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SERVICE TESTS OF POSTS TREATED WITH WOOD PRESERVATIVES

A. R. Olson and H. A. McKusick

The wood of only a few native species is naturally resistant to wood rotting fungi, especially since the loss of the durable chestnut. Since the demand greatly exceeds the supply of posts and poles of the durable species, non-durable species have been treated with wood preservatives. Recently, southern yellow pine which has been pressure-treated with creosote has been the principal source of wood highway posts and utility poles in Connecticut. Connecticut timbers and other methods of treatment have been tested by this Station to find for users of posts an economical local supply and for foresters a market and money for forest improvement. The cooperation of the Connecticut State Highway Department and the Forestry Division of the Connecticut Park and Forest Commission has been essential and freely given.

Tests of both highway posts and fence posts are reported here. Since the requirements of highway posts differ greatly from those of farm fence posts, particularly as to safety, the tests are reported separately: Chapter I - Highway Post Survey, A 1965 Progress Report. Chapter II - Service Tests of Treated Farm Fence Posts.

CHAPTER I

HIGHWAY POST SURVEY, A 1965 PROGRESS REPORT

A. R. Olson

A study of the service life of wood posts used in highway fencing in Connecticut was begun in 1940. This Station cooperated with the Connecticut State Highway Department in making this study which has included nearly 9,000 posts. Most were set on shoulders of the road and bore two galvanized woven steel cables fastened to the posts with eyebolts; a few were used to support woven wire along boundaries of adjacent property. They were 7 feet long for cable and 8 feet long for wire and were set to a depth of 3-1/2 feet. With one exception, all posts were in the round and all had received preservatives as later described.

In 1940, some 4,800 posts which had been set between 1933 and 1935 were tagged and examined. Also, some 3,300 posts which had been set in 1939 and 1940 were tagged at this time. In addition, some 800 posts were set after 1940 and were also included in the study. The posts were examined for condition at 5-year intervals until the study was terminated for a specific treatment because nearly all posts had deteriorated, or were replaced for other reasons.

Examination consisted in excavating to a depth of 12 inches, sounding with a light hammer to detect decay, and where decay was detected, using a probe to determine extent. The term decay, as here used, includes deterioration caused by fungi and insects. That is, the rare damage by ants and termites was called 'decay' along with the more common deterioration by fungi. No attempt was made to examine the post below the excavation since experience had indicated that deterioration at ground line is more advanced than at levels more than 12 inches below that line.

The results through 1950 were reported in a bulletin[1] of this Station. Subsequent progress reports[2,3] reported observations in 1955 and 1960. The present bulletin reports the 1965 examination and provides information on tests for as long as 25 years.

In examining the post, it was considered as two parts:

A. The Butt (B) from 6 inches above ground to the bottom.

B. The Top (T) from 6 inches above ground to the top.

This indicated the effectiveness of the treatment separately for the above ground and below ground parts. The condition of the butt and top part of each post was determined and recorded as

BG or TG Good. No evidence of decay. Serviceable.

BPD or TPD Partially Decayed. Decay present but an effective diameter of 6 inches or more of sound wood still remained at and below the top cable bolts. Serviceable.

BD or TD Decayed. Decay had decreased the effective diameter of sound wood to less than 6 inches at or below the top cable bolt. Unserviceable.

The criteria for judging the tops and butts of posts and for determining whether a post was serviceable were far more rigid than would be used to define the conditions of farm or other posts where human life is not at stake. Moreover, Connecticut State Highway specifications state that the diameter of a wood post must not be less than 6 inches. By implication, this would mean that a post must have a minimum effective diameter of 6 inches at all times.

1/ Hicock, H. W. and A. R. Olson. 1954. Preservation of Wood by Simple Methods. Conn. Agr. Expt. Sta. Bull. 581. 66 pp.

2/ Hicock, H. W. and A. R. Olson. 1956. Highway Post Survey. A 1956 Progress Report. Conn. Agr. Expt. Sta. Circ. 196. 12 pp.

3/ Olson, A. R. 1961. Highway Post Survey. A 1960 Progress Report. Conn. Agr. Expt. Sta. Circ. 217. 16 pp.

Preservatives

Ten different treatments are represented in this study.

Pressure with creosote.

Red and southern yellow pine posts were purchased under a specification which called for a retention of 6 pounds of Grade 1 A.W.P.A. coal tar creosote per cubic foot. All posts were framed to final size and bored for eyebolts prior to treatment.

The hardwood posts set in 1939-40 were purchased untreated by the Highway Department, which had them custom-treated in 8-foot lengths. Creosote specifications were the same as for the pines. They were framed and bored after treatment. The tops were given a brush coat of creosote after setting.

An additional 158 maple and birch and 47 red pine posts were set in 1951. These were treated as the previously mentioned pines except that a retention of 8 lbs. of creosote was specified.

Pressure with Wolman salts.

These hardwood posts, almost entirely oak, had been pressure-treated with Wolman salts. Specifications for the treatment are not available but presumably were standard for this material.

Open tank, butts only, with creosote.

The butts of posts of white and red oak, maple, birch, and pitch pine were treated with Grade 1 A.W.P.A. coal tar creosote. Specifications of the Highway Department at that time stipulated that the top 2-1/2 feet of the post should not be treated with creosote because this would interfere with the application of white paint. Later, visibility was provided by reflectors, and this permitted full-length treatment. The lower 4 feet of the post were immersed at 215° F. for 4 to 6 hours. Some posts were subjected to a cold bath for 4 to 16 hours, others were not. Poor service may sometimes have been due to omission of the cold bath, but the rapid spread of decay from the untreated tops made it impossible to evaluate the effectiveness of the cold bath. Practically all the maple and birch posts were incised from 18 inches below to 6 inches above ground line to provide better impregnation.

Open tank, full length, with creosote.

Oak, maple and birch posts were treated with Grade 1 A.W.P.A. coal tar creosote by immersing the tops in creosote at 110-120° F. for 2 to 4 hours and then immersing the butt ends in creosote at the same temperature for 4 to 5 hours. All posts were framed to final dimensions but not bored before treatment. Bore holes were later treated with creosote.

Cold soaking with pentachlorophenol.

These treated posts of red pine were purchased from a Connecticut supplier who cold-soaked them fully immersed in a 5% solution of pentachlorophenol in furnace oil for 48 to 96 hours. His treatment resulted in absorptions of 7 to 9 pounds of solution per cubic foot and penetrations at mid-point of 1-1/2 inches or more.

Barrel method with zinc chloride.

These red pine posts were obtained from a Connecticut supplier who treated them, unseasoned, by immersing one end in a barrel or tank containing a 33-1/3% solution of zinc chloride. After sufficient solution to provide 1 pound of dry salt per cubic foot of wood in the posts had been taken up, the posts were removed from the treating solution and allowed to stand with the intake ends up for 90 days or more to equalize the distribution of the preservative within the posts. They were framed and bored after treatment.

Osmosalts.

These lobolly pine posts were obtained from a supplier in Virginia who had sprayed a solution of Osmosalts onto peeled, unseasoned posts. They were then dead-stacked and additional Osmosalts sprayed on the ends. After this, the piled posts were covered tightly with a waterproof paper for 30 days to provide moist conditions for movement of the preservative into the wood and also to prevent leaching by rain. The preservative was applied at the rate of .3 pounds of Osmosalts per cubic foot of wood.

Butts brushed with creosote.

A high grade creosote formulated for brushing was applied to the butts of white and red oak, white-cedar, and black locust posts just before setting.

Butts brushed with 8-13 tar.

Oak, pitch pine, and black locust posts were treated with 8-13 tar in the same manner as brushing with creosote. The oak posts had been slabbed on two sides.

Butts dipped in hot coke-oven tar.

The lower 4 feet of white and red oak posts were immersed in hot coke-oven tar for one minute.

Results

Table 1 shows the percentages of posts still serviceable in both butts and tops The percentages are based on the number of posts originally set less those removed for reasons other than decay; the reasons include accidental breakage, road relocation, and new driveways. Whether the post decayed at top or butt is also indicated in Table 1 by the percentage of unserviceable posts that failed first at top and first at butt.

Pressure with creosote.

More pine than hardwood posts endured. The diffuse-porous maple and birch failed before the ring-porous oaks. After similar periods of service, the maple and birch, which were treated with 8 pounds of creosote and were set in 1951, were in better condition than those which were treated with 6 pounds and set in 1939-40. White oak was more durable than red oak as would be expected from the relative durability of their heartwoods.

The explanation for the decay at the top of oak and middle of maple and birch is likely the penetration of preservatives. Preservative penetrated so deeply into the ends of maple and birch that no untreated wood was exposed when the ends were cut off in framing. In oak, on the other hand, the preservative penetrated the heartwood little. The subsequent brushing of the trimmed top was superficial, and decay entered through the checks or cracks which developed there.

Radial penetration, on the other hand, was shallow midway between the ends of maple and birch but reached the heartwood throughout the length of oak. Therefore, maple and birch decayed more at the soil line than did oak.

Pressure with Wolman salts.

After 20 years, nearly two-thirds of the posts had become unserviceable due entirely to deterioration in the butts. After 5 years of service, the butts of all of the posts were listed as "partially decayed" because a thin layer of wood on the outer surface had become soft and crumbly. This layer was dark brown but did not appear as wood decayed by fungi. This deterioration continued until untreated wood on the interior was exposed; and after 10 years, the number of posts unserviceable increased greatly.

Open tank, butts only, with creosote.

After 5 years, the posts deteriorated rapidly until at 15 years nearly half the white oak and three-quarters of the posts of other species were unserviceable. Early inception of decay in the tops caused 70 to 90% of the failures in the oak, maple and birch posts and nearly 60% of those in pitch pine. This proportion may have been still greater since decay from the top down through the untreated interior of the butt had likely been the cause of the butt, as well as the top, being unserviceable at the time of examination. The paint on the untreated tops would retard evaporation of moisture and favor decay.

Open tank, full length, with creosote.

For the first 15 years, the effectiveness of this treatment compared with that of pressure with creosote. After 15 years, the oak and maple posts deteriorated more rapidly; and at 20 years, more than one-third of the oak and nearly one-half of the maple had become unserviceable. Decay in the tops was more frequent in the oaks whereas decay in the butts caused most of the failures in maple and all in birch.

Cold soaking with pentachlorophenol.

After 15 years, 99% of the posts were in serviceable condition. In 12% of the posts, small thin patches or streaks of decay had developed on one side of the post. It was only minor. This decay was first noticed at 5 years; but by the end of 15 years, the decayed wood had mostly eroded, exposing sound wood underneath.

Barrel method with zinc chloride.

Approximately 100 posts were set in 1948. After 17 years, 89% had become unserviceable, all due to decay in the butts. After comparable service time, these posts were in poorer condition than some farm fence posts and tobacco tent poles which were treated with zinc chloride.

Osmosalts.

After 7 years, 8% and after 9 years, 17% of the posts were unserviceable due entirely to decay in the butts.

Butts brushed with creosote.

Nearly 90% of the white oak and nearly all red oak posts had become unserviceable after 5 to 7 years due almost entirely to decay in the butts. The white-cedar fared better and 40% were still serviceable after 15 to 17 years. The better condition of the white-cedar is attributed to the greater durability of the heartwood of white-cedar. Because of durability of the heartwood of black locust, together with the thinness of the sapwood, 97% of the locust posts were still serviceable after 15 to 17 years.

Butts brushed with 8-13 tar.

This treatment was as ineffective as brushing with creosote. Also, most failures in oak were due to early decay in the butts. The untreated tops of the pitch pine were more susceptible to decay than those of oak. The natural durability of the heartwood of black locust, rather than the preservative treatment, accounts for the durability of black locust.

<u>Butts dipped in hot coke-oven tar.</u>

This was nearly as ineffective as brushing with creosote or 8-13 tar. Again, the failures nearly all began in the butts.

Summary and Conclusions

1. Pressure treatment with 6 pounds of creosote per cubic foot provided excellent protection to the posts of red pine and southern yellow pine. Current highway specifications calling for an 8 pound-per-cubic foot treatment should provide an even more effective treatment. A similar treatment would very likely provide good protection also to other hard pines having a thick sapwood. Since the red pine posts with this treatment excelled all others in these tests for fully 25 years and since red pine is abundant locally and in the size suitable for posts, this species merits special attention.

2. Pressure treatment with creosote was less effective on hardwoods than on pines. The difference is attributed to poorer impregnation and distribution of the preservative in the hardwoods.

3. Full length open-tank treatment with creosote was nearly as effective as pressure treatment. The great increase in service life between butt and full length open-tank treated posts demonstrates the need for treating tops as well as butts.

4. Although the test has only lasted 15 years, the persistence of 99% of the red pine treated by cold soaking in pentachlorophenol is outstandingly good.

5. Pressure treatment with Wolman salts protected against decay above but not below ground. Below ground the peculiar deterioration made treatment less effective.

6. Zinc chloride treatment of red pine was less effective than similar treatments of other of the same species. The reason is unknown.

7. Brushing on or briefly immersing in the preservative failed to provide adequate protection against decay in the posts of non-durable woods. Even when creosote was used, the treatment was ineffective because it did not impregnate the wood deeply.

8. Posts treated throughout their length should be fully framed prior to treatment.

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Table 1. Performance of posts in service tests by preservative treatment and species.

Treatment, Preservative and Species	No. Posts Set	Per Cent Serviceable After 5-7 yrs	10-12 yrs	15-17 yrs	20 yrs	25 yrs	Where Unserviceable Posts Failed Butt Per Cent	Top Per Cent
Pressure, Creosote								
White Oak (1)	249	100	97	80	82	64	61	39
Red Oak (1)	520	100	98	85	73	58	62	38
Maple (1)	68	98	82	54	34	17	98	2
Birch (1)	42	100	100	79	55	28	100	0
Maple and Birch (1A)	158	100	100	99	--	--	100	0
Red Pine (1B)	596	100	100	100	99	97	100	0
Southern Yellow Pine (1)	482	100	100	97	95	90	93	7
Pressure, Wolman Salts (1)								
Oak	386	100	95	74	36T	--	100	0
Maple	9	100	100	89	22T	--	100	0
Open Tank, Butts only, Creosote (2)								
White Oak	400	90	67	54T	--	--	11	89
Red Oak	1264	90	43	26T	--	--	14	86
Maple	1293	91	46	25T	--	--	27	73
Birch	304	87	39	21T	--	--	19	81
Pitch Pine	361	88	61	24T	--	--	42	58
Open Tank, Full Lgth, Creosote (1)								
Oak	195	100	100	92	63T	--	22	78
Maple	51	98	91	77	56T	--	86	14
Birch	53	100	98	96	90T	--	100	0
Cold Soaking, Pentachlorophenol (3)								
Red Pine	413	100	100	99	--	--	75	25
Barrel Method, Zinc Chloride (4)								
Red Pine	56	96	64	11T	--	--	100	0
Osmosis, Osmosalts (5)								
Loblolly Pine	196	92	--	--	--	--	100	0
Butts Brushed, Creosote (2)								
White Oak	415	11	3	2T	--	--	88	12
Red Oak	32	3	1	0T	--	--	91	9
White-Cedar	660	67	47	40T	--	--	92	8
Black Locust	75	99	99	97T	--	--	100	0
Butts Brushed, 8-13 Tar (1)								
Oak	78	11	3T	--	--	--	90	10
Pitch Pine	32	9T	--	--	--	--	59	41
Black Locust	357	100	100	98	86T	--	93	7
Butts Dipped, Hot Coke-Oven Tar (1)								
White Oak	82	44	15T	--	--	--	89	11
Red Oak	150	39	4T	--	--	--	84	16

(1) Set 1939-40. (1A) Set 1951. (1B) 549 Set 1939-40, remainder in 1951.
(2) Set 1933-35. (3) Set 1951. (4) Set 1948. (5) Set 1953.
T = Tests Terminated.

CHAPTER II

SERVICE TESTS OF TREATED FARM FENCE POSTS

A. R. Olson and H. A. McKusick

Following the loss of chestnut as a source of posts for fences, this Station investigated treatments that might preserve other less durable native species.

Among those tested were the "sap stream methods" using zinc chloride. The different "sap stream methods" all introduced the water-soluble chemical into the sap channels of the freshly cut wood. Since distribution of the preservative throughout the post is essential to protection against decay, treatments have all been designed to distribute evenly the one pound of zinc chloride or three-quarter pound of chromated zinc chloride introduced for each cubic foot of wood.

To test the effectiveness of the preservative treatments, posts were treated and set in fence lines. The treatment of these posts was reported in a bulletin of this Station[1/]. The posts were set in a fence line around a pasture in Coventry, Connecticut, and along a property line in Pomfret, Connecticut. They have been examined periodically for up to 16 years and the results are reported here.

The Forestry Department of the Connecticut Park and Forest Commission cooperated in these tests and one of the authors (H. A. McKusick) is on the staff of the Commission. R. H. Fenton, of the Northeastern Forest Experiment Station, helped in the preservative treatments.

The Preservative Treatment

Zinc chloride was generally used in these treatments although chromated zinc chloride was also used. Dry salt and concentrations of 66, 50, 33, 25, 10, and 5% of the preservative in solution were employed. Red pine, red maple, aspen, gray birch, and American elm were used.

Posts were treated during the spring before the deciduous trees were in leaf and when the wood would be wettest, during the summer when the trees were in leaf and the wood would be driest, and after leaf fall when the wood would again be moist.

Barrel or Trough.

Freshly cut posts were placed upright in a tank with the small end immersed in zinc chloride solution. When sufficient solution had been taken up through the immersed ends to provide 1 pound of dry salt for each cubic foot of wood, the posts were removed and set with the small ends up. This inversion is necessary to distribute the preservative which will initially be concentrated near the intake end.

1/ Hicock, H. W. and A. R. Olson. 1954. Preservation of Wood by Simple Methods. Conn. Agr. Expt. Sta. Bull. 581. 66 pp.

In one experiment, we tested the effect of species and season of treatment, Table 2.1. Ten posts each of red pine, red maple, aspen, gray birch and elm were treated during summer and autumn 1949 and during spring 1950. All were treated with 50% solution of zinc chloride. Immediately after intake of preservative, the posts were set around a pasture on the Nathan Hale State Forest in Coventry.

In a second experiment, we tested the effect of salt concentration and season of treatment of red pine and red maple. Ten posts each of red pine and red maple were treated with solutions of 66, 50, 33, and 25% zinc chloride during spring, summer, and autumn. Those treated in the spring and autumn were set along a property line in Pomfret, Connecticut, for service testing.

Dry Salt.

Ten posts each of red pine, red maple, aspen, gray birch, and elm were set. Then a short section of tire tube was attached to the top of each post and sufficient dry zinc chloride to provide 1 pound for each cubic foot of wood was placed in the tube. Moisture from the post and the atmosphere dissolved the zinc chloride, and it slowly moved into the post. Treatments were made during spring, summer, and autumn.

Stepping.

This treatment was performed in dense plantations of red pine. The tree was cut and lodged against an adjacent tree. The butt of the tree was then placed in a metal container, and into which sufficient salt solution was poured in to provide the required quantity of salt per cubic foot of stem. One pound of zinc chloride or 3/4 pound of chromated zinc chloride per cubic foot of wood was used. The concentrations were 5 and 10%. Most trees were treated in mid-summer and a few as late as mid-October. Posts cut from the treated trees were set in the fence line in Coventry.

Time Required for Treatment.

A person wishing to treat a lot of posts will want to know how much time is required to administer the treatments. Therefore, we have given in Table 2.1 the number of days that were required for the intake of the required amount of chemical.

Table 2.1 - Time to treat by method of treatment, solution concentration and season of treatment.

Species	Method of Treatment	Solution Concentration Per Cent	Solution Intake Time - Days Spring	Summer	Fall
Red Pine	Barrel	50	6	4	5
Red Maple	"	"	16	1	5
Aspen	"	"	23	3	1
Gray Birch	"	"	22	13	14
Elm	"	"	8	3	8
Red Pine	Barrel	66	3-1/4	7	11-3/4
" "	"	50	4-1/4	3-1/2	4-3/4
" "	"	33	8	5-1/2	2
" "	"	25	8	4-1/4	4-3/4
Red Maple	"	66	2	12	12-1/4
" "	"	50	1-3/4	3/4	4-3/4
" "	"	33	3-3/4	3/4	4
" "	"	25	12-3/4	1-1/4	4
Red Pine	Dry Salt	Dry Salt	25	25	46
Red Maple	" "	" "	38	42	103
Aspen	" "	" "	27	33	45
Gray Birch	" "	" "	40	52	101
Elm	" "	" "	47	31	36
Red Pine	Stepping	5		1-1/2	
" "	"	10		1	

Results

After having been set in the fence lines, the treated posts were examined at about 3-yearly intervals. The condition was noted at the butt, the part from 6 inches above ground to the bottom, and at the top, the part from 6 inches above ground to the top. If decay was present and a vigorous push or pull of the post caused breakage, the post was classed as decayed and unserviceable. If decay had destroyed the ability to hold nails, the post was also classed unserviceable. Less advanced decay was also noted, but the post was classified only partially decayed and still serviceable.

The criteria for serviceability was less severe for these posts than for the highway posts since protection of life is not a factor.

Barrel Method with several species and seasons.

The percentage of posts serviceable after different periods is shown in Table 2.2. It also shows whether butts or tops failed first.

In red pine treatments during spring, summer, or fall, all provided good protection and all or nearly all posts were serviceable after 15 to 16 years.

Red maple treated during the fall was well protected, and 90% of the posts were serviceable after 15 to 16 years. Treatment of red maple during the other seasons, however, failed to protect adequately.

Aspen was well protected by spring and fall treatments, and all were serviceable after 15 to 16 years. Summer treatment of aspen was fairly successful, and 80% were serviceable after 12 to 13 years and 60% after 15 to 16 years.

Treatment of gray birch was the most effective in the spring,, and 90% of the posts remained serviceable after 15 to 16 years. Treatment during the other seasons afforded less protection.

Treatment of elm was most effective in the fall, and 70% of the posts were serviceable after 15 to 16 years.

All failures were due to decay in the butt parts of the posts for all species except gray birch where six of the eight failures were due to decay in the tops.

Barrel Method with several concentrations and seasons.

All treatments of red pine provided good protection. Only one post was unserviceable after 14 to 15 years, Table 2.3.

In red maple, the fall treatment was much more effective than the spring treatment, Table 2.3. Only one of the posts treated in the fall was unserviceable after 14 to 15 years. The spring treatment provided only fair protection regardless of concentration. The advantage of fall treatment of red maple has already been seen in Table 2.2.

All of the failures in these red pine and red maple posts were decay in the butts.

Dry Salt.

All red pine posts treated in this fashion were serviceable after 15 to 16 years, Table 2.4.

Spring treatment was most effective in red maple, and 80% of the posts were serviceable after 15 to 16 years. The fall treatment of red maple provided less and the summer treatment still less protection. Spring treatment also provided the best protection for aspen posts with all serviceable after 15 to 16 years, but treatment during the other seasons provided nearly as great protection. Spring treatment also provided the greatest protection in gray birch and elm. Treatment in the summer was less effective and in the fall even less effective.

As in the barrel treatment with 50% zinc chloride solution, all failures of all species except gray birch were due to decay in the butts. Eight of the 25 failures in the gray birch posts treated with dry salt were due to decay in the tops.

Stepping.

This method was also effective in providing long life to red pine posts, Table 2.5. Nearly 80% of the posts were treated with chromated zinc chloride and the remainder with zinc chloride. The only posts unserviceable after 15 to 16 years were 3 of the 56 posts treated with chromated zinc chloride.

Conclusions

1. Red pine was more easily protected than the other species in these tests. Evidently, red pine can be effectively treated to provide long life by any of the three methods in the spring, summer, or fall.

2. The effect of season of treatment differed among the other species in the barrel treatment. The spring treatment was the most effective in gray birch, the spring and fall treatments provided equally good protection in aspen, and the fall treatment was the most effective in maple and elm.

3. Among those posts treated with dry salt, the spring treatment was the most effective in all of the species. Since the spring treatment was the most effective among the deciduous species in the dry salt treatments and since the moisture content of the deciduous species may be expected to be highest in the spring before the trees leaf out, moisture is evidently essential to success by the dry salt method.

4. Salt concentration little affected the longevity of the red pine and red maple posts treated by the barrel method. However, a longer time is required for intake by red pine and maple of the 66% solution during summer and fall and of the 25% solution during spring.

Table 2.2. Service tests of posts of five species treated with 50% solution of zinc chloride by barrel method during spring, summer, and fall. Data based on 10 posts of each species treated in the spring, 10 of each species in the summer, and 10 of each species in the fall.

		Percentage of Posts Serviceable after					Where Posts Failed	
Species	Season of Treatment	3-4 yrs	6-7 yrs	9-10 yrs	12-13 yrs	15-16 yrs	Butt	Top
							Number	
Red Pine	Spring	100	100	100	100	100	0	0
" "	Summer	100	100	100	100	100	0	0
" "	Fall	100	100	100	90	90	1	0
Red Maple	Spring	100	90	50	10	10	9	0
" "	Summer	100	90	40	20	20	8	0
" "	Fall	100	100	100	100	90	1	0
Aspen	Spring	100	100	100	100	100	0	0
"	Summer	100	100	80	80	60	4	0
"	Fall	100	100	100	100	100	0	0
Gray Birch	Spring	100	100	100	100	90	0	1
" "	Summer	100	90	90	90	60	2	2
" "	Fall	100	100	100	80	70	0	3
Elm	Spring	100	90	80	50	50	5	0
"	Summer	50	30	20	20	20	8	0
"	Fall	100	90	90	90	70	3	0

Table 2.3. Service tests of posts of red pine and red maple treated with different concentrations of zinc chloride in solution by the barrel method during spring and fall.

Species	Season of Treatment	Treating Solution Concent. %	No. Posts Set	Percentage of Posts Serviceable after 5-6 yrs	8-9 yrs	11-12 yrs	14-15 yrs	Where Posts Failed Butt	Top
								Number	
Red Pine	Spring	66	9	100	100	89	89	1	0
" "	"	50	10	100	100	100	100	0	0
" "	"	33	9	100	100	100	100	0	0
" "	"	25	9	100	100	100	100	0	0
Red Maple	Spring	66	7	86	71	57	57	3	0
" "	"	50	5	100	80	60	60	2	0
" "	"	33	8	100	87	62	37	5	0
" "	"	25	8	100	62	62	50	4	0
Red Pine	Fall	66	8	100	100	100	100	0	0
" "	"	50	10	100	100	100	100	0	0
" "	"	33	10	100	100	100	100	0	0
" "	"	25	7	100	100	100	100	0	0
Red Maple	Fall	66	6	100	100	83	83	1	0
" "	"	50	8	100	100	100	100	0	0
" "	"	33	5	100	100	100	100	0	0
" "	"	25	8	100	100	100	100	0	0

Table 2.4. Service tests of posts of five species treated with zinc chloride by the dry salt method during spring, summer, and fall. Data based on 10 posts of each species treated in the spring, 10 of each species in the summer, and 10 of each in the fall.

Species	Season of Treatment	Percentage of Posts Serviceable after 3-4 yrs	6-7 yrs	9-10 yrs	12-13 yrs	15-16 yrs	Where Posts Failed Butt (Number)	Top (Number)
Red Pine	Spring	100	100	100	100	100	0	0
" "	Summer	100	100	100	100	100	0	0
" "	Fall	100	100	100	100	100	0	0
Red Maple	Spring	100	100	100	100	80	2	0
" "	Summer	90	80	50	30	30	7	0
" "	Fall	100	100	90	80	60	4	0
Aspen	Spring	100	100	100	100	100	0	0
"	Summer	100	100	80	80	80	2	0
"	Fall	100	100	100	90	90	1	0
Gray Birch	Spring	100	100	100	100	100	0	0
" "	Summer	90	90	80	50	20	8	4
" "	Fall	90	70	30	20	10	9	4
Elm	Spring	100	100	100	100	80	2	0
"	Summer	100	80	70	50	50	5	0
"	Fall	100	90	80	20	10	9	0

Table 2.5. Service tests of posts of red pine treated with zinc chloride and chromated zinc chloride by the stepping method.

Preservative	Concentration in Solution Per Cent	No. of Posts	Percentage of Posts Serviceable After 3-4 yrs	6-7 yrs	9-10 yrs	12-13 yrs	15-16 yrs	Where Posts Failed Butt Number	Top
Zinc chloride	10	7	100	100	100	100	100	0	0
" "	5	8	100	100	100	100	100	0	0
Chromated zinc chloride	10	31	100	100	100	97	97	1	0
" " "	5	15	100	100	100	100	93	1	0
" " "	(1)	10	100	90	90	90	90	1	0

(1) Strength of solution varied but enough salt was used to provide 1 pound of salt per cu. ft. of wood.