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New research shows some H1 radiata can resist rot

There has been much publicity over 'dry rot' and other decay in the timber framing of relatively new buildings which leak. Hot off the press comes some new research which puts some facts behind the claims and counter claims about the use of treated timber.

Because there have been no systematic chemical analyses of the failed timber, it has not been possible to associate the decay with either treated or untreated timber (although it is highly unlikely that decayed Douglas Fir samples, recorded from a number of houses, would have been treated).

The question has been asked (and answered in the negative without any evidence being offered!) whether H1 treatment, intended only to prevent wood-boring insect attack, would have prevented the decay.

The research described here was designed to answer that question objectively. The test, used routinely at Forest Research to rapidly assess the efficacy of wood preservatives, relies on the fact that when fungi decay wood, they cause it to lose weight. Thus weighing test samples at constant moisture content before and after exposure to decay gives a quantitative measure of relative effectiveness of various timber treatments.

 Samples of timber used in the Forest Research project, showing the different levels of rot in timber with different treatments.

Test fungi

In this test, three decay fungi were used:

1. *Coniophora puteana* — a 'wet rot' of timber in buildings. It is not common in New Zealand, but in Europe it is called the "cellar fungus" as it is usually associated with wood in damp situations. The strain used in the test is very tolerant to a range of timber preservatives.
2. *Serpula (Merulius) lacrymans* — the true 'dry rot' fungus. This fungus is also not common in New Zealand buildings because it is generally associated with wood in close proximity to masonry. In Europe it typically occurs on wood embedded in, or in contact with, wet brickwork. The strain used was European and is used in European standard tests for assessing decay resistance of wood.
3. The third fungus (coded N4) was isolated from decayed wood from a house in Auckland. It has not been botanically identified, but it causes a brown rot in untreated wood.

Timber treatment types

Of particular interest was the decay resistance of timber treated to H1 retentions of boron and LOSP (permethrin), plus the decay resistance (if any) of relatively high retentions of boron and of LOSP with fungicide added.

The specific treatments used in the research were with:

1. thickened boron treatment, to a range of levels including H1
2. permethrin (LOSP) to H1
3. permethrin plus fungicide (IPBC)
4. boric acid in methanol to a range of levels.

The test procedure involved radiata pine sapwood blocks treated with the preservatives being first weighed at 12% moisture content. They were then sterilised, exposed to the decay fungi for six weeks, re-conditioned to 12% moisture content and finally reweighed. Any weight loss was recorded and the mean for each set of eight blocks was used as a relative measure of effectiveness of each treatment.

Results: some H1 treatments help prevent rot

The results are shown in Table 1. They can be summarised as follows:

- All three fungi caused significant weight loss in untreated blocks, ranging from 17 – 26 % weight loss.
- *C. puteana* (the wet rot) caused significant weight loss in blocks treated with boron (to a

retention of 0.08 % boric acid equivalent (BAE)), but caused no decay in blocks treated to retentions of 0.15% BAE and above.

- *S. lacrymans* (dry rot) and the unidentified local brown rot (N4) caused no decay in any of the boron-treated blocks.
- All three fungi caused significant decay in permethrin/LOSP-treated blocks. Weight losses caused by *C. puteana* and N4 were very similar to those caused in untreated blocks, but *S. lacrymans* caused only half the decay of untreated blocks.
- Addition of IPBC increased the fungicidal effectiveness of permethrin/LOSP. While at the highest addition level (0.024%) it did not fully control decay by *C. puteana*, the lowest retention markedly inhibited decay by the other two fungi and controlled it to below significant levels (3% weight loss) at an addition of 0.012%.
- *C. puteana* caused significant decay in blocks treated to 0.15% BAE and very slight (but significant) decay in blocks treated to 0.27% BAE cut from samples treated by the TILT process. The other two fungi caused no decay at any retention in this series of treatments.

Table 1. Percentage weight losses of blocks after exposure to decay.

Treatment type	Level	% weight loss		
		<i>C. puteana</i>	<i>S. lacrymans</i>	N4
Untreated		25.90	17.50	19.12
	Retention Analysed % BAE			
Thickened boron	0.08	16.02	-0.29	0.61
	0.15	0.41	-0.26	-0.05
	0.19	-0.04	-0.31	-0.29
	0.21	-0.11	-0.23	-0.34
	0.32	-0.20	-0.56	-0.41
	0.35	-0.29	-0.39	-0.42
	0.43	-0.21	-0.25	-0.45
Permethrin LOSP	Nominal %			
	0.006	26.70	9.35	17.74
Permethrin + IPBC LOSP (% IPBC in LOSP solution)	0.006 + 0.008	28.35	3.93	2.52
	0.006 + 0.012	22.36	1.92	-0.40
	0.006 + 0.016	15.36	1.10	-0.74
	0.006 + 0.024	9.86	-0.39	-0.87
Boric acid/methanol	Analysed BAE % X-Sect			
	0.15	7.23	-1.19	-0.92
	0.24	0.62	-1.63	-1.53
	0.26	2.62	-1.74	-1.57
	0.27	3.43	-1.95	-1.75
	0.52	-0.68	-1.31	-1.61
	0.53	0.13	-0.03	0.00
	0.84	0.74	0.33	0.46
Key:		Significant weight loss	Insignificant weight loss	

Conclusions

A strain of the true dry rot fungus and a local brown rot isolate of unknown species can cause significant weight losses to untreated wood and wood treated with the insecticide permethrin as an LOSP H1 treatment. However, decay by both fungi is completely controlled by levels of boron in H1-treated wood.

Decay by these two fungi is similarly controlled if the fungicide IPBC is added to permethrin/LOSP at a concentration of 0.012% in the treating solution.

Decay by the wet rot fungus *Coniophora puteana* is less readily controlled by boron or IPBC, but this fungus does not appear to feature in decayed timber taken from recently constructed dwellings. Thickened boron-treated wood appears more resistant to decay by this fungus than wood treated using the TILT Process. This may be because thickened boron contains the fungicide ►

octhlinone at a low concentration (which is added to prevent mould growth during diffusion storage). This fungicide also shows activity against decay fungi and, even at the low levels which would be present in treated wood, it could well augment the fungicidal effectiveness of boron compounds.

Boron treatment is an effective treatment to control the true dry rot and retentions present in H1 boron-treated wood are sufficient for this purpose. The addition of the fungicide IPBC to H1 LOSP treatment also readily controls dry rot. ◆

What about the effects of leaching?

Obviously, if boron-treated wood is exposed to a severe leaching environment (i.e. a lot of water), there will be losses of the preservative and its effectiveness will decrease. But how severe is this and what losses can be expected?

A trial was set up in 1951 to determine leaching rates of boron from treated wood exposed to the elements. The trial consisted of 50 x 100 x 2400 mm radiata pine treated to 0.32% and 0.55% boric acid. Almost immediately after treatment, the timber was erected as vertical frames. Samples were taken for cross-section analysis at 6, 12 and 26 weeks.

After six weeks exposure during which 140 mm of rainfall was recorded, the lower retention timber had lost 9% of its original boric acid loading and the high retention had lost 13% of original loading. Even after 26 weeks outdoor exposure and 522 mm of rain, the low retention timber still contained 72% of original loading and the high retention timber still contained 67%.

It is hard to envisage any situations in modern dwelling construction where such severe leaching could take place. Certainly, a high wood moisture content (such as around 28 – 30% MC, although dry rot will attack timber with lower MC) is required for untreated wood to be prone to decay. This is happening in cases where leaks occur!

Conclusions

The evidence from the recent study indicates that H1 boron treatment, but not H1 LOSP (unless amended with a fungicide), will prevent decay by dry rot, provided the treated timber is not subjected to severe leaching.

However, it is worth remembering that for boron to leach from wood requires a flow of water over it for a significant period of time or it must be immersed in pools of water, the volume of which must be high in relation to the volume of wood it surrounds. Neither of these conditions is likely to be met in situations where framing timber is encased in a cladding which subsequently fails. ◆

BRANZ comment: Timber treatment and subfloor framing

The research results outlined by Mick Hedley in the above article assist in the debate about the timber treatment levels needed for subfloor framing. The use of a damp-proof membrane over the ground is being suggested by some as being sufficient to change the relative humidity (RH) of the air in subfloors to the extent that treatment of kiln-dried framing timber is then not required. However, the air under a building will usually be at least as moist as that outside the building, even if a damp-proof membrane is used. In many parts of the country, and especially on the West Coast and the northern half of the North Island, RH exceeds 80% for long periods of time. Research has shown that radiata pine exposed at 80% RH will have an equilibrium moisture content of 18%. NZS 3602 *Timber and wood based products for use in building* Clause 105.5 states that kiln-dried untreated timber must be maintained at or below 18%, which is not possible where the RH exceeds 80%.

As neither NZS 3602 nor MP 3640 *Specification of the minimum requirements of the New Zealand Timber Preservation Council Inc* differentiate between the various treatments used for H1 protection (copper chrome arsenate, LOSP or boron treatments), and in light of Mick Hedley's findings and other research, and unless it can be clearly shown that the atmosphere under a building is going to remain at less than 80% RH, then ***the prudent designer would specify H1-treated radiata pine timber with a boron preservative to provide fungal and insect protection to all subfloor framing, even if a damp-proof membrane is to cover the ground.***