EVALUATION OF TWO METHODS USED IN ASSESSING WOOD FINISHING SYSTEMS AGAINST BLUE STAINING FUNGI

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AHMAD SHAKRI MAT SEMAN. 1989. Evaluation of two methods used in assessing wood finishing systems against blue staining fungi. Two testing methods, EN 152 and Chiptest, were evaluated to assess the effectiveness of wood finishing systems against blue-stain fungi. Method EN 152 was by exposing the treated samples to natural weathering, followed by laboratory fungal test. The Chiptest method was by laboratory fungal test without exposure to weathering. The assessments were done on the surface discolouration and blue-stain free zone. The study showed that EN 152 method was the more suitable for determining the effectiveness of the finishing system against blue-stain fungi.

Key words: Scots pine - finishing - EN 152 method- Chiptest method - blue-stain fungi - surface discolouration

Introduction

The significance of blue-stain fungi causing disfigurement of timber in service has been reported by Dickinson (1971) and Bravery and Miller (1980). These fungi can penetrate certain types of coatings or gain access to the timber through natural cracks or small breaks in the film and thence proliferate within the timber structure. A number of methods are being used at present to assess the effectiveness of wood preservatives in preventing blue-stain and decay attack.

One of the standard methods for determining the effectiveness of wood-finish formulations against blue-stain fungi is European standard EN 152 (Anonymous 1984). This standard is a laboratory method which combines natural weathering and biological assay and takes about 7.5 *mth.* There was thus a need to have a shorter method. I designed another method - the Chiptest method, to assess the effectiveness without natural weathering. Here, I compare the two methods for determining the effectiveness of wood-finish formulations against blue-stain fungi.

Materials and methods

The sapwood of sound, straight grained, knot-free and stain-free scots pine were used as test samples. The size of the samples for EN 152 and Chiptest method were $110 \times 40 \times 10$ *mm* and $50 \times 30 \times 4$ *mm*, respectively. The surfaces to be coated with finishes were sanded smooth with grit-size 80 sandpaper. After conditioning at $20^{o}C$ and 65% relative humidity for two weeks the cross sectional ends of the samples were sealed with three coats of Tivosan. Ten low built and high built finishing formulations were used in this study. Two compounds containing anti-blue-stain chemicals, preventol A4 and IPBC were incorporated into the proprietary wood stain for application as shown in Table 1. The low built formulation was applied as an undercoat and the high built formulation as the topcoat. The average amount of finishing formulations applied on each sample is given in Table 2. However, for finishing system C, high built formulation containing 0.65% IPBC was used as topcoat for the EN 152 test. Also, for the finishing system D, high built formulation was used as an undercoat. In all the tests only three longitudinal surfaces of the samples were coated.

Table 1. Anti-blue-stain ingredients in the proprietary wood stain used

Finishing systems	Concentration of active ingredients (%)	
	Low built undercoat	High built topcoat
A	0.2 IPBC	0.2 IPBC
B	0.2 PA-4	0.2 PA-4
C	0.5 IPBC	0.2 IPBC*
D@	1.15 PA-4	1.15 PA-4
E	0.65 PA-4	0.65 PA-4
F (Control)	0	0

* 0.65% IPBC was used for EN 152 test samples
@ High built formulation was also used as undercoat

Table 2. The average amounts of formulations applied on test specimens

Finishing systems	Average amounts of formulations applied on each wood specimen ($g\ m^2$)	
	EN 152	Chiptest
A	167	112
B	157	106
C	106	95
D	90	92
E	157	98
F	167	102

The test fungi used in this study were *Aureobasidium pullulans* (de Bary) Arnand, strain P 268 (Hann-Munden) and *Schlerophoma pityophila* (Corda) V. Hohn, strain S 231 (Hann-Munden). The spore suspension of the test fungi was prepared by inoculating three pieces of agar containing the fungi into flasks containing malt-extract and nutrient solution at pH 4.2.

Biological test with EN 152 standard method

Six replicate samples were used for each coating system in this test. The test was conducted based on EN 152 method (Anonymous 1984). The coated samples were exposed in the open on the roof of a building, in the University of Ghent, Belgium. The samples were placed at an angle of 45° facing southwest and approximately 30 *m* above sea level. At the end of the test, surface discolourations were evaluated and the blue-stain free zone was measured. Surface discolourations were graded visually according to the ratings given below:

0 = not blue stained: no blue-stain can be detected visually on the surface,

1 = insignificant blue stained: the surface exhibits only individual small blue stained spots with a diameter of 2 *mm* or more,

2 = blue stained: the surface was continuously blue stained up to a maximum of one third, or partially blue stained or in streaks up to half the total area,

3 = strongly blue stained: more than one third of the surface was continuously blue stained or more than half was partially blue stained.

In addition, the samples were cut parallel to the end faces at 30 *mm* from each end. The depth of blue-stain free zone of both cut surfaces was measured with a measuring device at three fixed points, that is, the middle and at a distance of 10 *mm* from each side of the specimen (Figure 1).

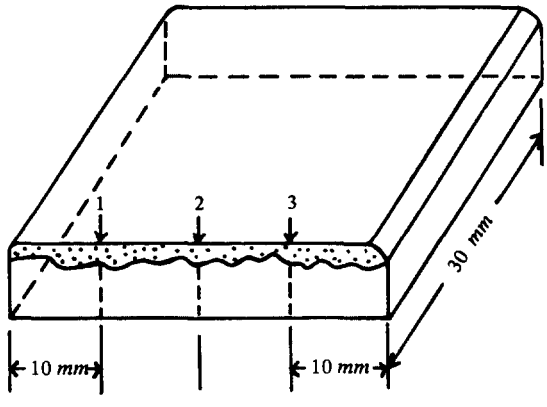

Figure 1. A specimen showing the measurement of the depth of blue-stain free zone

Chiptest method

Three replicate samples were coated with each finishing system. After coating all samples were conditioned for a period of one week and then 10 *mm* sections were cut from each of the cross sectional surfaces and discarded. The middle portion was sliced parallel to the grain into five slices 4 *mm* thick and marked as shown in Figure 2. The samples were then sterilized by using 1.5 Mrad Gamma irradiation for about 60 *h*. Petri dishes containing vermiculite and distilled water were steam sterilized and used for incubation of the samples. The sterilized samples were first dipped for 1 to 2 *s* in the spore suspension of blue staining fungi, *A. pullulans* and *S. pityophila* and then transferred aseptically to the petri dish. About 30 *ml* of the spore suspension was poured over the treated samples and incubated at 25°*C* and 70% relative humidity for six weeks. At the end of the incubation, surface discolourations were evaluated and the blue-stain free zone was measured. The surface discolourations were assessed according to the ratings given below:

0 = not blue stained: no blue-stain can be detected visually on the surface,
1 = below 20% blue stained,
2 = between 20 - 40% blue stained,
3 = between 40 - 60% blue stained,
4 = between 60 - 80% blue stained,
5 = more than 80% blue stained.

The blue-stain free zone was measured at both sides of the 'a'at seven points for each side at 0.5 *mm* interval from the centre (Figure 3). The mean free blue-stain zone was taken from these 14 readings.

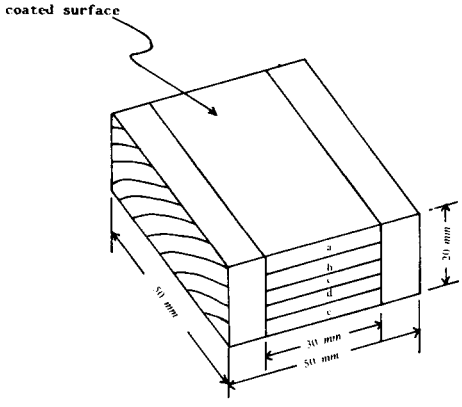

Figure 2. Preparation of slices for Chiptest

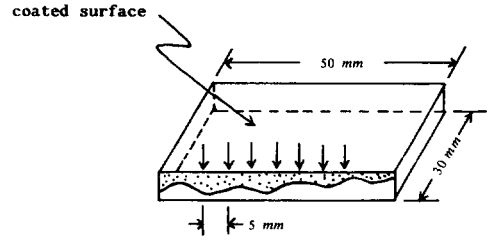

Figure 3. The top slice showing the measuring of depth of blue-stain free zone

Results and discussion

The surface discolouration ratings obtained in the EN 152 and Chiptest methods are given in Table 3. The results obtained in the two tests were quite different. The Chiptest gave zero rating for all the systems tested indicating that no discolouration by the blue staining fungi occurred whereas in the EN 152 method ratings ranged from 0 to 3.

Table 3. Ratings of surface discolouration from EN 152 and the Chiptest methods

Finishing systems	EN 152		Chiptest	
	Range	Mean	Range	Mean
A	0 - 2	1.0	0	0
B	0 - 1	0.7	0	0
C	1 - 3	2.4	0	0
D	1 - 2	1.6	0	0
E	0 - 1	0.2	0	0
F	2 - 3	2.8	0	0

The difference in the results obtained in the two test methods could be most probably due to the period of exposure in the EN 152 method. It is most likely that during the exposure period, failure of the finishing systems could have occurred as a result of degradation by ultraviolet irradiation. In addition, exposure to rain could also result in damage to film. Minute checks or cracks might be present to allow access to the the blue-stain organisms. The nett result of the exposure is that in the laboratory fungal test, the staining fungi may have had easy access to the surfaces of the samples. In the Chiptest method, none of the treated surfaces were attacked. However, in both tests the untreated surfaces were attacked by blue-stain fungi. The mean depth of the blue-stain free zone from both methods are given in Table 4. The mean values obtained by EN 152 and the Chiptest methods ranged from 0.3 to 4.9 *mm* and 0.1 to 1.5 *mm*, respectively. This shows that the EN 152 test samples had greater protection from blue-stain than the Chiptest samples eventhough the EN 152 samples were exposed to natural weathering for a period of six months before being submitted to laboratory fungal test (Table 4).

Table 4. The mean depth of blue-stain free zone from EN 152 and Chiptest

Finishing systems	The mean depth of blue-stain free zone (*mm*)	
	EN 152	Chiptest
A	2.2	0.4
B	1.0	1.5
C	4.9	0.2
D	3.7	1.3
E	1.5	1.2
F	0.3	0.1

Weathering had contributed to the higher values of blue-stain free zone in EN 152 samples. During weathering, the weathered surfaces may have allowed the ingredients of the finishing system to move down into the samples through cracks and splits that had occurred. Hence, regions of the protective area may be deeper. This could explain why the blue-stain free zones given by EN 152 method were higher than the values obtained by the Chiptest method. In the Chiptest samples, it can be assumed that no consequent movement of the active ingredients into the wood specimens occurred during the fungal test.

Conclusion

The results of this study show that the EN 152 method is a more severe test for assessing wood finishing formulations against blue staining fungi. The method takes into account the effect of weathering when compared to the Chiptest method. It is more appropriate that samples should be exposed to weathering before being submitted to laboratory fungal test. This reflects the actual conditions the exterior finishes are subjected to in normal usage. Exterior finishes are applied to timber which is exposed to weathering. It is therefore recommended that to assess the effectiveness of finishes, the EN 152 method should be used. The Chiptest method could be used provided that the treated samples are exposed to artificial weathering prior to the laboratory fungal test.

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