Closed Loop Recycling of Preservative Treated Wood

Todd F. Shupe

Associate Professor

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LSU AgCenter Research & Extension

School of Renewable Natural Resources
Louisiana State University

Historical CCA Production

•Over 6 billion board feet (14.2 million cubic meters) of lumber treated with CCA are produced annually in the United States (Micklewright 1998).

•In 1997, for example, some 581.4 million cu. ft. was treated with waterborne preservatives, which more than 98% is CCA (Micklewright 1998).

Talking Points

- Disposal problem
- Recycling potential
- Value-added products
- Closed loop recycling

Major Current Disposal Options

- Incineration (not recommended by industry)
- Landfilling (landfill lining issue)
- Other - reuse, abatement, modification, retreatment, and destruction

- Environmental concerns
- Costly

The Present

- It has been estimated that about 5 million tons of spent preservative treated wood is disposed of annually into landfills in the United States (Falk 1997), and most of this was treated with CCA (Cooper 1993; Micklewright 1994).

The Future

- Cooper (1993) estimated that the future volumes of CCA-treated wood removed from service in the United States would rise from 1 million m^3 in 1990 to 16 million m^3 in 2020.
- 300 metric tons of CCA-treated wood waste disposed in FL in 1996 …. and will reach 2700 metric tons by 2016 (Solo-Gabriele and Townsend 1999).

Recycling Potential

•Falk (1997) stated that at this time, the recycling potential for treated woodwaste is unknown.

•According to Falk , a major problem associated with recycling treated wood is that products made from recycled treated wood may not have the same resistance to decay and insects as the original treated wood product.

• There is a need for extensive research into ways of reducing, reusing, recycling, and disposing of treated wood in environmentally acceptable ways (Cooper 1994).

Head Lines

Perspective: A Call for CCA Phase-out

Environmental Building News Vol. 6, No. 3 -- March 1997

Given the alarming situation that has arisen with disposal of CCA-treated wood over the past two decades (see page 1), the editors of *Environmental Building News* are taking the unusual step of proposing a phase-out of this product. This recommendation is driven not by the toxicity of CCA-treated wood in use, but by concerns relating to its disposal.

http://www.buildinggreen.com/news/CCA_phase-out.html

Head Lines

Action Alerts

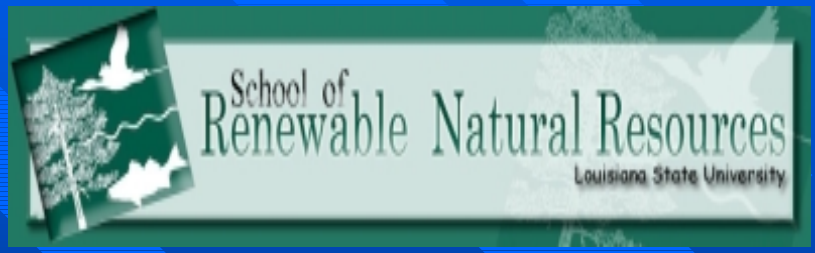
Beyond Pesticides Tells EPA to Fully Protect Public from Wood Preservatives

Beyond Pesticides believes that EPA's announcement to phase out arsenic-treated wood will not fully protect the public. Beyond Pesticides expressed the following concerns in a meeting with EPA on February 6th: 1) Phase out is too long; It should be technically feasible by the end of this year; 2) The voluntary cancellation does not include industrial uses of CCA, such as utility poles and marine pilings; and 3) Risk assessments will be stopped as part of their closed-door negotiations with the wood preservatives industry. Furthermore, EPA has not yet addressed safe disposal methods or how they will deal with existing structures made with CCA.

http://www.beyondpesticides.org/WOOD/alerts/

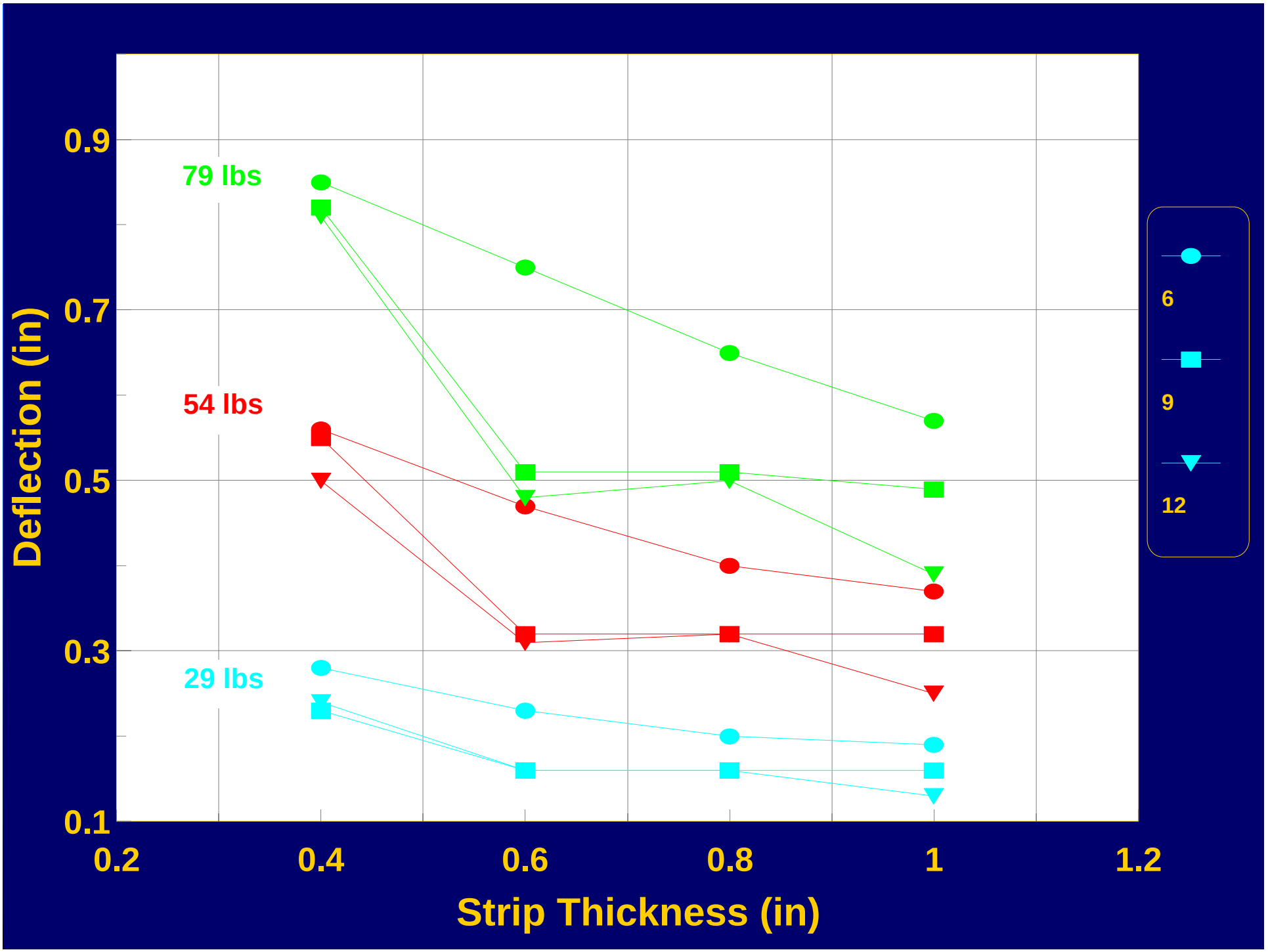
Main Research Objective

- To develop a complete closed-loop recycling system to achieve zero discharge of CCA into the waste stream, which will be economically viable and environmentally friendly



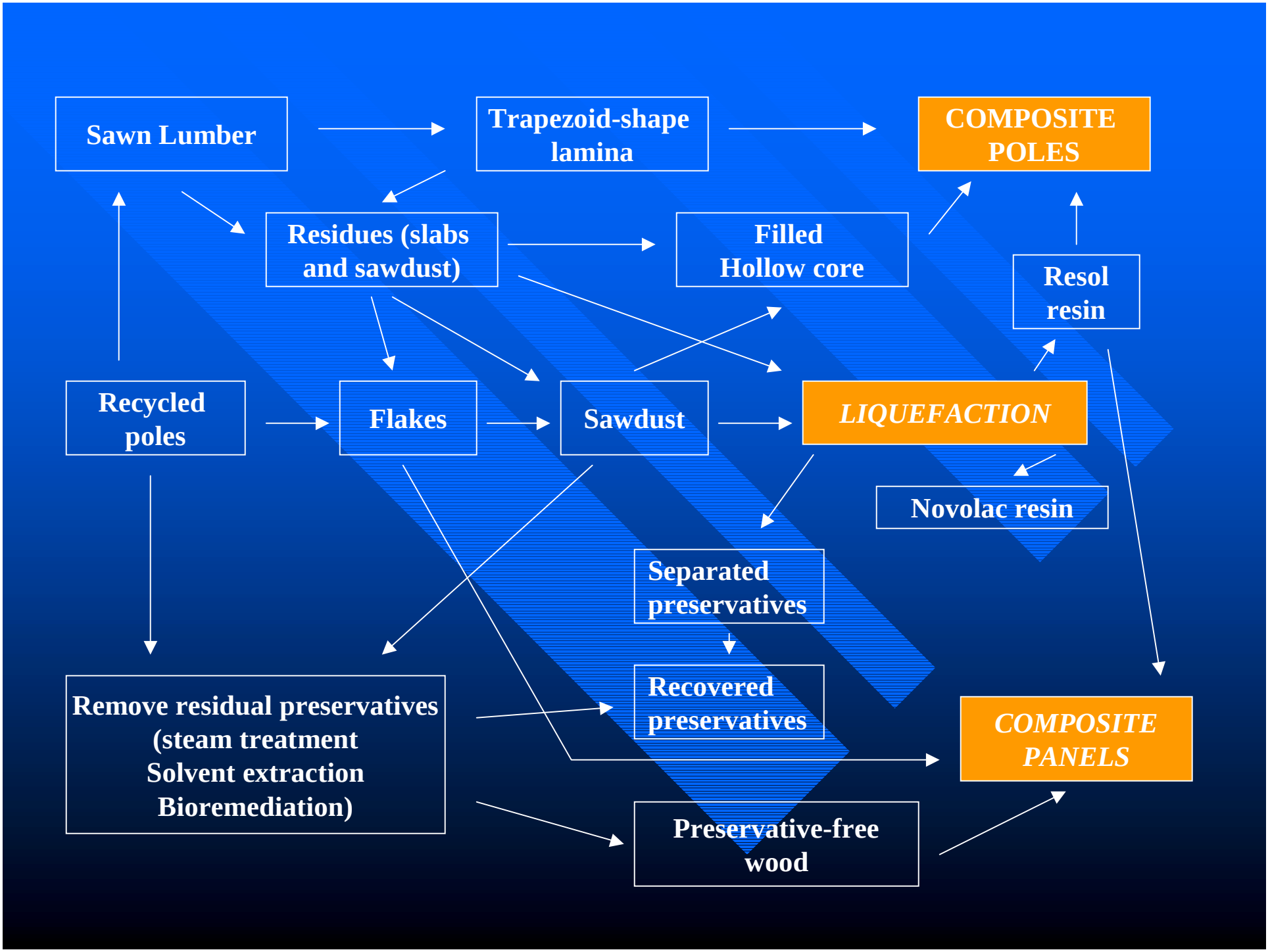
Guard Rails

Lumber

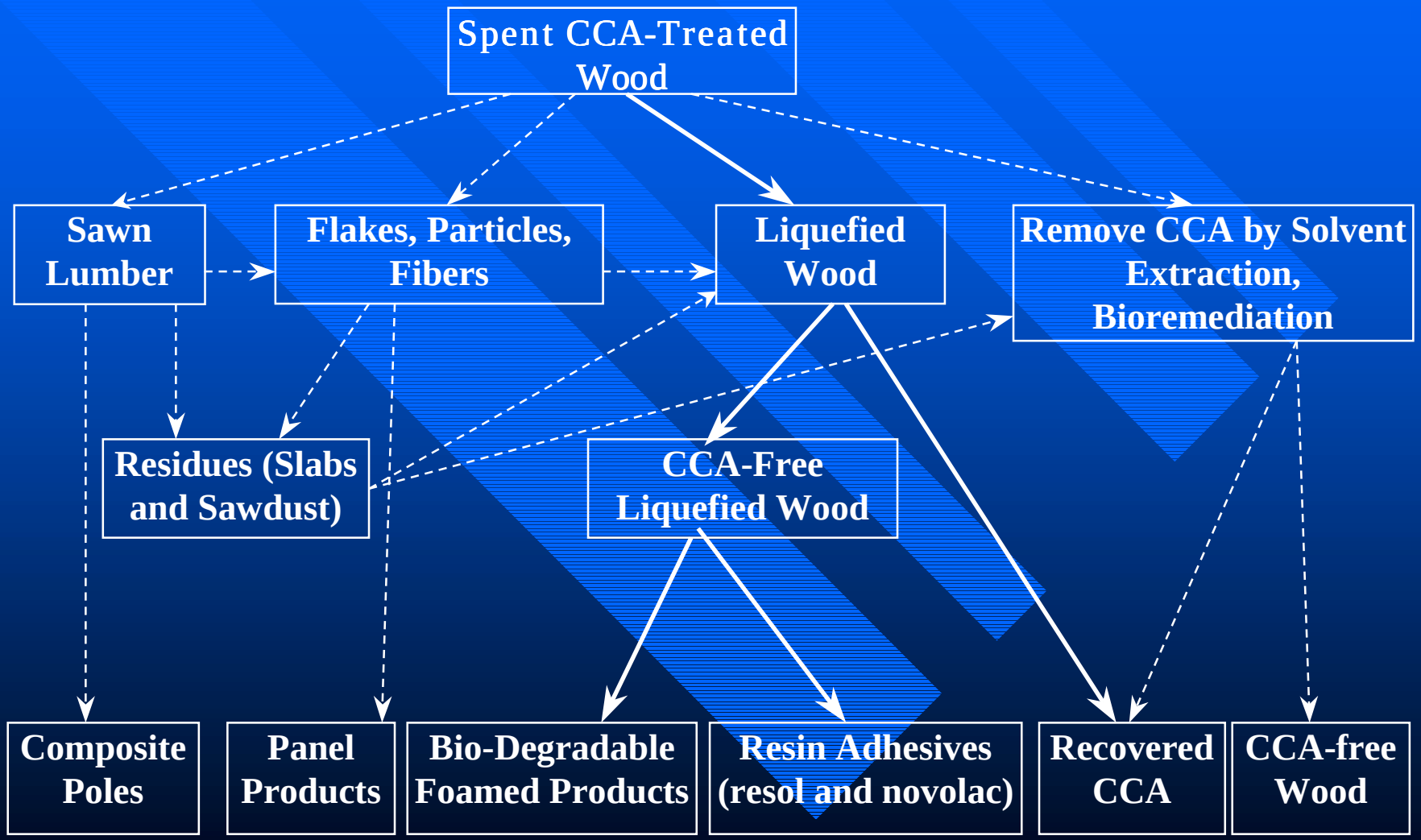

0.9
0.7
0.5
0.3
0.1
Deflection (in)
79 lbs
54 lbs
29 lbs
0.2
0.4
0.6
0.8
1
1.2
Strip Thickness (in)
6
9
12

Liquefaction

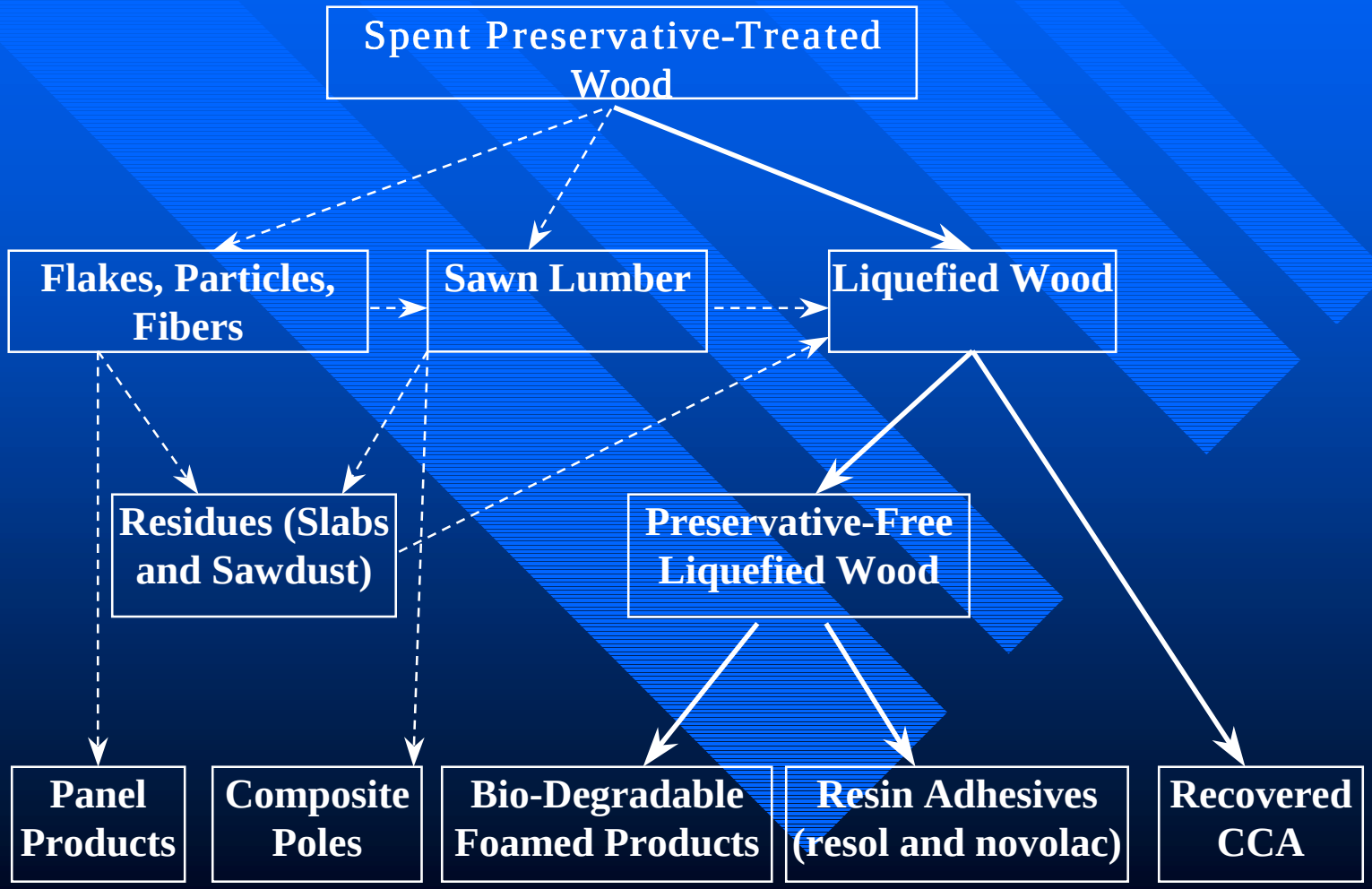
Liquefaction converts wood to a viscous liquid by using organic reagents and low temperatures. This CCA removal technology will liquefy CCA-treated wood in the presence of organic solvents at a mild temperature (120-150 ^{0}C) with an acidic catalyst. The liquefied wood can then be dissolved in a mixed solvent followed by separation of the CCA compounds with the addition of coagulants and precipitants.


Sawn Lumber
Trapezoid-shape lamina
COMPOSITE POLES
Residues (slabs and sawdust)
Filled Hollow core
Resol resin
Recycled poles
Flakes
Sawdust
LIQUEFACTION
Novolac resin
Separated preservatives
Recovered preservatives
Remove residual preservatives (steam treatment Solvent extraction Bioremediation)
COMPOSITE PANELS
Preservative-free wood

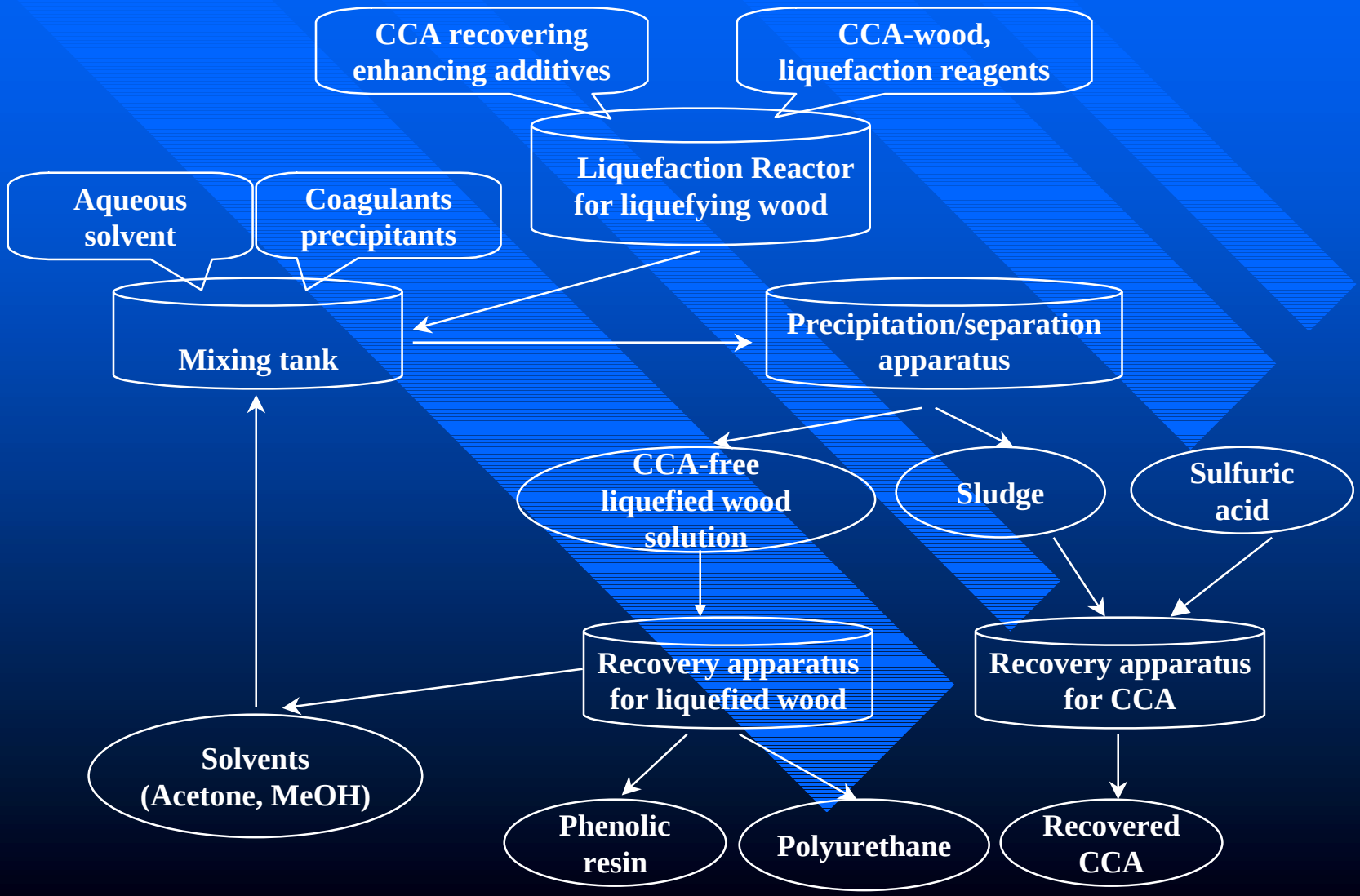
Present situation of treated wood recycling



Complete Closed-loop Recycling System for CCA-treated-wood

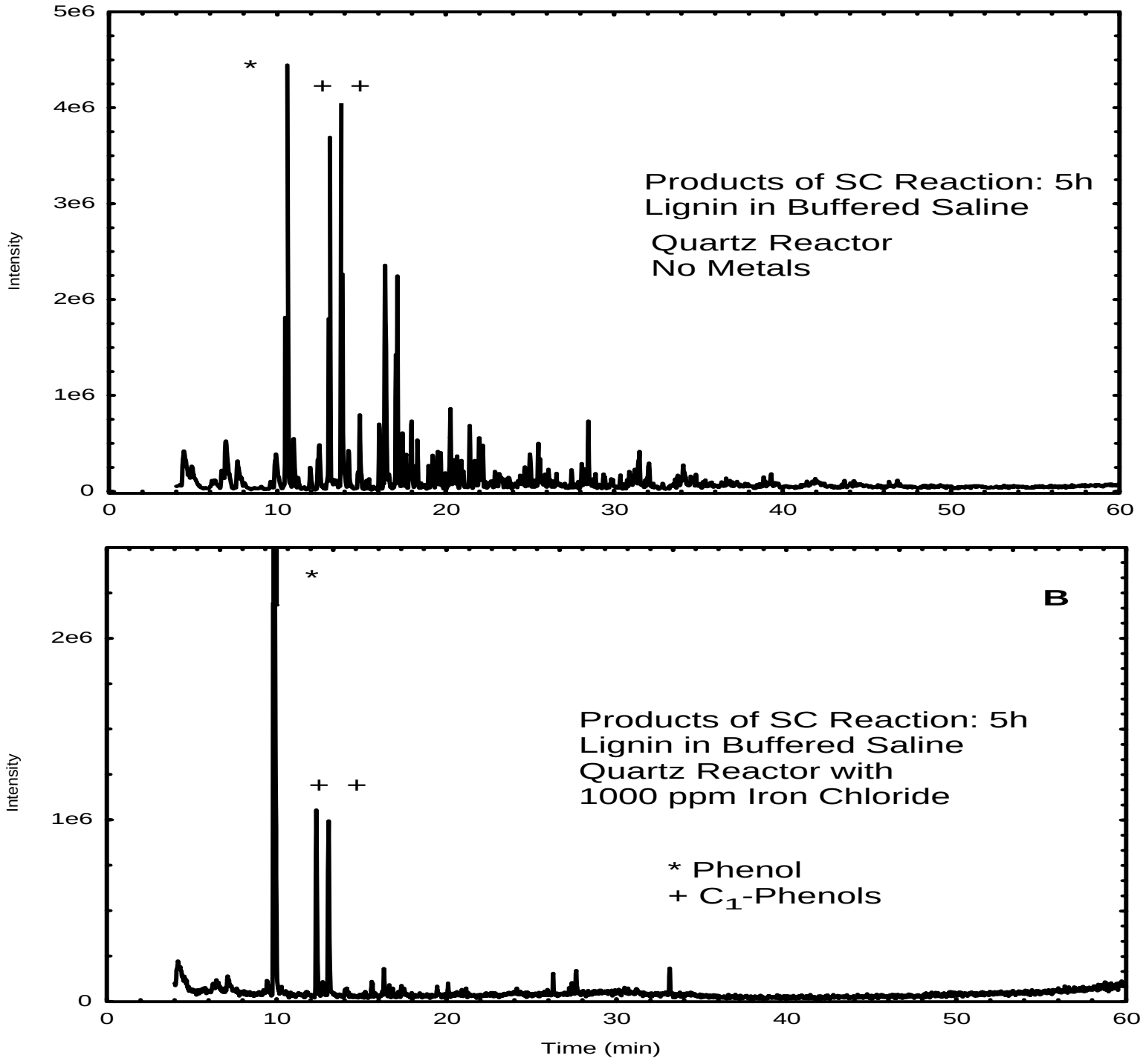


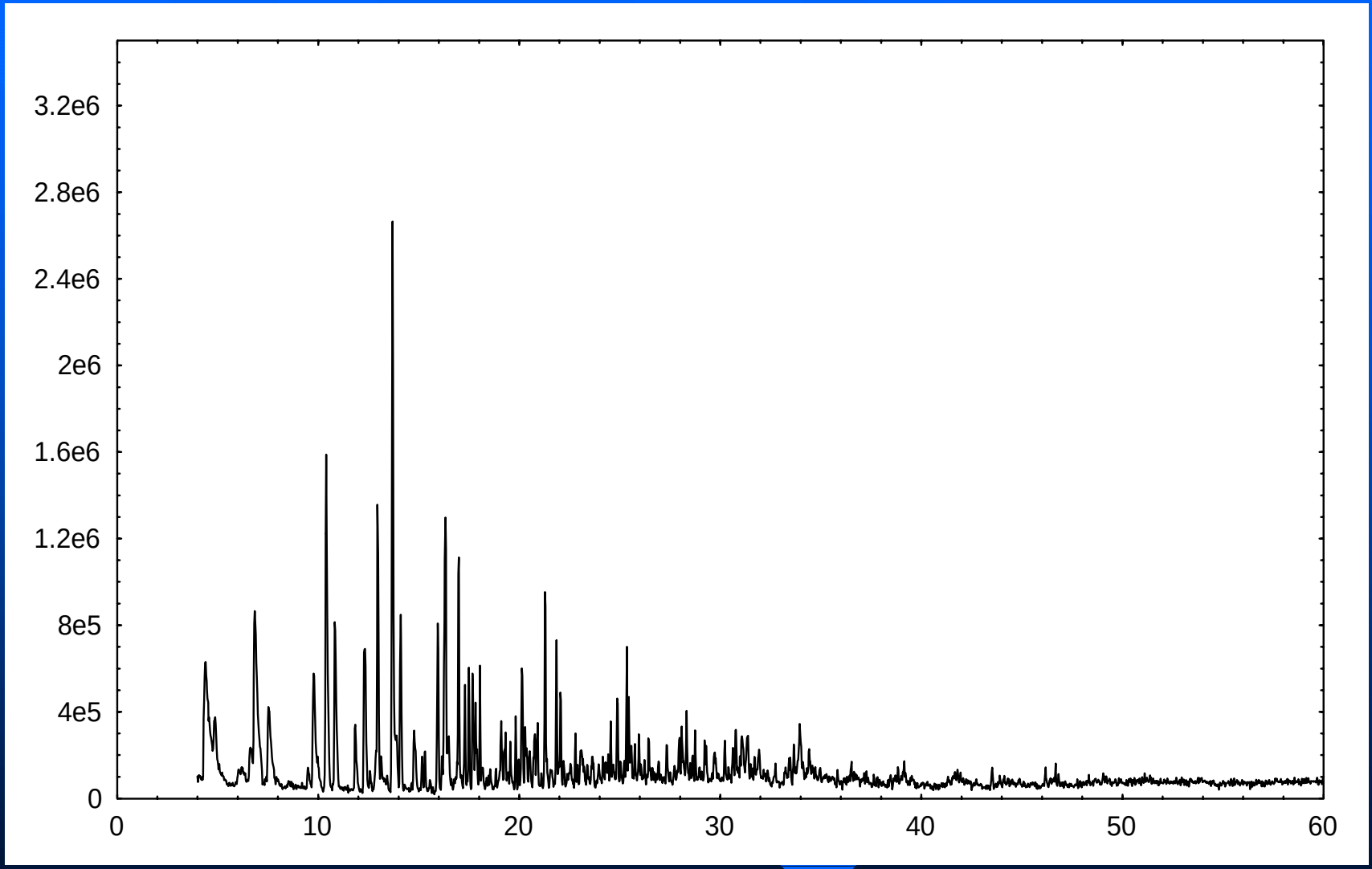
Experimental Plan flow chart



Super Critical Water

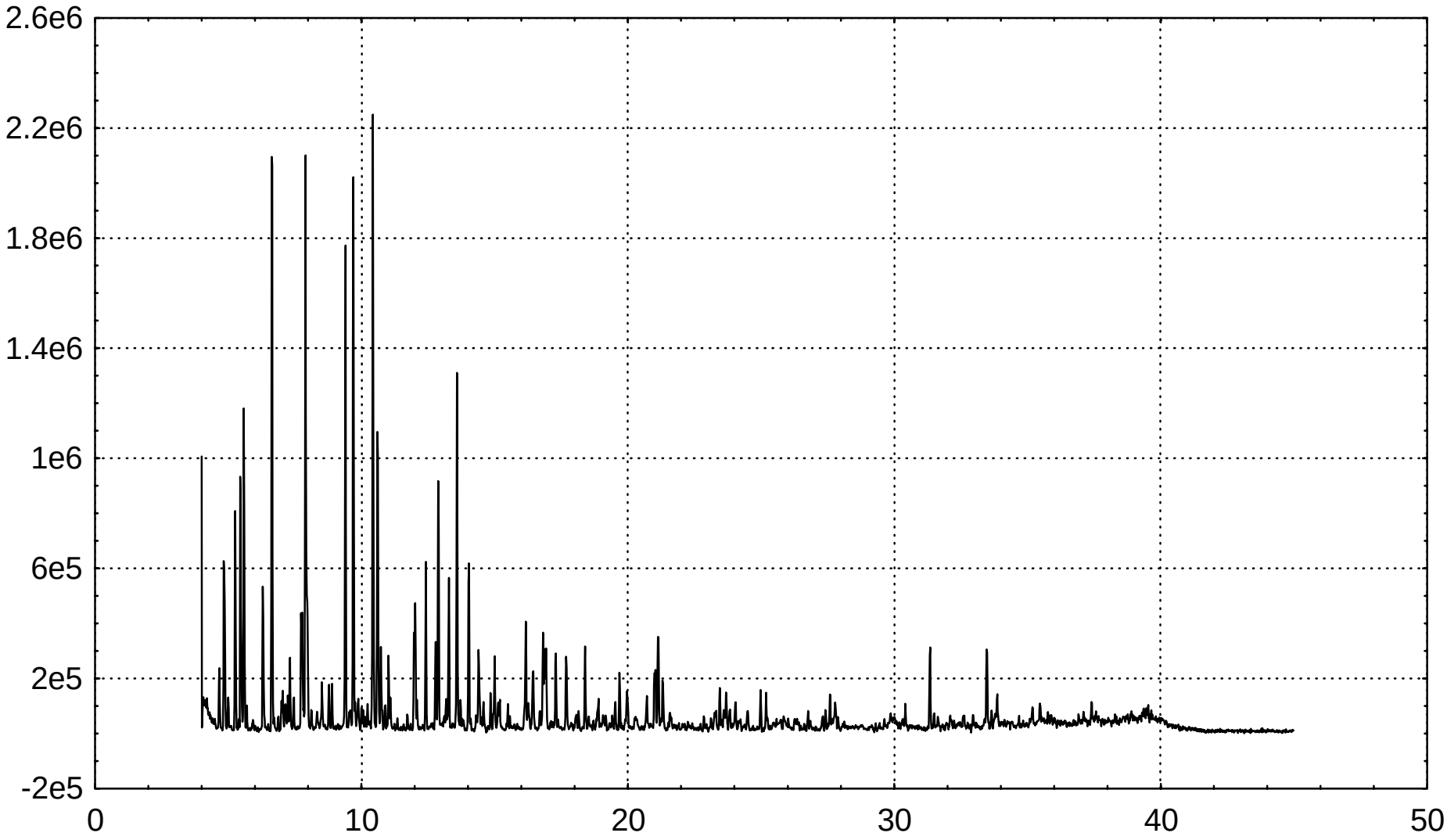
- SC water (>374 ^{o}C/221 bar) under anoxic-reducing conditions can be used for a variety of synthetic chemical transformation purposes.
- The SC phase is one of the most energetic and chemically dynamic conditions known for aqueous systems
- The nature, rates, and yields of these reactions simply are unprecedented in other aqueous systems including a) liquid water under conditions normally observed, b) very high pressures, c) superheated steam, as well as other supercritical fluids (e.g., CO2; Van Eldik and Hubbard 1997).


5e6
4e6
3e6
2e6
1e6
0
Intensity
*
+ +
Products of SC Reaction: 5h
Lignin in Buffered Saline
Quartz Reactor
No Metals
0
10
20
30
40
50
60
B
2e6
1e6
0
Intensity
*
+ +
Products of SC Reaction: 5h
Lignin in Buffered Saline
Quartz Reactor with
1000 ppm Iron Chloride
* Phenol
+ C1-Phenols
0
10
20
30
40
50
60
Time (min)


3.2e6
2.8e6
2.4e6
2e6
1.6e6
1.2e6
8e5
4e5
0
0
10
20
30
40
50
60

Wood + CCA after SCW Treatment

(Wood ALONE no hydrocarbons)



Industrial Applications

- “Green” recycling
- Rural economic development

CONCLUSIONS

- The CCA-wood can be liquefied in the usual liquefaction condition
- This chemical process removed more than 80% of CCA form spent CCA-treated wood
- The presence of $FeSO_4$ in the liquefaction greatly improved the detoxification efficiency.
- By this process, not only CCA can be recovered but also the detoxified wood can be reused as a chemical raw material.

Conclusions

- Mechanical and physical properties do not substantially decrease with as much as 50 percent treated material in the furnish of the panels.
- Decay resistance increases commensurate with CCA percentage.

Conclusions

- Recycled composite poles have sufficient bonding and decay resistance properties.
- Mechanical property testing is on-going and in-field testing is planned.

Acknowledgements

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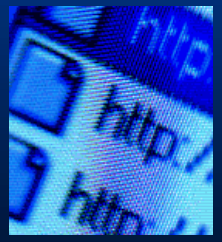
- USDA Forest Service

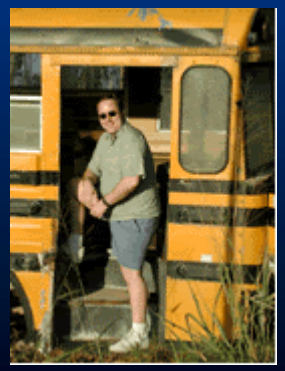
Contact Us

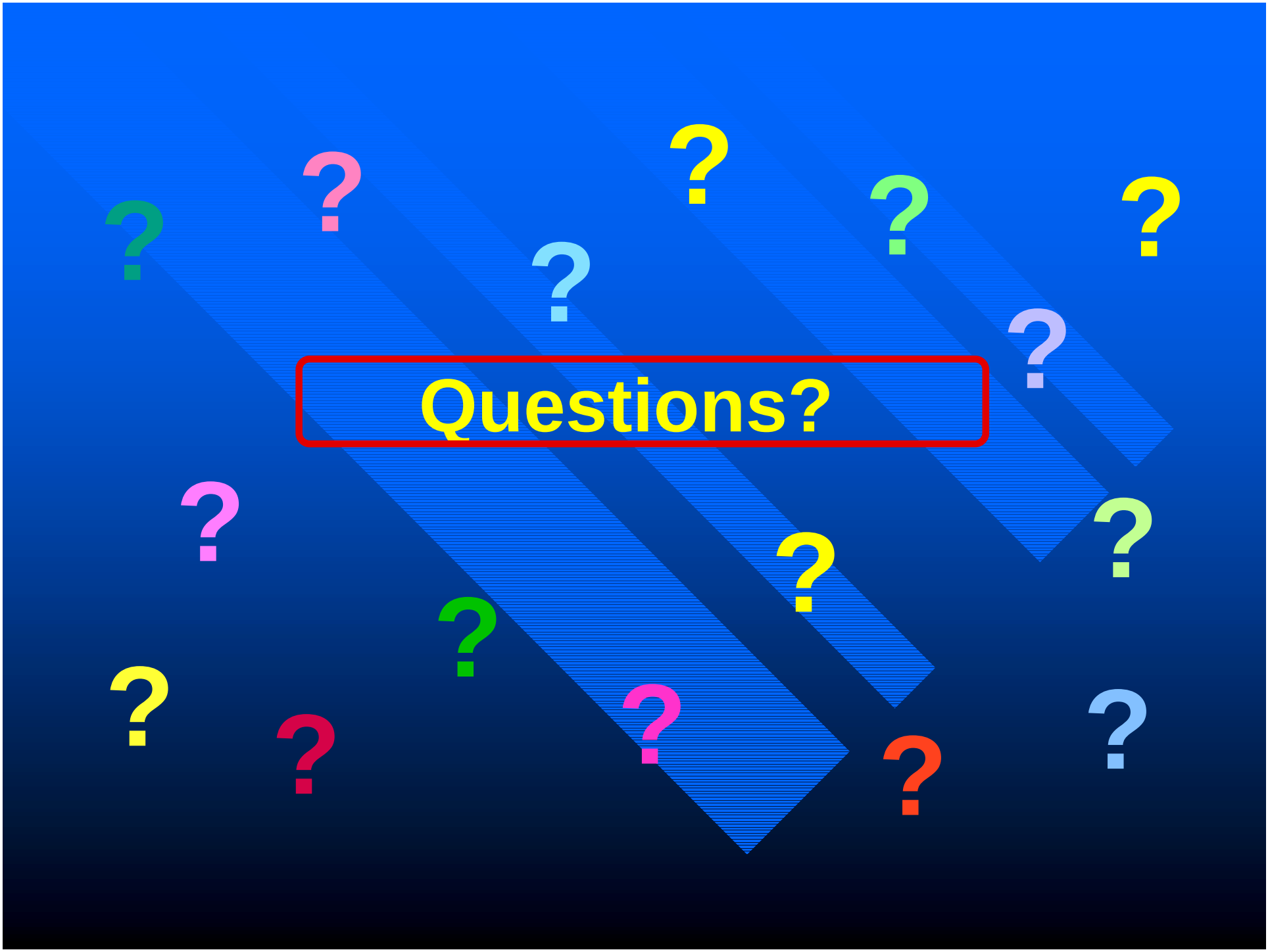
School of Renewable Natural Resources
Louisiana State University
Rm. 111 Renewable Natural Resources Bldg.
Baton Rouge, LA 70803-6202

phone: (225) 578-6432
fax: (225) 578-4251



http: http://www.rnr.lsu.edu/
e-mail: tshupe@lsu.edu




Questions?