

# Durability of Heat Treated Composites

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# Objective

- Examine the potential of heat treatment during composite manufacturing to enhance durability

# Early Work

- 1915 Tiemann – superheated steam at 150° C for 4 hours and reduced moisture sorption by 10-25%
- WWII activity
  - Lignostone and Lignifol in Germany
  - Staypak and Staybwood in US at FPL

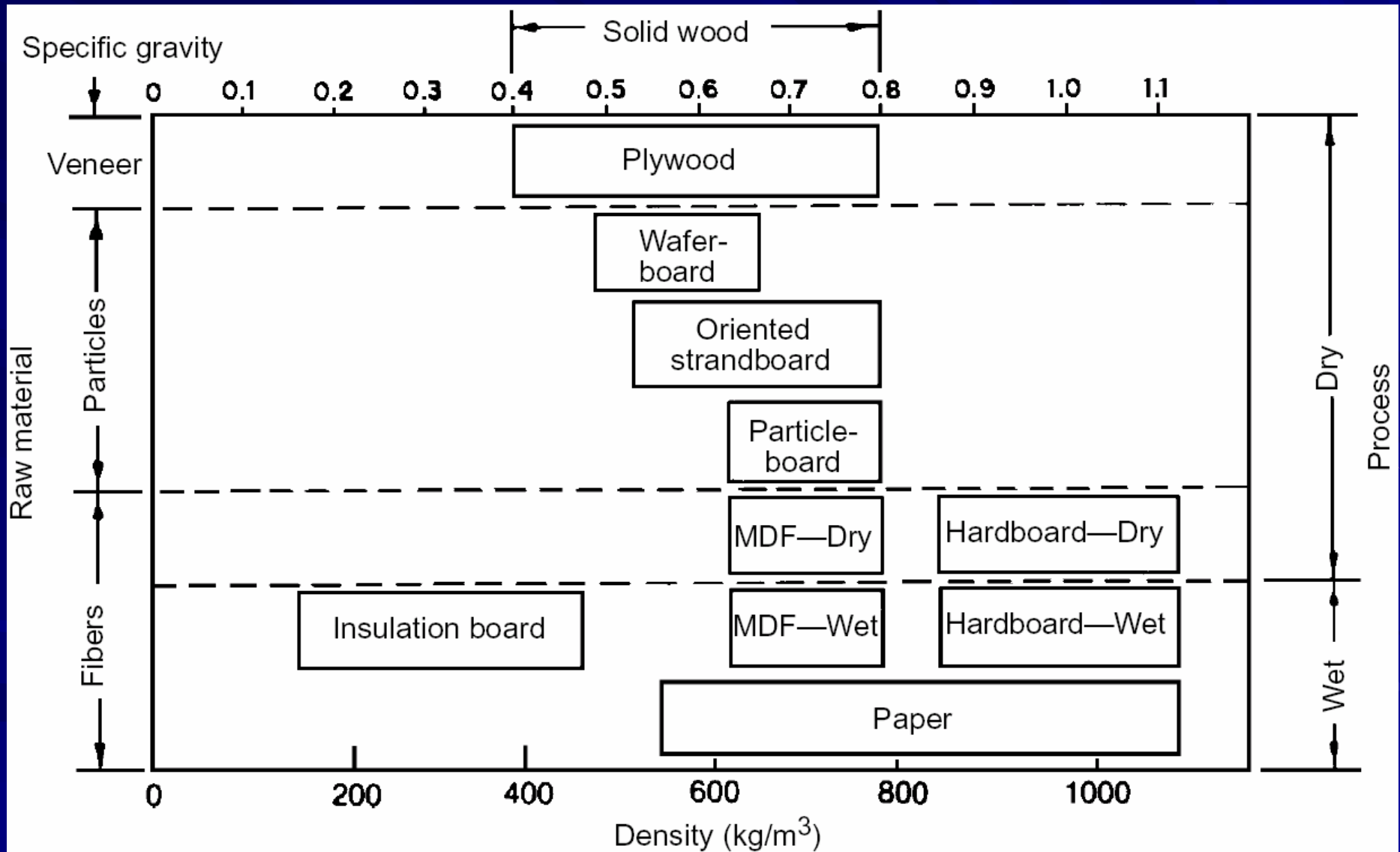
# Commercial Processes

- Menzholz (Hot Oil Treatment) (Germany)
- Plato (2step kiln-dry) (Netherlands)
- Retification (France)
- Perdure (France)
- Thermowood (Finland)

# Heat Treatment Benefits/Issues

<b>Positive</b>	<b>Negative</b>
Dimensional Stability	Toughness
Reduced Hygroscopicity	Abrasion Resistance
Improved Biological Attack	Increased Cracks and Splits
	Darkening

# Wood Composites Overview

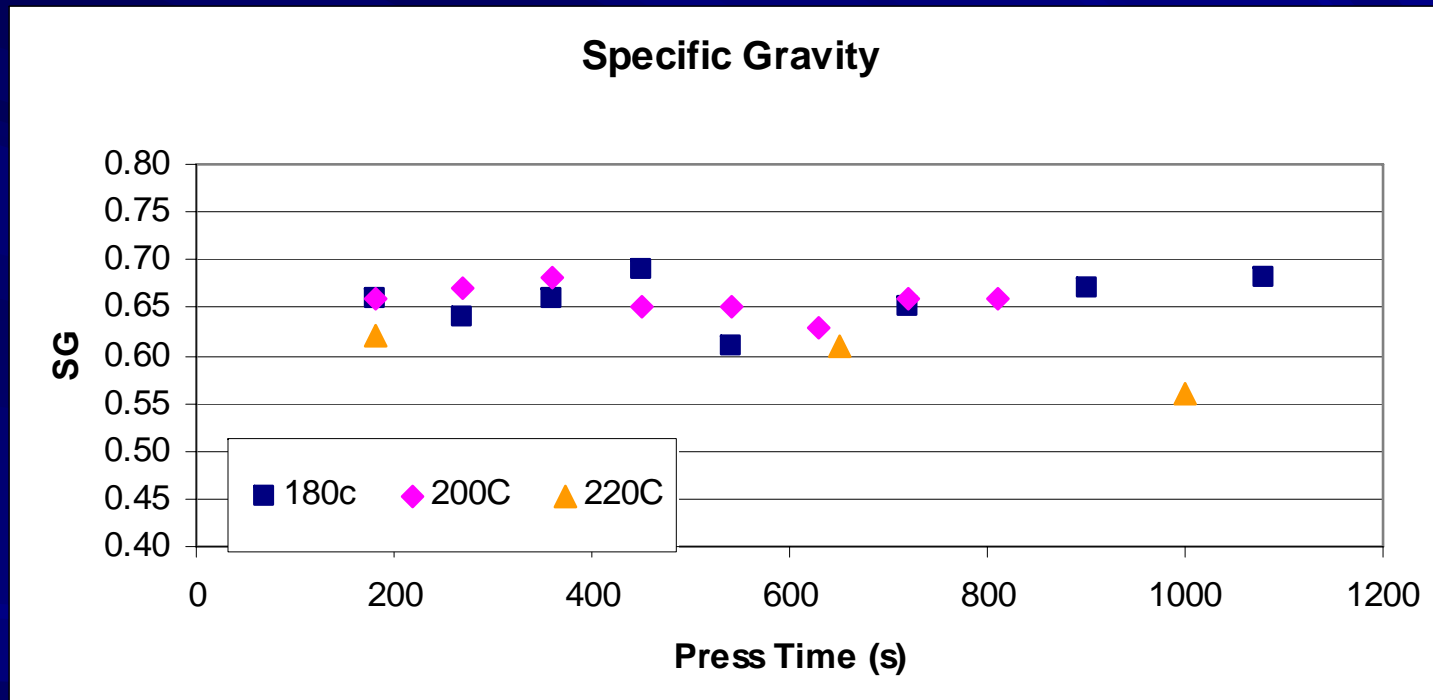


# Effects of extended hot-pressing of MDF

*Winandy & Krzysik (2006) In-progress*

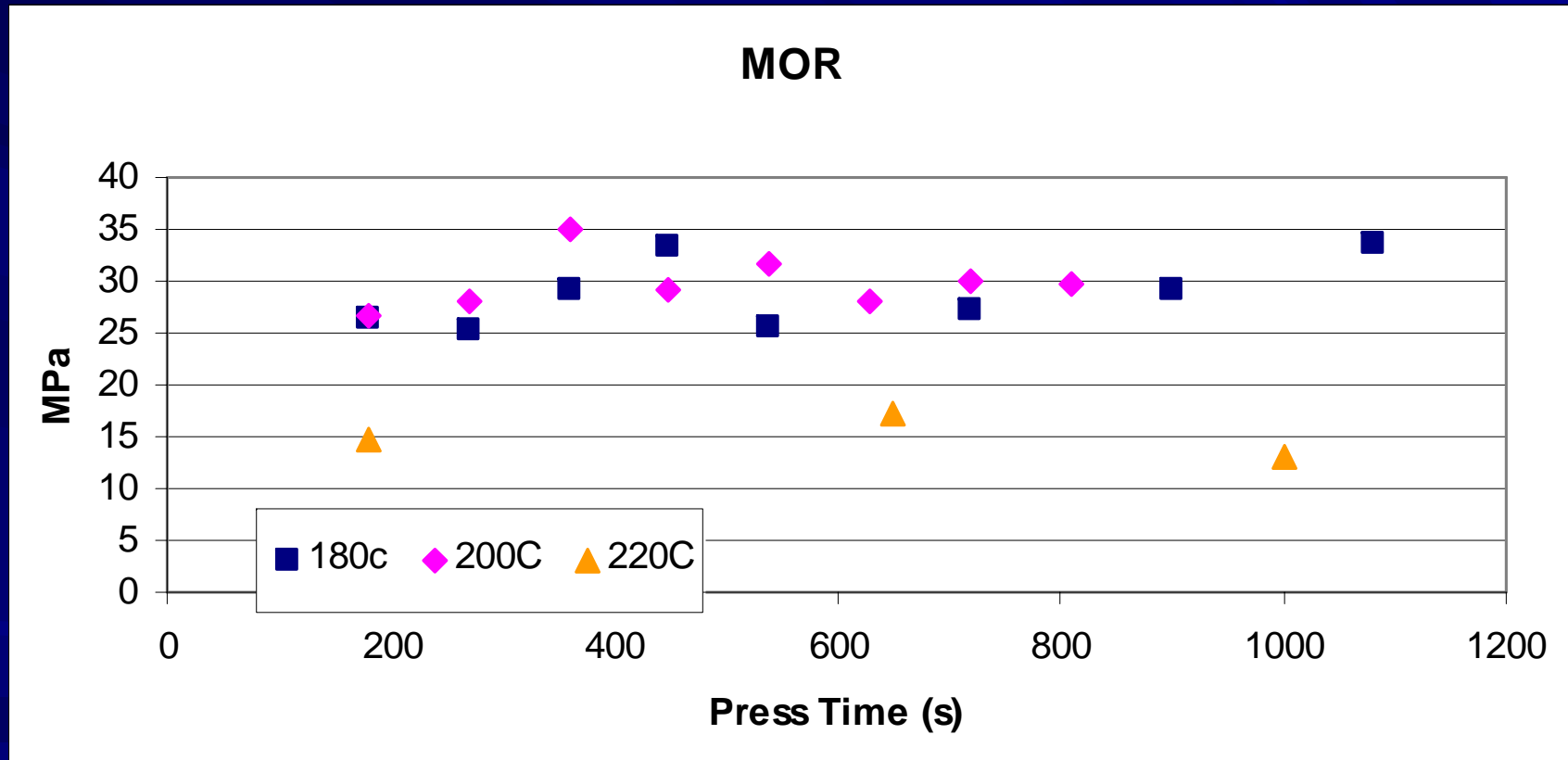
- MDF from commercial Aspen TMP fiber
- 5% Phenolic resin
- 3 Hot-press Temperatures  
(180, 200, 220 C)
- 8 Hot-press durations per temperature  
(3 to 18 minutes)
- Evaluate properties =  $f(\text{Temp} \ \& \ \text{Time})$

# Effects of extended hot-pressing of MDF



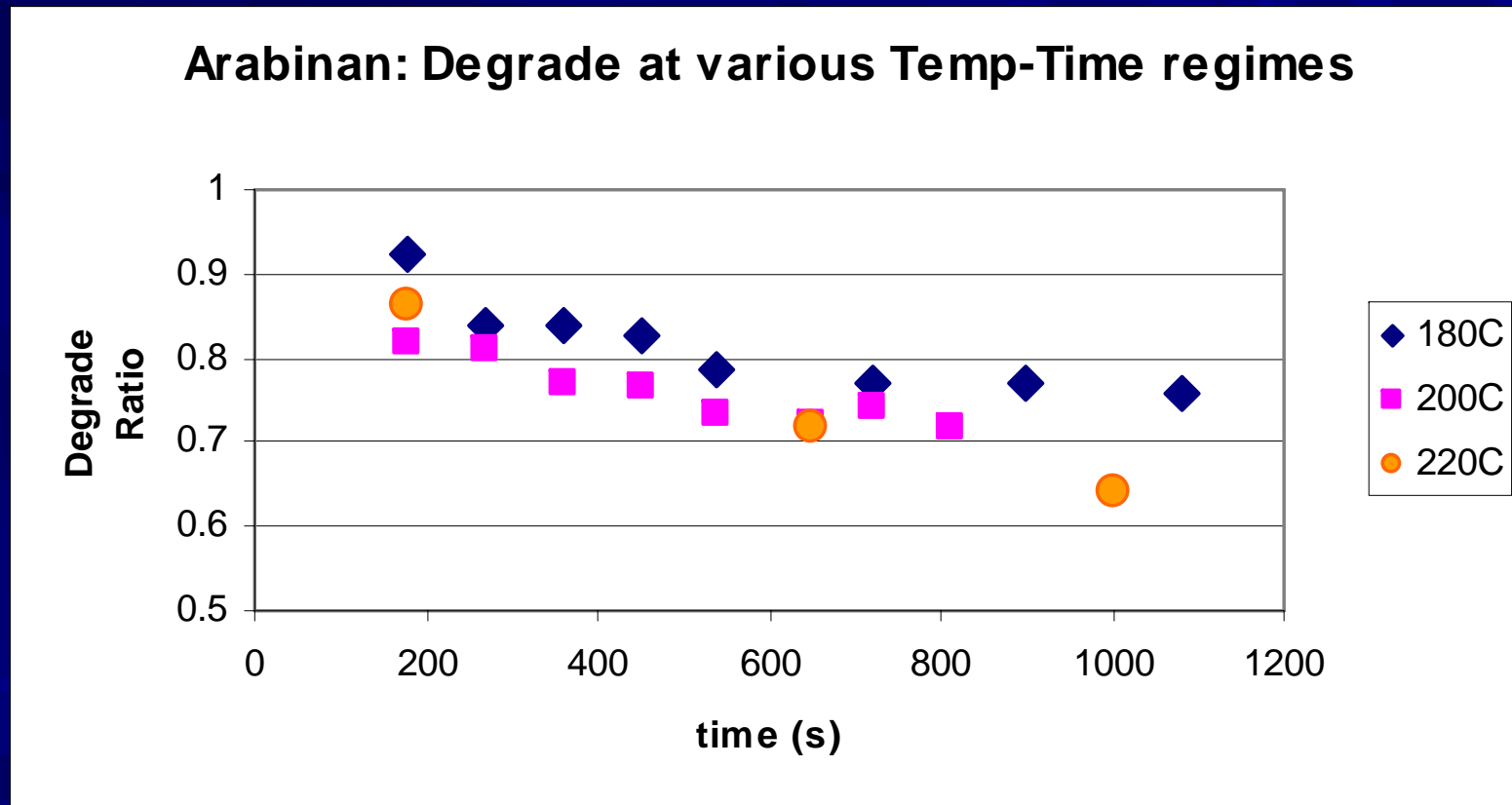
*Winandy & Krzysik (2006) In-progress*

# Effects of extended hot-pressing of MDF



*Winandy & Krzysik (2006) In-progress*

# Effects of extended hot-pressing of MDF



# Results of extended hot-pressing of MDF

- Wood Chemistry (very slightly affected)
- Hygroscopicity (reduced)
- Dimensional Stability (enhanced)
- Mechanical Properties (reduced)
- Durability (testing in-progress)

*Winandy & Krzysik (2006) In-progress*

# What About Termites?

## *Coptotermes formosanus*



# Effectiveness of HT to Termites

*(solid wood, composites unknown)*

- Scots pine and Norway spruce  
50.8 by 25.4 by 0.64 mm  
(2.0 by 1.0 by 0.25 inch)
- Each sample was cut into two 25 mm by 25 mm squares
- Matched samples were used for
  - Moisture content determination
  - Termite testing

*Smith et al (2003) IRG/WP 03-40264*

# Material Treatments

- 20 Scots pine and 10 Norway spruce specimens were subjected to an oil heat treatment at 220°C in rape seed oil
- After 32 minutes the middle of the specimens reached 220°C
- Oil temperature (220°C) maintained for four hours

# Impregnation Treatment

- 10 Scots pine specimens were impregnated with hot (rape seed) oil
- Vacuum pressure treated (15 minutes vacuum at 20 mbar followed by 15 minutes pressure at 10 bar) with rape seed oil at 120°C
- Conditioned in 120°C hot air for 24 hours.

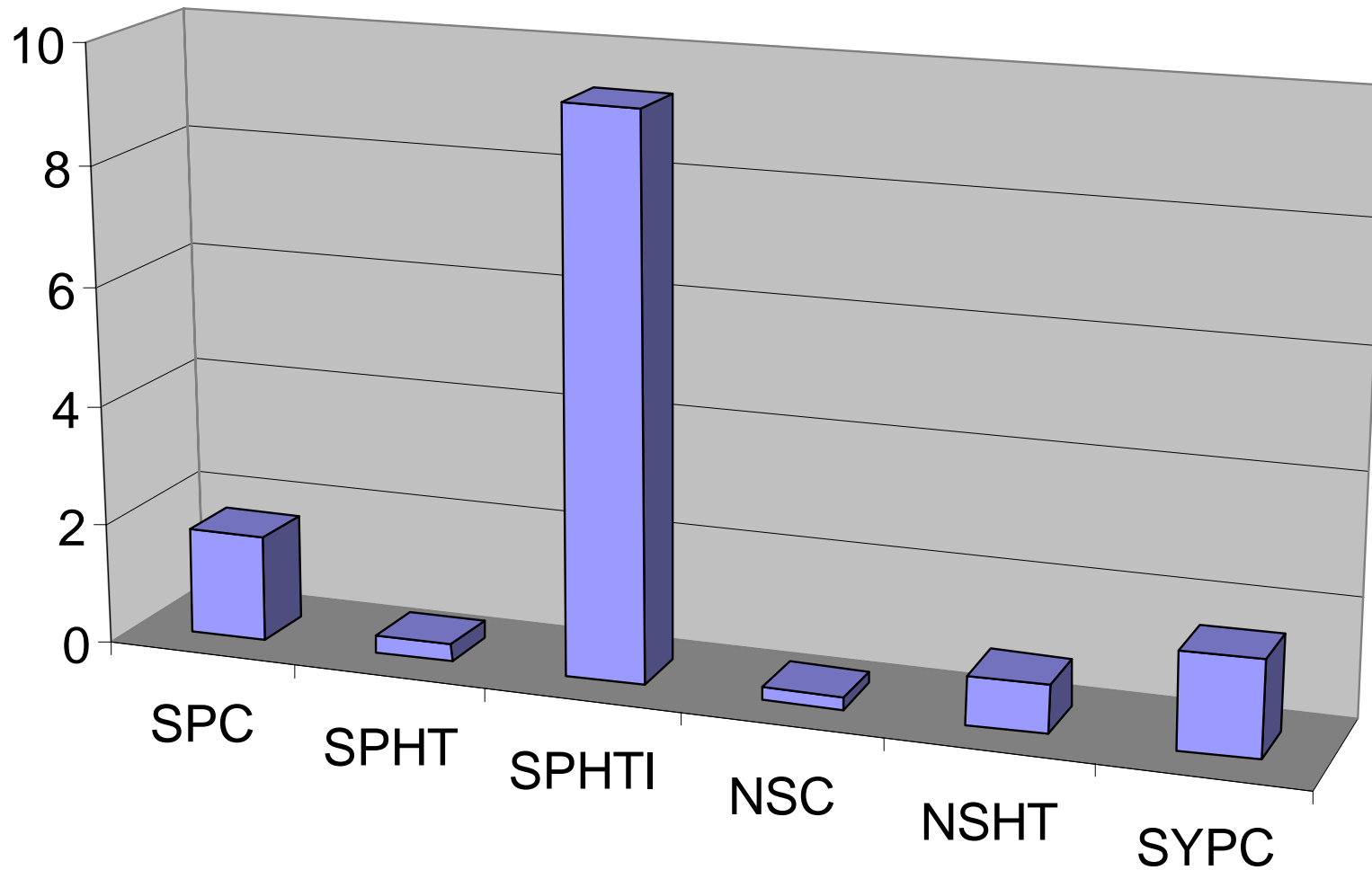
# *Coptotermes formosanus* Testing

- AWPA E-1 97
- Single choice or no-choice method
- Tests were run for 28 days
- Termites obtained from state park below New Orleans

# *Coptotermes formosanus* Testing



# Sample rating (0 failure and 10 minimal attack)



# Examples of Heat Treated Sample Results



Photos by Jay Curole, LSU

# Termite Durability Conclusions

- Heat treatment by the hot oil method alone did not resist attack by Formosan subterranean termites
- Impregnation with rape seed oil to a retention of 0.40 gm/cc did show promise
- It is unknown if this retention value is the threshold or whether a lesser oil-retention may work as well

*Smith et al (2003) IRG/WP 03-40264*

# Questions

