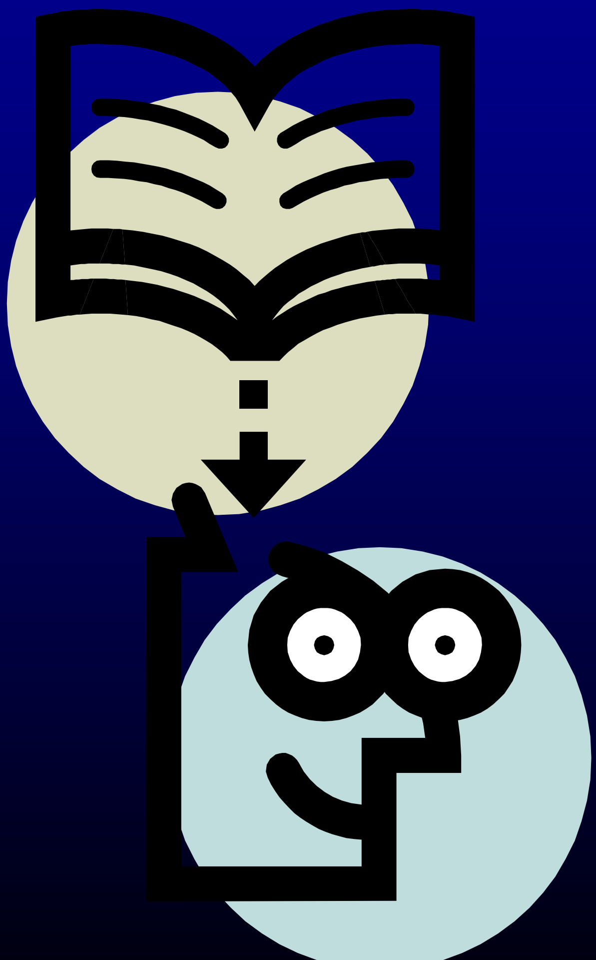
Engineered Wood Composites

- Wave of the future
- Increased durability essential
- Addition questions
- Compatibility
- ZnB (7+), Cu (1) used now

Current research is looking at:

- Composite durability, modeling
- Addition methods
- New preservatives
- New products such as Steam Pressed Scrim Lumber with enhanced properties

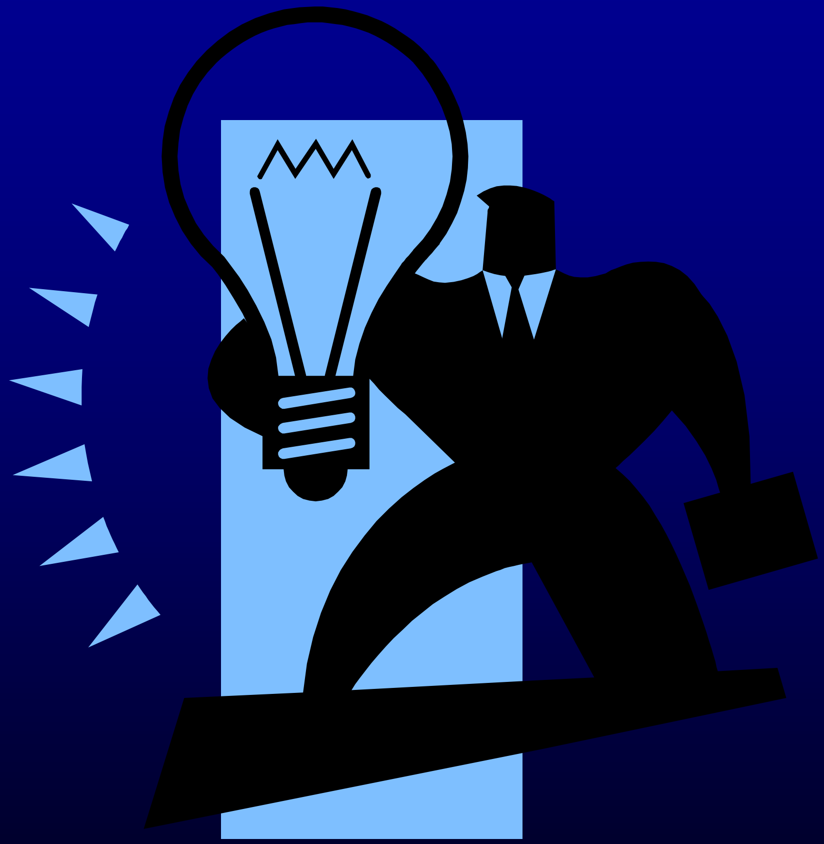
Public Education



- Perceive health risk
- Unfamiliar with CIS
- Long-term exposure
- Technology transfer

What About the Future?

- Stabilizing wood is a continuing goal
- Threats from substitutes are real
- Systems targeted to a specific end use
- Lower retentions = less environmental impact
- Composites
- Better education




“Conserve the forests by
preserving the wood'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