Winter Treatments Protect Birch Roundwood During Storage

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Abstract

When ends of bolts and veneer logs of paper birch were sprayed with fungicides and coated with vapor-resistant compounds during cold months in northern Wisconsin and upper Michigan, they were protected from serious decay throughout the ensuing warm months. No significant disadvantage of treating in the coldest weather was noted except that the end-coating compound had to be warmed until of spreading consistency. In comparatively cold weather, treating could be greatly delayed without much deterioration; bolts cut in November and January and treated in March deteriorated little. Delaying treating until the warmer weather of April gave less protection. An end-coating was necessary to prevent checking of the sprayed surface if logs were stored into spring and summer. Basic guidelines are provided to protect northern hardwood logs and bolts during storage.

LOGS AND VENEER BOLTS of a number of northern hardwood species can be protected from decay during storage by treating the ends with fungicidal solution in mild or warm weather and, if necessary, adding a moisture-retarding coating to control checking. Essential requirements based on experiments in which log treating was done in mild or warm weather have been reported (1-4).

Northern hardwoods are extensively cut during fall, winter, and early spring; therefore, the experiments described here were to determine if logs could be effectively end-treated during cold weather. In particular, we wanted to know: 1) if low temperatures would adversely affect treatment application or effectiveness, 2) which treating material would serve most effectively, and 3) what delays between cutting and treating might be safely tolerated in cold weather.

The experiments were carried out by the U.S. Forest Products Laboratory, Madison, Wisconsin, in cooperation with the Nekoosa Edwards Paper Company, Port Edwards, Wisconsin, and Anthony and Company of Escanaba, Michigan.

Procedure

Two sets of paper birch (*Betula papyrifera* Marsh.) roundwood were used 1) bolts cut for the experiment and 2) veneer logs being processed commercially. The paper-birch bolts, 3 feet long and 8 to 12 inches (0.91 by 0.20 to 0.30 m) in diameter, were cut during the period from November to April in north-central Wisconsin to compare the effectiveness of: 1) four

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fungicidal sprays, 2) nine end-coatings, 3) a single treatment (a fungicidal spray or an end-coating) with double (both) treatments, and 4) various time delays in treating.

The bolts were treated, then piled in partial shade with their lengths in a north-south orientation to determine if treatment effectiveness, especially for end-coatings, might be influenced by intensity of solar heating. Midday temperatures during treating were: November, 50°F (10°C); January, 3°F (−16°C); March, 36°F (2°C); and April, 45°F (7°C). If end-coating was used, its condition after storage was noted. Bolts were then split, and depths of penetration of internal decay and brown oxidation stain from the bolt ends were recorded.

The veneer logs were end-treated with either a single treatment (a 5 percent pentachlorophenol (penta) spray or a viscous asphalt cutback coating), or they were treated with both. The condition of the logs was assessed by examining the veneer as it came from the logs.

Mean temperatures for the test areas were: fall, 43°F (6.1°C); winter, 15°F (−9.4°C); spring, 38°F (3.3°C); and summer, 64°F (17.8°C). Mean annual precipitation was ***32*** inches (81.3 cm).

Treatment of Bolts

Fungicidal sprays. – Bolts were cut and treated in April and stored until October to assess the protection provided to the treated, stored wood. The bolt ends were sprayed with one of four commercial fungicides (the type marketed to protect stored lumber), then asphalt cutback of troweling consistency was applied. The four fungicides included are listed in Table 1.

End-coating.–Bolts were cut and treated in November, then stored until October (11 months). Bolt ends were sprayed with a 5 percent solution of sodium pentachlorophenate (sodium penta) in water, after which one of the nine end-coatings listed in Table ***2*** was applied.

Viscous asphalt cutback, an end-coating of asphalt and oil, has proved effective in preventing decay and stain ***(3)***. The intent of the work here was to ascertain whether any of the eight new compounds, submitted for trial by the manufacturers, might have advantages over the asphalt cutback–in cleanliness, ease of application, and durability over a long storage period.

Single treatments.–The foregoing investigations involved two-step treatments–a fungicide followed by

Table 1.—DECAY PENETRATION IN BOLT ENDS SPRAYED WITH FOUR FUNGICIDES AND END-COATED[1]. BOLTS CUT AND TREATED IN APRIL; OBSERVED IN OCTOBER.

Spray composition	Average penetration of decay from bolt ends[2]			
	Main decay[3]		Deepest decay[4]	
	South end (in.)	North end (in.)	South end (in.)	North end (in.)
Pentachlorophenol, 5% in mineral spirits	6	2	12	4
Sodium pentachlorophenate, 2.5% in water	1	<1	4	<1
Mixture of sodium pentachlorophenate and ethyl mercuric phosphate, 1.4% in water	3	3	4	4
Sodium pentachlorophenate plus borax, 1.4% + 2.1% in water	2	2	3	3
Untreated	10	10	13	13

[1] Coating was an asphalt cutback of troweling consistency.
[2] Each value is average of 10 bolts.
[3] Main body of decay, manifested by relatively solid discoloration of wood.
[4] Streak or spire of apparent decay in advance of main decay.

Table 2.–DECAY AND STAIN PENETRATION IN BOLT ENDS SPRAYED[1] AND END-COATED WITH NINE COATINGS. BOLTS CUT AND TREATED IN NOVEMBER; OBSERVED IN OCTOBER.

End-coating	Average penetration of decay from bolt ends[2]		Average penetration of brown oxidation stain[2] (in.)	Final condition of coating
	Main decay (in.)	Deepest decay (in.)		
Viscous asphalt cutback	1	4	10	Intact; flexible
Fluid asphalt cutback	12	14	([3])	Failed
Viscous coal-tar pitch	2	7	7	Intact; flexible
	<1	<1	7	
Extremely viscous crude petroleum	2	6	10	Intact and soft
Thin paste with base of reclaimed rubber	13	14	([3])	Failed
Viscous paste with base of reclaimed rubber	10	13	([3])	Flaked off
Thermoplastic mixture of reclaimed rubber and asphalt	5	12	14	Some failure on south ends
Pigmented varnish with filler	5	0	14	Brittle and flaking
No treatment (controls)	13	14	([3])	—

[1] 5% sodium pentachlorophenate in water.
[2] Each value is average of three or four bolts.
[3] Oxidation stain obliterated by decay.

Table 3.—DECAY PENETRATION IN BOLT ENDS WITH SINGLE TREATMENT—SPRAY-TREATED OR END-COATED.

End treatment	Month cut and treated	Average penetration of decay from bolt ends[1]		
		July	October	
		Main decay (in.)	Main decay (in.)	Deepest decay (in.)
Spray only: Pentachlorophenol, 5% in mineral spirits	March	2	12	14
	April	–	10	14
Spray only: Borax 8% + boric acid 8%	March	0	10	12
	April	0	11	13
End coating only: asphalt cutback of troweling consistency	March	0	2	3
Same end coating but containing 5% w/w of pentachlorophenol	March	0	<1	<1
	April	–	1	3
Untreated	March	2	11	14
	April	0	10	13

1 Each value is average of five bolts (usually).

an end-coating. The effectiveness of a one-step, or single, treatment (a fungicide spray or an asphalt cutback end-coating or a fungicide incorporated into an end-coating) also was evaluated. Type and time of treatment of bolt ends, plus length of storage, are shown in Table 3.

Delayed treatment.—Specific objectives here were to ascertain safe limits for delayed treating when logs were cut during cold-weather months. Bolts were cut in November, January, March, and April, treated when cut or 1 to 5 months later, then stored until October (6 to 11 months) (Table 4). Bolt ends were sprayed with a 5 percent solution of penta in mineral spirits or sodium penta in water, then coated with asphalt cutback at troweling consistency. During cold weather, the sodium penta solution was warmed to avoid freezing and the end-coating warmed until of a spreading consistency. The presence of occasional thin patches of ice on some bolt ends did not prevent good spread of the asphalt cutback.

Treatments of Commercial-Size Veneer Logs

This investigation differed from the previous four studies involving bolts in the size and source of the logs, the storage site (upper Michigan instead of Wisconsin), and the method of assessing degrade. The purpose was to determine the efficacy of winter-applied end sprays and coatings on paper birch veneer logs of commercial size stored in the open. The logs, about 12 inches in diameter by 100 inches long (0.30 by 2.54 m), were cut in January and end-treated several days later with either a 5 percent penta spray or a viscous asphalt cutback coating or with both (Table 5). The logs were then stored in the open for 9 months when they were cut for veneering into 14-inch-long (0.36m) bolts. Final condition of the treated logs was assessed by estimating the percentage areas of visibly deteriorated veneer.

Table 4. — DECAY AND STAIN PENETRATION IN BOLT ENDS AFTER TREATING[1] DELAYS.

Month treated	Average penetration of decay from bolt ends[2]: Main decay, South end (in.)	Main decay, North end (in.)	Deepest decay, South end (in.)	Deepest decay, North end (in.)	Average penetration of brown oxidation stain[2] (in.)
NOVEMBER-CUT BOLTS					
November	2	<1	6	<1	10
January	5	<1	10	2	10
March	3	<1	8	2	11
April	12	7	15	9	15
Untreated	13	12	14	14	([3])
JANUARY-CUT BOLTS					
January	1	0	4	0	7
March	1	<1	2	<1	5
April	2	1	5	5	11
Untreated	13	13	14	14	([3])
MARCH-CUT BOLTS					
March	2	1	4	3	7
April	8	4	13	8	13
Untreated	11	10	14	14	(3)
APRIL-CUT BOLTS					
April	6	2	12	4	10
Untreated	10	10	13	13	([3])

[1]Spray in November and January was sodium pentachlorophenate in water; in March and April, pentachlorophenol in mineral spirits. End-coating asphalt was a cutback of troweling consistency, warmed in January and March, to provide spreading quality comparable to that in other months.
[2]Each value is average for 10 bolts.
[3]Oxidation stain in control bolts was obliterated by decay.

Table 5. — DECAY AND BROWN OXIDATION STAIN ON VENEER SHEETS FROM LOGS CUT AND TREATED IN JANUARY; OBSERVED IN OCTOBER.

Log ends	Number of bolts represented	Serial position of bolts from end of log[1]	Average area of veneer sheet: Decayed (%)	With brown oxidation stain (%)
Untreated	8	1	61	([2])
	6	2	8	74
	11	[3]2-4	–	22
Not sprayed but single-coated with asphalt cutback at troweling consistency	15	1	<1	65
	11	2	0	28
Not sprayed but single-coated with asphalt cutback at troweling consistency containing 5 pct penta	16	1	<1	47
	16	2	0	22
Sprayed and single-coated with asphalt cutback at troweling consistency	13	1	<1	36
	2	2	0	1
	16	32-4	–	7
Sprayed and double-coated with asphalt cutback at troweling consistency	12	1	0	19
	2	2	0	5
	9	32-4	–	1

[1]Logs were about 100 inches long, and provided seven 14-inch bolts for veneering.
[2]Oxidation stain obliterated by decay.
[3]Interior position could not be identified.

Results

Bolts

Fungicidal sprays.—The effects of the four fungicides and a viscous asphalt cutback end-coating are given in Table 1. In this table, main decay refers to the main body of decay, manifested by relatively solid discoloration of the wood and deepest decay, to a streak or spire of apparent decay in advance of main decay.

Six months after treatment all sprays had held main decay to penetrations of 1 to 3 inches (Table 1) (2.54-7.62 cm), except for 6-inch (15.24 cm) penetration in the south end of bolts treated with penta in oil. Because of the long-established reputation of potency of 5 percent penta, the lesser protection provided here presumably can be attributed to a weakness in the end-coating rather than in the fungicide. At treating time oil remaining on the flooded bolt ends thinned out the asphalt coating slightly, which could have weakened the end-coating.

End-coatings.—The effects of the nine end-coating compounds are summarized in Table 2. In this table, brown oxidation stain refers to a chemical discoloration caused by air in contact with certain constituents of the wood. Like decay, this oxidation stain moves in from the log ends and degrades birch and maple logs and bolts during warm weather. Three of the new compounds tested resembled asphalt cutback because they were relatively viscous and applicable in a thick

film. Two were viscous coal-tar pitch formulations and a third was an extremely viscous crude petroleum product. All remained flexible, appeared intact over the test period, and were as effective as the asphalt cutback in preventing decay and oxidation stain. Three other compounds incorporating reclaimed rubber, and one described as a pigmented varnish with filler, were either the least effective or failed.

Single treatments.—Average decay penetrations from bolt ends after a single treatment—end-spraying or end-coating—are given in Table 3. In July, after 3 to 4 months' storage, decay was slight, even in the untreated bolts. However, by mid-October after 6 to 7 months' storage, the two sets spray-treated only—using strong solutions of penta or borax-boric acid—were as heavily decayed as the controls. In contrast, the two sets of bolts end-coated only were in as good condition as bolts that had received both fungicidal spray and end-coating in the other experiments. Because of the effectiveness of the end-coating alone, the merit of incorporating penta, 5 percent (w/w), in one of the coatings could not be discerned.

Delayed treatment.—Results of delays of zero to 5 months in spray treating plus end-coating of bolts cut in November, January, March, and April are summarized in Table 4. Treating within less than 24 hours after cutting held the main decay of bolts in all four cutting months to depths not exceeding 2 inches (5.08 cm), except for the April-cut bolts for which penetration averaged 6 inches (15.24 cm) in the south end of the bolts. The deep decay is atypically high; however, from results of earlier experiments entailing prompt treating (3), it is probably not representative. Postponing treatment of the November- and January-cut bolts until March did not substantially affect control of decay. Delays extending into April, however, permitted the main decay to penetrate 7 to 9 inches (17.78 to 22.86 cm) deeper into the November-cut bolts and 3 to 6 inches (7.62 to 15.24 cm) deeper into the March-cut bolts. A similar increase did not occur in the January-cut bolts; reasons for this were not apparent.

Average penetrations of main decay and of deepest decay were greater in bolt ends facing south than in those facing north (Table 4).

Brown oxidation stain penetration was generally not affected by end-treatment in the November-cut bolts. However, some limitation of stain was evidenced in the January- and March-cut bolts (Table 4).

Veneer Logs

All four treatments tried on the commercial-size veneer logs yielded veneer almost free of decay (Table 5). By contrast, veneers from the untreated control logs were severely decayed. Bolts second from the end had 8 percent of the area decayed, which indicates that with no protection, decay in paper birch may progress into the log somewhat deeper than 14 inches (0.36 cm) during a warm season in the latitude (46 to 47°N.) of the experiments.

Oxidation stain in the treated logs was not controlled as well as decay, although stain was considerably reduced in groups treated with 5 percent penta plus a single or a double end-coating of asphalt. Control of stain in logs with only end-coating was much less effective, raising the question of whether penta spray aided in controlling stain in the other bolts.

Discussion and Conclusions

Although this work was to assess the effectiveness of winter end-treating in preventing decay and stain in stored paper birch roundwood, the information applies to maple and other birch species with a naturally fungus-resistant bark. The other woods respond to decay control chemicals even more effectively than does paper birch (2-4). End treatment with a fungicide is appropriate, however, only for our northern latitudes where insects capable of penetrating the bark of stored roundwood and introducing fungal spores to the underlying wood are not a storage problem. Elsewhere, it may be necessary to include an insecticide in the spray, and spray the bark as well as the ends.

The study showed that spraying log ends with fungicide, followed by coating with viscous asphalt, can be managed easily in temperatures near and below freezing if the coating material is warmed to manageable consistency. Such cold weather treating can prevent decay through the entire period of ensuing warm weather. Treating can be delayed for several weeks after cutting with little adverse effect if climatic conditions are similar to those in this study, and the delay with paper birch at least does not extend into April. These favorable results resemble those in New Hampshire (3) in which yellow birch (*Betula alleghaniensis* Britton) bolts cut in February were successfully protected until the following October by spraying and end-coating in April.

Small manufacturing plant reports "procedure necessary to operation."

The potential for industrial use of chemical protection during winter was strikingly indicated in the spraying and end-coating of commercial-size veneer logs of paper birch. The small specialty-manufacturing plant where the veneer logs were treated adopted the treatment procedure, and reported it necessary to its operation.

The relatively good condition of untreated bolts cut in March and April and stored until July reflects the limiting influence of the cool temperatures during spring and early summer in the storage area. From this it might be generalized that in similar northern climates hardwood roundwood cut in winter or spring and utilized in June or early July requires little protection against decay.

Penetration of decay, deeper in the south end than in the north end of treated bolts, probably reflects greater heating at that end, thus formation of more fine checks. Hence, there is an earlier opportunity for initiation of decay at the south end. This observation suggests that treated ends of logs and bolts during

storage should not be subjected to intense sunlight. They could be placed in shade or, where storage is in the open, oriented to avoid direct southern exposure of the ends.

When used with an effective end-coating, sodium penta alone or in mixture with borax or an organic mercury fungicide (no longer recommended due to environmental hazards) provided a fungicidal protection as effective as a comparable concentration of penta in oil. Other lumber-dipping compounds that have proved effective may also be expected to serve well if concentrations are increased to levels needed for logs and bulk-stacked lumber items that do not dry out significantly during storage. However, decay control fails if these proved effective compounds are used on logs without the supplementary protection provided by an end-coating. This confirms that end-checking must be prevented (3,4) to successfully store northern hardwoods throughout a long season of mild weather. If checks develop, decay fungi can enter through the shallow barrier of fungicide to unprotected wood beneath.

This viscous asphalt end-coating alone, a strictly physical barrier, when applied in cold weather, was effective in preventing decay. However, how effective

. . . end checking must be prevented . . .

it would be if applied in warm weather should be determined. A high level of protection simply by a coating was quite uncertain since even slight checking of the coating might permit spores of the decay fungi to pass through; also one would not expect a coating to necessarily physically arrest development of spores lodged in crevices of the wood before the coating was spread. Incorporating a fungicide in the coating, such as penta, should be helpful, but this also should be tested further.

The three most effective end-coating materials—asphalt, coal-tar pitch, and crude petroleum—looked much alike. All were quite viscous, which made it possible to spread a comparatively thick coating. A suitable spread-on type of end-coating compound apparently must combine moderate thickness, a degree of flexibility to bridge pre-existing or later-developing small checks, and a capacity to adhere to the wood through months of either cold or warm weather or both. Pastes with a base of reclaimed rubber failed to adhere to log ends during storage.

Brown oxidation stain, troublesome especially in summer-stored paper birch, was reduced by the most effective treatments to approximately half or less than that of the less effective treatments. Improved control of this stain probably will depend on developing an end-coating more impervious to air.

Practical Guidelines

Six guidelines based on work reported both here and in the literature are given for chemically protecting hardwood logs and bolts stored in the north-central United States and other areas of North America with comparable climate:

1) Treat only species such as birches and maples that have bark proved to be naturally fungus resistant. Trials on American beech (*Fagus grandifolia* Ehrh.) and black oak (*Quercus velutina* Lam.) have not been successful although all surfaces have been sprayed with a fungicide.

2) In warm weather (late spring through summer) treat no later than 1 to 3 days after cutting. Treating should be soon after cutting to prevent decay fungi from getting established at a greater depth in the log than will be reached by the fungicide.

3) Treating during cold weather of late fall to early spring may be postponed several months, but with at least paper birch, delay preferably should not extend into April if storage is prolonged into warm weather. Ordinarily, no treatment should be needed for logs stored only in cold weather. In northern climates this will generally include storage through June.

4) Protection can best be assured by flooding the log ends with fungicide, then adding a moisture retarding end-coating to minimize development of drying checks that penetrate the thin layer of treated wood. (With northern hardwoods above approximately the 44th parallel, spraying with an insecticide to control beetle attack is not needed.)

An end-coating may be unnecessary for decay control if no more than about 6 to 8 weeks of warm weather occurs during the storage period. The coating may be useful, however, for limiting brown oxidation stain. (If preventing oxidation staining is of prime importance, a double thickness of coating may be considered.)

5) For fungicidal spray, antistain chemicals for protecting lumber on the seasoning yard generally should be effective on logs if used at three to five times ordinary solution strengths. A 3 to 5 percent solution of pentachlorophenol in light oil or, if in nonfreezing weather, of sodium pentachlorophenate in water can be used.

6) For end-coating, commercially available bituminous compounds such as those based on asphalt or coal-tar pitch are effective and easily applied. The compound should be sufficiently viscous (troweling consistency) to permit forming a film thick enough to hide minor surface irregularities made by the saw and to bridge any existing checks. In cold weather it may be necessary to warm the compound to suitable spreading consistency. The coating should cover the entire end surface inclusive of the bark edge.

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