

# **Biological performance of wood-based composites post-treated with preservatives**

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# Importance of WBCs

- Increased utilization of WBCs
  - Depletion of high quality wood
  - Wide acceptance in construction
  - New composite technologies
- Protection requirements for WBCs
  - moisture, weather, biological agents (decay fungi, insects, and marine borers) and fire when used in the exposed outdoor environments



# Comparison of protection methods

## Post-treatment

- Advantages
  - Easy to apply
  - No modification of manufacturing process
- Disadvantages
  - Envelope protection only
  - No processing after treatment
  - Effects on mechanical and physical properties

## In-process treatment

- Advantages
  - Protection throughout the board thickness
- Disadvantages
  - Possible unfavorable chemical interaction with adhesive(s)
  - Degradation of mechanical properties
  - Emissions during manufacturing and processing

# Objectives

- To examine feasibility of post-treatment of WBCs
- To investigate the effectiveness of ACQ and CA retention levels on biological performance (decay and termite) in field tests
- To inquire long term field test data

# Materials and Methods

# Features of WBCs tested

Wood-based composite	Thickness (mm)	Density (g/cm <sup>3</sup> )	Adhesive	Raw material
Softwood plywood (SWP)	12.1	0.59	PF Type-1	Softwood, 5 ply
Hardwood plywood (HWP)	11.7	0.50	PF Type-1	Hardwood, 5 ply
Medium density fiberboard (MDF)	12.0	0.71	MUF	Hardwood fibers
Oriented strand board (OSB)	12.7	0.63	PF	Aspen
Particleboard (PB)	11.9	0.71	MUF	Hard-/softwood mix



# Preservative Chemicals

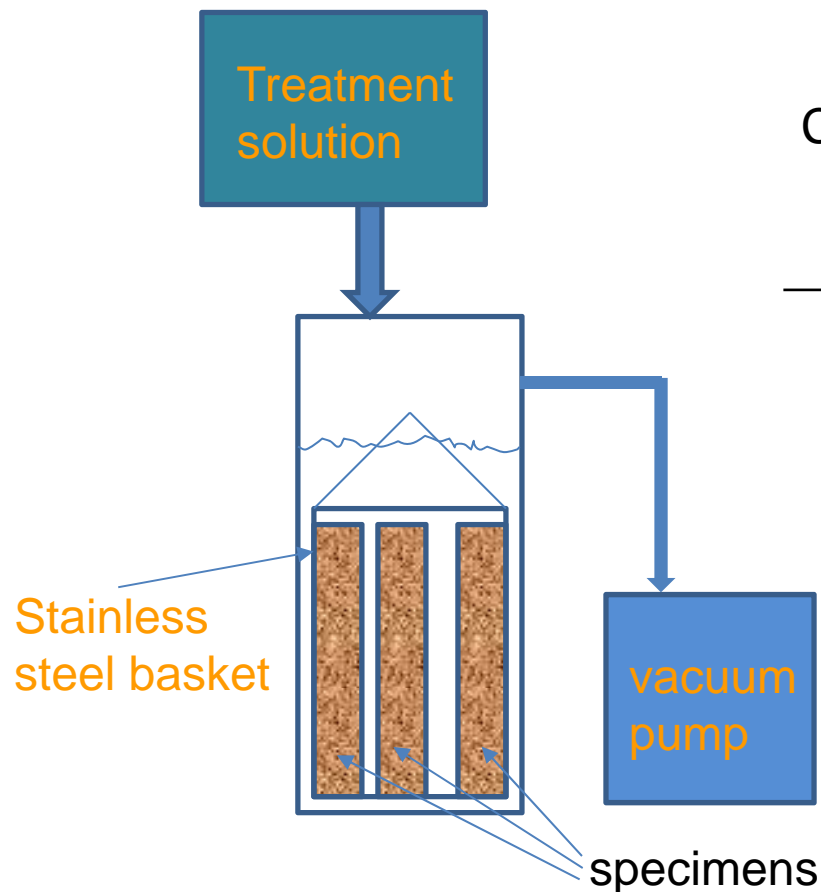
- Alkaline copper quaternary (ACQ)
- Copper azole (CA)
- Widely accepted as alternatives to CCA
- Higher treatment solution uptake and penetration when compared to acidic water-borne preservatives

# Target retentions

- According to JAS 2007, for sugi lumber (solid wood)
  - 0.65, 1.3 and 2.6 kg/m<sup>3</sup> as ACQ, respectively for K1, K2 and K3
  - 0.25, 0.5 and 1.0 kg/m<sup>3</sup> as CA, respectively for K1, K2 and K3
- For field tests of WBCs (no standard)
  - 2.6, 5.2 kg/m<sup>3</sup> as ACQ
  - 1.0, 2.0 kg/m<sup>3</sup> as CA

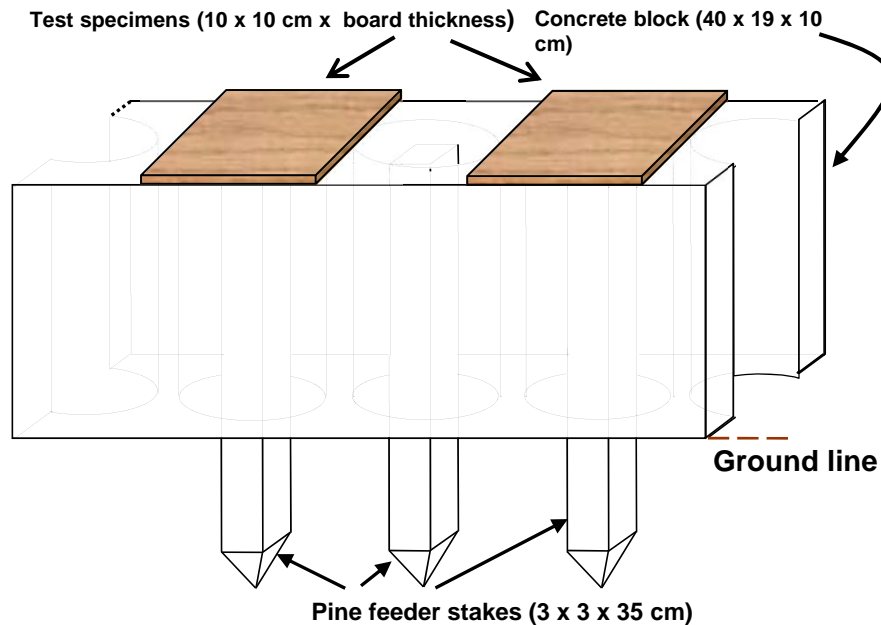


# Details of Vacuum Treatments



Composite	Treatment schedule [time (min)]		Water uptake (kg/m <sup>3</sup> )
	Dry vacuum	Wet vacuum	
SWP	30	60	153
HWP	30	20	193
MDF	10	1	398
OSB	10	1	339
PB	10	1	364

# Field Test



To simulate crawl space conditions in Japanese homes

AWPA Rating; 10 sound, 9 Trace of attack, 7 Moderate attack, 4 Heavy attack, 0 Failure, disintegration of specimen

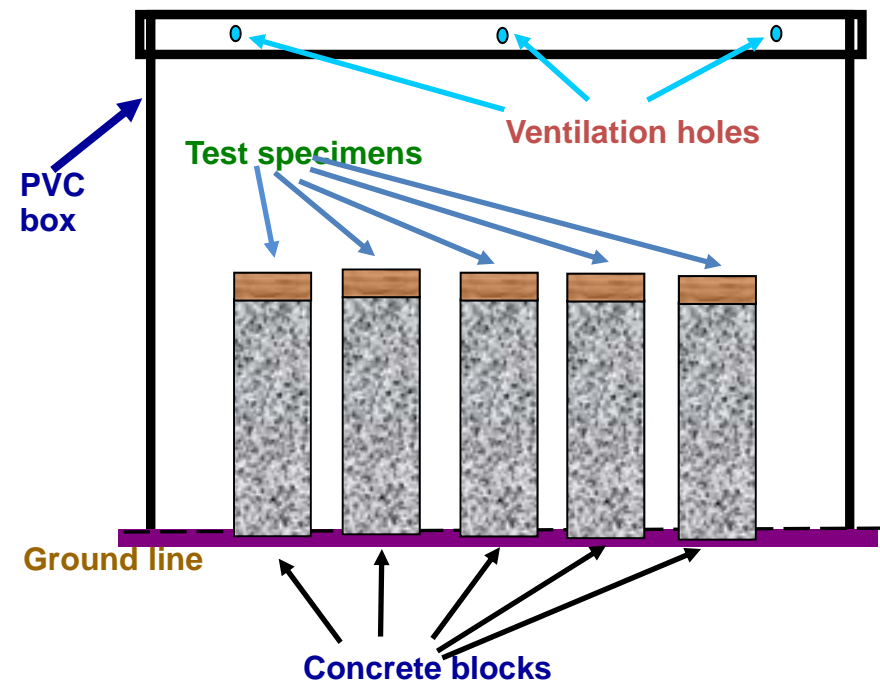
## The Living Sphere Simulation Field (LSF) in Kagoshima Prefecture

Mean annual rainfall : 2265 mm

Mean annual temp.: 18°C

Scheffer's climate index: 90

*C. formosanus*, *R. speratus* and wood-rotting basidiomycetes are present.



# Results

# Retentions

## ACQ treatments

Target retentions (kg/m3)	SWP	HWP	MDF	OSB	PB
<b>2.60</b>	3.26 (0.19)	2.05 (0.50)	2.85 (0.07)	2.45 (0.60)	2.58 (0.15)
<b>5.20</b>	6.24 (0.50)	6.88 (1.45)	5.76 (0.10)	5.49 (0.97)	4.58 (0.68)

## CA treatments

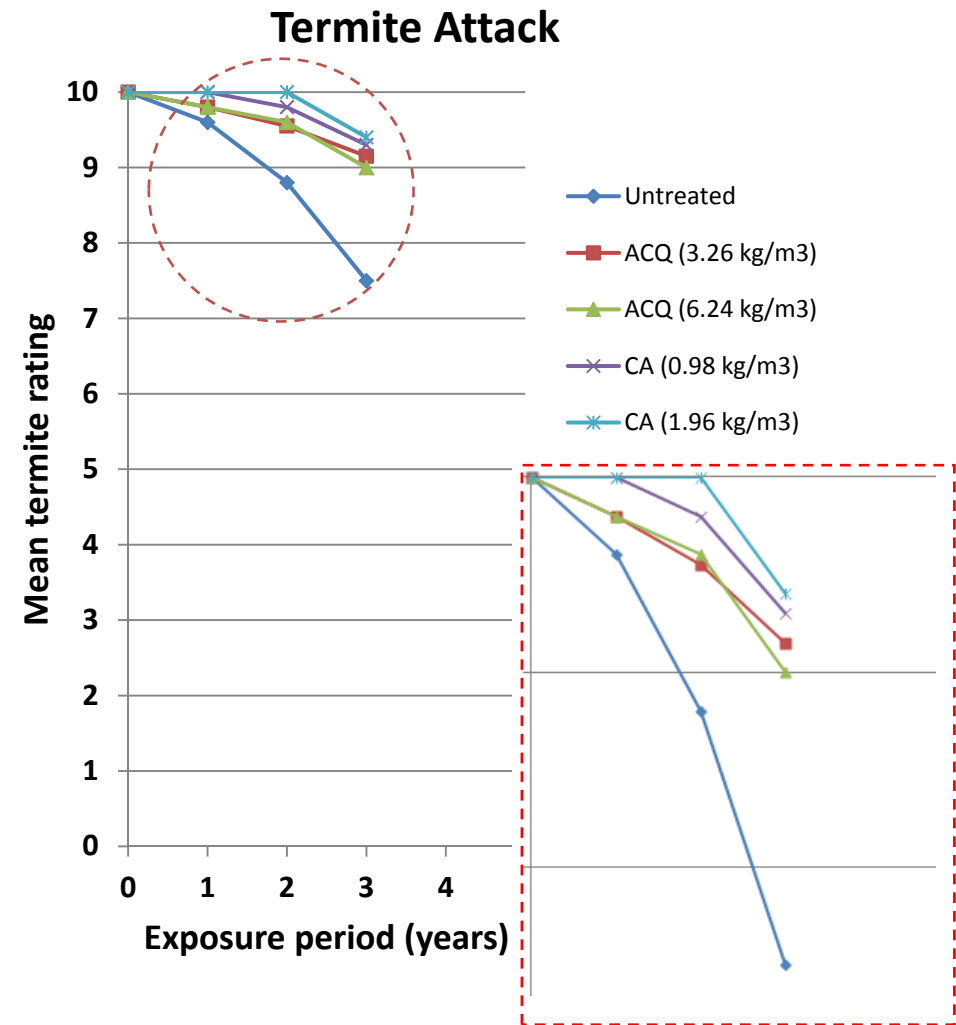
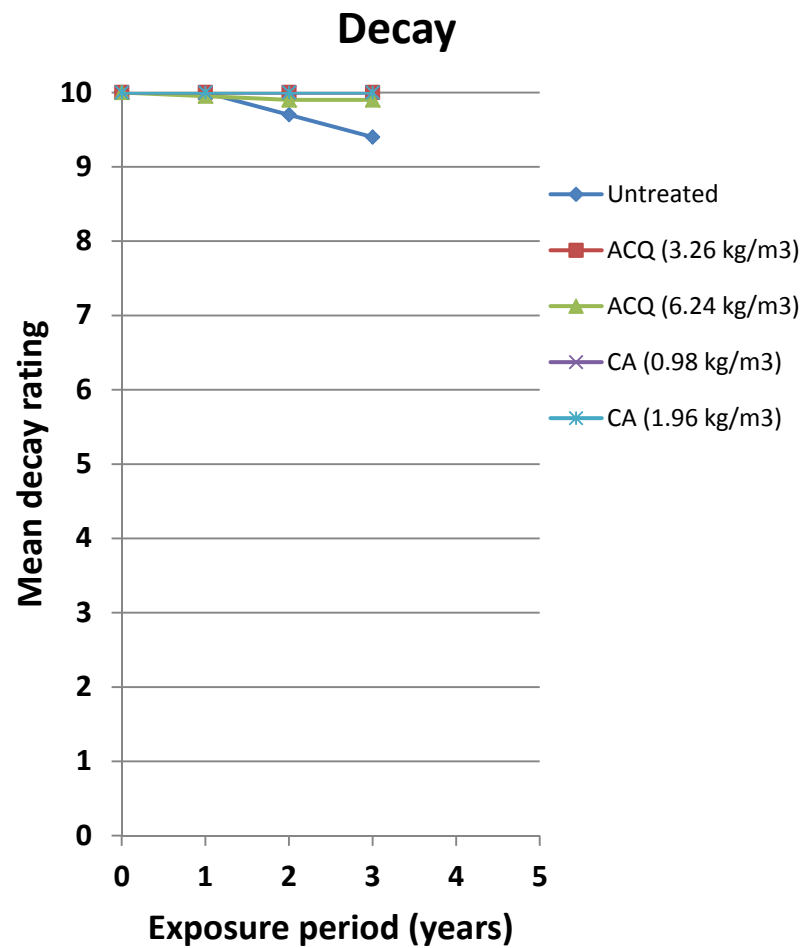
Target retentions (kg/m3)	SWP	HWP	MDF	OSB	PB
<b>1.00</b>	0.98 (0.05)	1.23 (0.29)	1.00 (0.01)	0.91 (0.29)	1.08 (0.04)
<b>2.00</b>	1.96 (0.18)	2.02 (0.24)	1.97 (0.04)	1.92 (0.58)	2.18 (0.04)



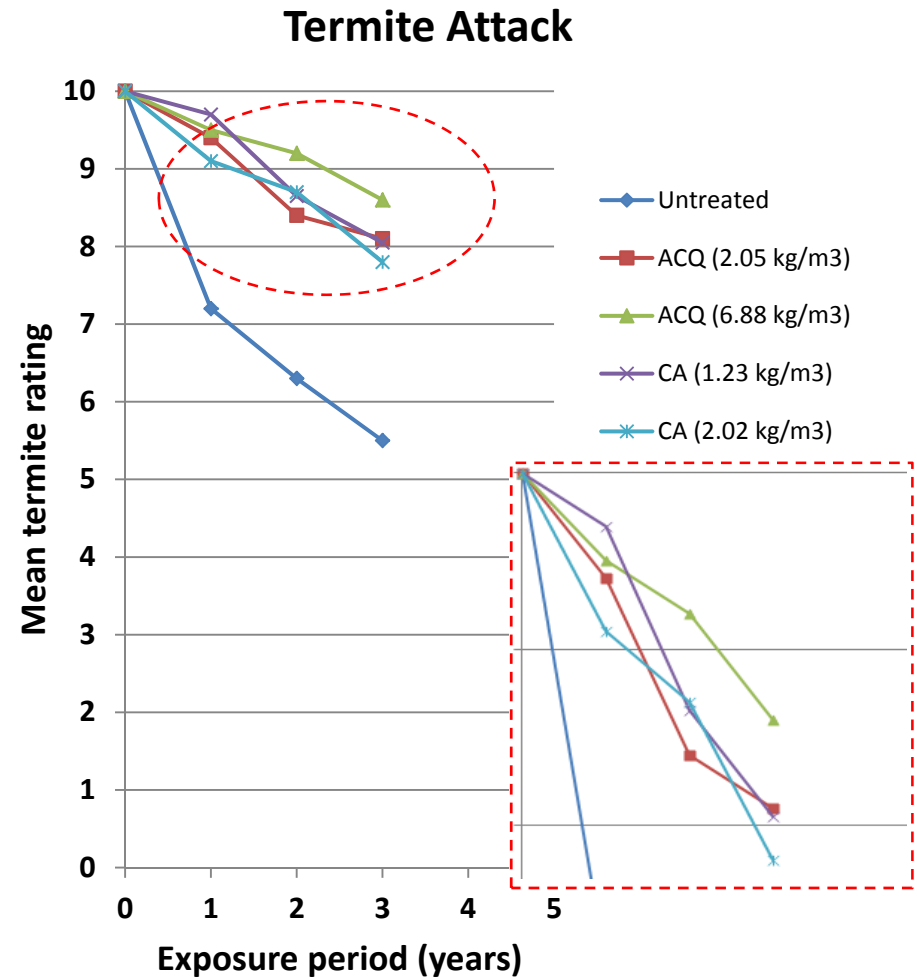
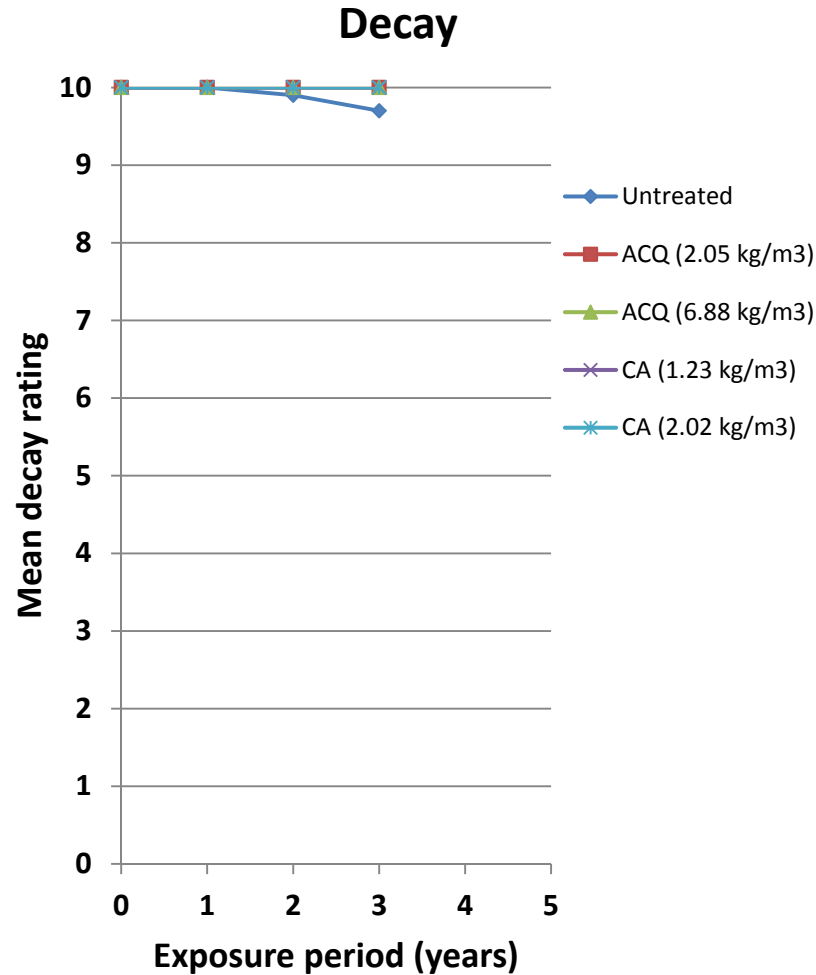
# Field test results (36 months exposure)



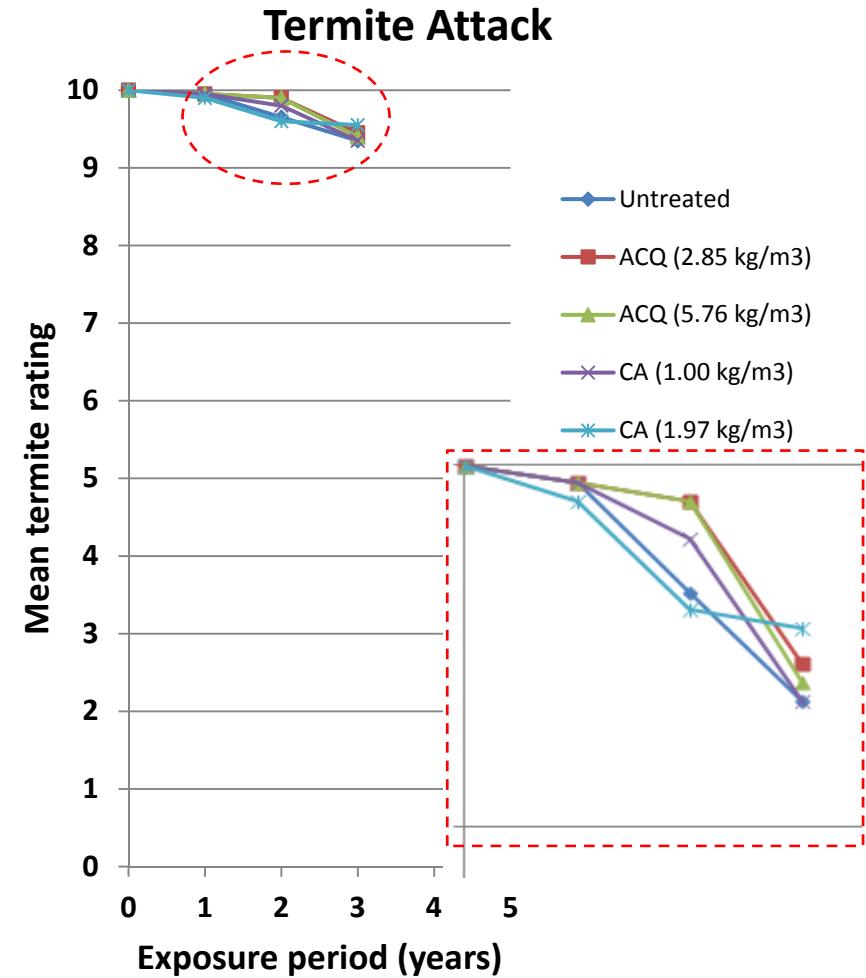
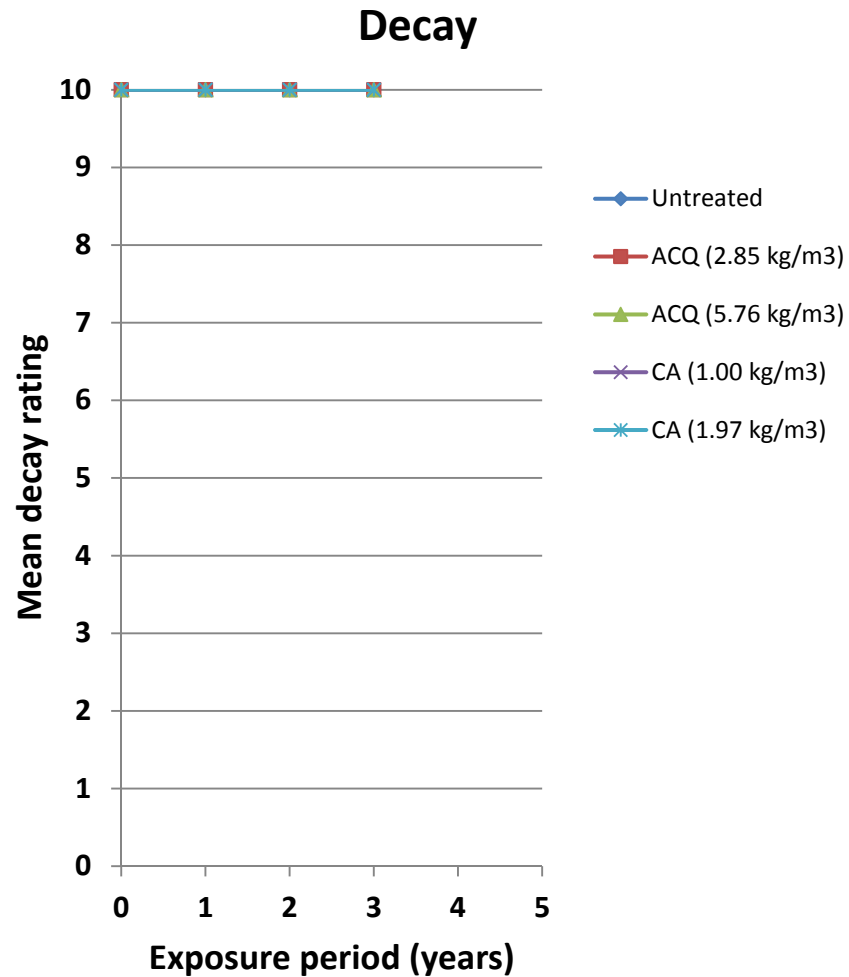
# SWP; progress in decay and termite attack



# HWP; progress in decay and termite attack

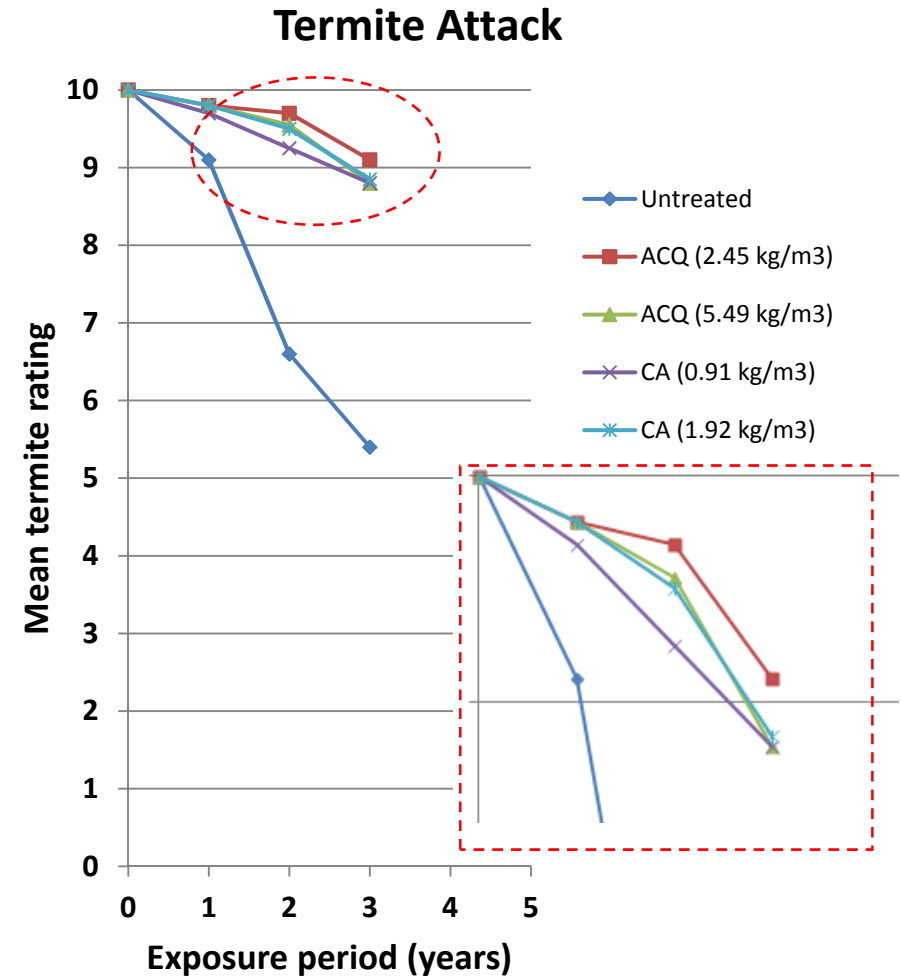
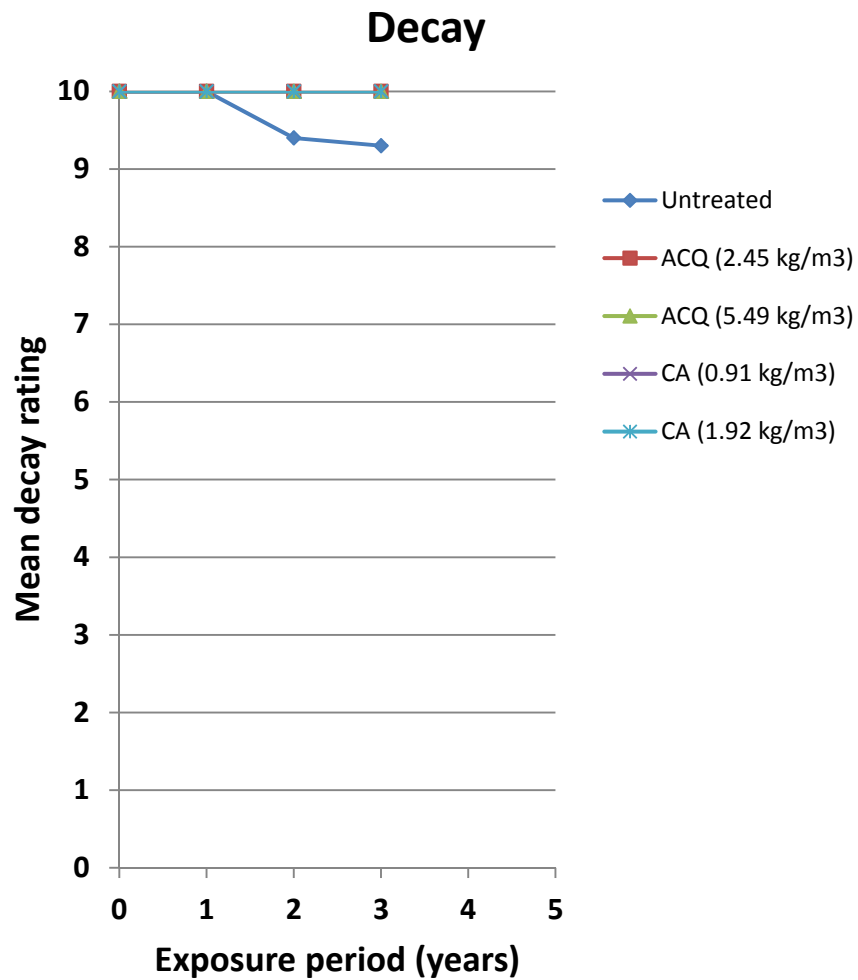


# MDF; progress in decay and termite attack



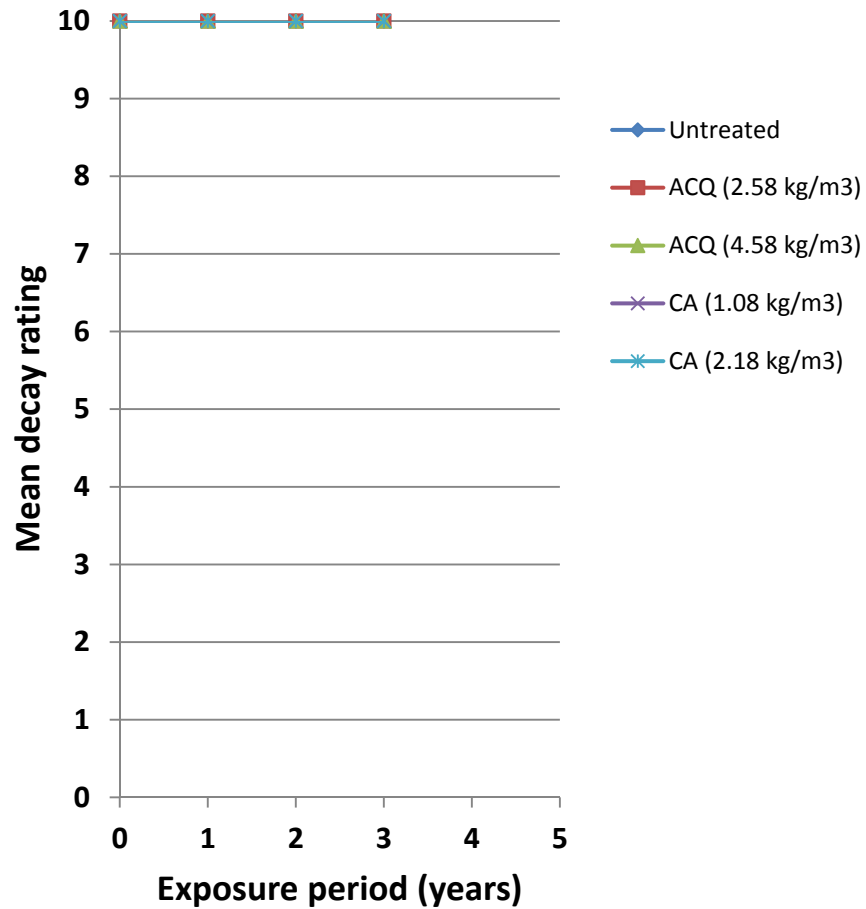


# OSB; progress in decay and termite attack

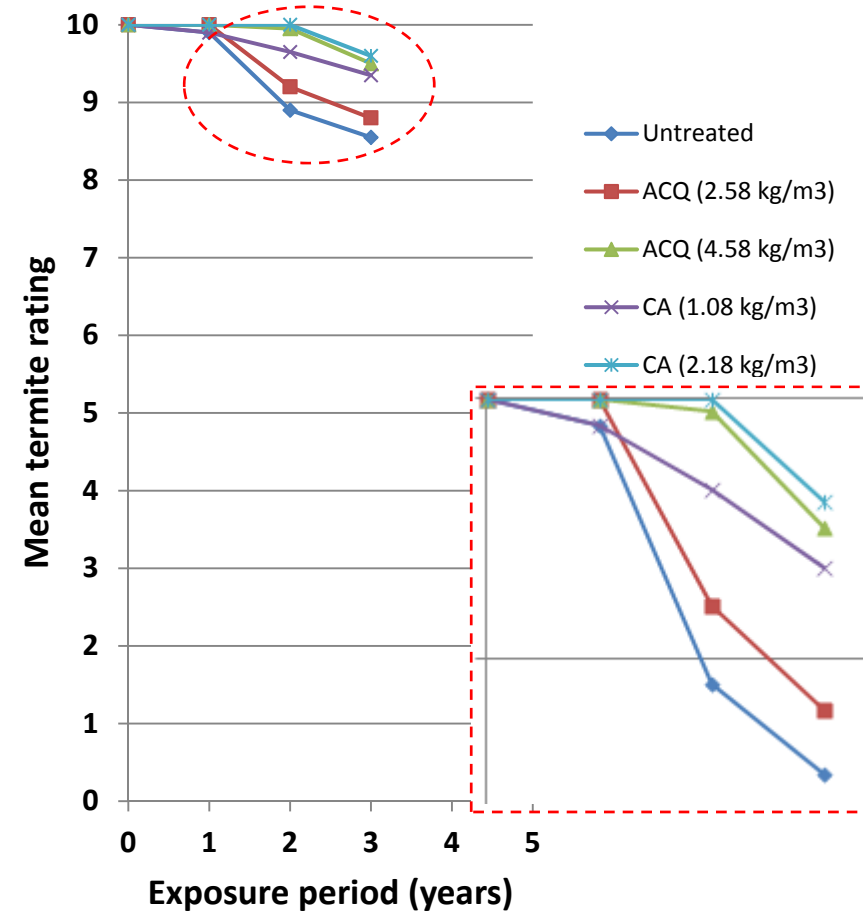


# PB; progress in decay and termite attack

## Decay



## Termite Attack



# Conclusions

- Untreated WBC are not durable enough, even in protected above ground conditions.
- MDF was naturally resistant to biological activity in the field conditions
- OSB showed the lowest resistance to decay and termite attack
- Post-treatment with ACQ and CA treatments at the retention levels tested significantly improved the termite resistance of SWP, HWP, OSB and PB.
- Termite damage started earlier and the severity of attack was always higher than fungal decay regardless of composite type.
- Preservative types and increased retentions did not significantly affect the decay and termite ratings so far (The test will be terminated in 2019)
- None of the preservatives or retention levels tested was successful in providing full protection (rating 10) at the end of 36 months.

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