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Durability of Three Species of Wood After Treatment

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Fig. 1.—American elm post after 10 years—hot and cold bath.

DURABILITY OF THREE SPECIES OF WOOD AFTER TREATMENT

WAYNE K. MURPHEY

In 1944, as a portion of the continuing program in fence post research, a project was initiated in cooperation with Koppers Company Incorporated to examine the effectiveness of three fungicides and three treatments of three species of wood. Creosote, copper naphthenate, and copper tallate preservatives were used in pressure treatment, hot and cold butt treatment, and 15-second dip treatment to American elm, sugar maple, and southern yellow pine posts. The tests were terminated after 15 years service life because it was felt the post had yielded sufficient information to permit conclusions to be drawn on the above variables.

Fig. 2.—Sugar maple hot and cold bath posts after 10 years. Creosote on left—Copper Naphthenate on right.

Methods and Materials.

The posts were peeled and seasoned six months prior to treatment and picked at random for each series of treatments. Twelve posts were used in the copper naphthenate and creosote series, and for the untreated controls Nine posts were used in the copper tallate series.

All treatments shown in Table 1 were done at the Technical Department of Koppers Company, Inc. Wood Preserving Division.

Annual inspections have been carried out since 1947 in which both the top and butt portions of the post was examined. Initially the posts were pulled from the ground for inspection. After the 1951 inspection the posts were moved from the original site. Inspections after this time were made by using a probe to determine conditions at ground line.

Results and Discussion

Table 2 shows the retentions of various treatment variables for each species.

TABLE 1.—Treatment Conditions

	Creosote	Copper Naphthenate	Copper Tallate
Pressure			
Initial air (psig)	60–90	60–90	----
Duration of initial treatment (min.)	15	15	----
Duration of preservative fill (min.)	5	5	5
Treatment temperatures (°F.)	190	120	140
Pressure (psig)	150	150	150
Duration of pressure period (min.)	90	60	120
Blow back time (min.)	5	5	5
Final vacuum (inches of mercury)	26	26	26
Duration of final vacuum (min.)	15–30	15–30	15–30
Hot and Cold			
Duration of hot soak (min.)	180	180	180
Temperature of preservative (°F.)	200	140	140
Duration of cold soak (min.)	60	60	60
Temperature of preservative (°F.)	80–90	80–90	80–90
Cold Dip			
Duration of dip (seconds)	15	15	----
Temperature (°F.)	80	80	----

TABLE 2.—Pounds of Preservative Retained per Cubic Foot of Wood

Treatment	American Elm			Sugar Maple			Southern Yellow Pine		
	Creosote	Cu.N	Cu.T	Creosote	Cu.N	Cu.T	Creosote	Cu.N	Cu.T
Pressure	6.7	8.9	11.7	8.8	8.6	7.9	8.0	8.0	8.0
Hot and Cold	8.7	6.8	4.9	4.8	6.3	3.8	6.5	1.9	3.0
15-Sec. Dip	0.8	1.3	----	0.6	0.8	--	0.7	0.6	--

The average life of posts shown in Table 3 are indicative of those which may be obtained in a fence line. The service life extrapolated from the tie renewal curves considers the average service life of the unit when 60 percent of the individuals have failed.[1] This is probably a

[1]McLean, J. D. (1951). Percentage Renewals and Average Life of Railway Ties. U.S.F.P.I. Report R886, U. S. Forest Products Laboratory, Madison, Wisc.

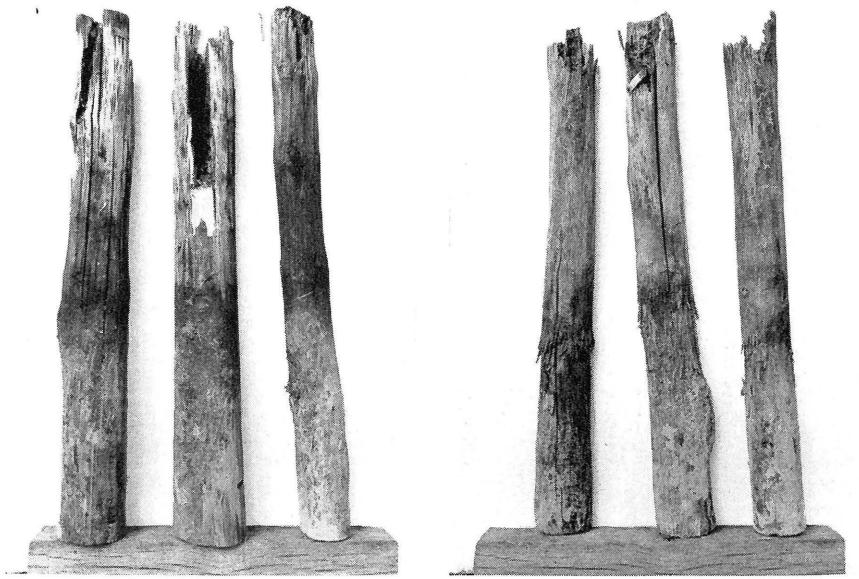

Fig. 3.—Butt Treatment After 15 Years.

Hot and Cold Bath
Creosote

American elm
Sugar maple
Southern yellow pine

Hot and Cold Bath
Copper Naphthenate

American elm
Sugar maple
Southern yellow pine

TABLE 3.—Service Life Months

Service	Preservative	Process	Retention *, † Lbs./Ft.‡		Index of Condition‡		Posts Remaining After 15 Years	Service Life Months
					Tops	Butts		
American elm	Creosote	Rueping	6.7	1.8	100	82	12	____
American elm	Creosote	Hot and Cold	8.4	2.2	0	75	12	____
American elm	Creosote	15 seconds dip	0.8	0.2	0	0	0	90.4
Sugar maple	Creosote	Rueping	8.8	1.3	100	79	10	264.0§
Sugar maple	Creosote	Hot and Cold	4.9	1.6	0	45	5	192.0§
Sugar maple	Creosote	15 seconds dip	0.6	0.1	0	0	0	69.6
Southern yellow pine	Creosote	Reuping	8.2	2.2	100	91	12	____
Southern yellow pine	Creosote	Hot and Cold	5.8	1.9	0	75	12	____
Southern yellow pine	Creosote	15 seconds dip	0.7	0.1	0	0	0	99.6
American elm	Copper Naphthenate	Rueping	0.49	0.08	100	96	12	____
American elm	Copper Naphthenate	Hot and Cold	0.34	0.05	0	85	6	204.0
American elm	Copper Naphthenate	15 seconds dip	0.06	0.02	0	0	0	120.0
Sugar maple	Copper Naphthenate	Rueping	0.40	0.08	100	74	12	____
Sugar maple	Copper Naphthenate	Hot and Cold	0.37	0.07	0	70	12	____
Sugar maple	Copper Naphthenate	15 seconds dip	0.04	0.01	0	0	0	84.0
Southern yellow pine	Copper Naphthenate	Rueping	0 44	0.14	100	95	12	____
Southern yellow pine	Copper Naphthenate	Hot and Cold	0.10	0.02	0	20	3	174.0§
Southern yellow pine	Copper Naphthenate	15 seconds dip	0.03	0.01	0	0	0	127.2

TABLE 3.—Service Life Months—Continued

Service	Preservative	Process	Retention *, † Lbs./Ft.‡	Index of Condition‡		Posts Remaining After 15 Years	Service Life Months
				Tops	Butts		
American elm	Copper Tallate	Lowry	0.59 0.09	100	75	9	----
American elm	Copper Tallate	Hot and Cold	0.25 0.07	0	20	5	180.0
Sugar maple	Copper Tallate	Lowry	0.40 0.07	100	40	8	----
Sugar maple	Copper Tallate	Hot and Cold	0.19 0.15	0	0	0	76.8
Southern yellow pine	Copper Tallate	Lowry	0.40 0.09	85	60	9	----
Southern yellow pine	Copper Tallate	Hot and Cold	0.15 0.18	0	0	2	108.0§
American elm	Untreated					0	57.6
Sugar maple	Untreated					0	60.0
Southern yellow pine	Untreated					0	86.4

*Mean and one standard deviation.

†Retention for copper naphthenate and copper tallate in pounds per cubic feet of metallic copper. Creosote pounds per cubic feet of No. 1 creosote.

‡Index of posts remaining after 16 years.

§Service life estimated from tie renewal curves.

greater percentage of failures than practical for a fence line since the failure of several adjacent units can render a fence line useless.

The calculations and service life reported are for the ground line conditions. The series of photographs show representative units of each series in the test. The conditions of the tops of the butt treated posts indicates failure long before the ground line decays. In several posts decay had not occurred in the treated outer ½ inch of sapwood leaving a shell of treated sound wood, behind which the wood has decayed as shown in Figures 1, 2, and 3.

Such results point out the necessity of treating the entire sapwood or to a depth sufficient to provide protection against checking or accidental chipping below the level of the preservative treatment.

The 15-second dip treatment did not place sufficient preservative into the post (Figure 4). Thus as seasoning checks progressed through weathering, untreated areas were exposed which later decayed.

Creosote and copper naphthenate preservative have shown to be effective as fungicides to wood-rotting fungi (Figure 5). The copper tallate is a metalic soap used during World War II as a paint drier which was thought to have properties as a wood preservative. It performed well in some posts, but was extremely variable. The copper content in the solution is probably the inhibitor and in its form as a tallate does not offer additional benefits to other wood preservatives placed in contact with the ground.

The southern yellow pine post pressure treated with creosote served as a control for the test variables. This species treatment is known to produce a satisfactory post since posts of this type have service life records of over 40 years. Generally sugar maple posts performed below the levels attained in the American elm and the southern yellow pine posts. The elm and pine posts were essentially equal except for the copper naphthenate hot and cold bath series of elm posts. Final retentions in these posts are one-third those of the other two species.

The economies of treatment can be calculated from costs in 1944. The change of prices since that time will approximately be the same between the preservatives. Since all other costs for each treatment will be relatively the same as to cutting, bucking, peeling, seasoning, treating and placing the post in the fence line, costs between treatments are calculated on the cost of the preservative. Assuming a 30-year life for the pressure treated posts, the economies of this treatment are shown in Table 4. The hot and cold butt treated posts service life depended on the decay of the top of the post. The service life of these posts was about two years longer than the untreated controls.

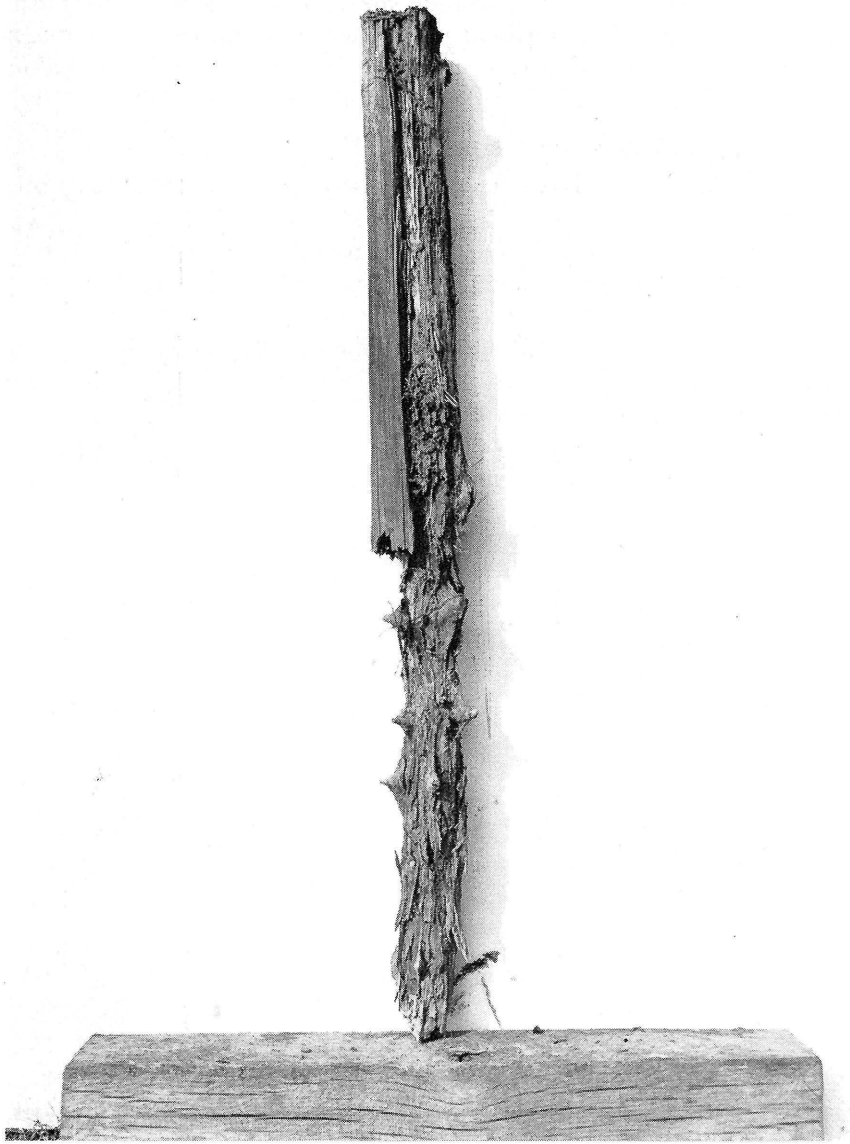

Fig. 4.—Southern yellow pine—15 second dip in creosote, after 15 years.

Replacement costs of these posts which have decayed would carry additional costs of removing, setting, and restapling.

The above costs do not include equipment costs nor preservative waste costs. Since a quantity of preservative is required for treatment, a sustained operation or a large quantity of posts is required to reduce extra preservative cost.

Conclusions and Recommendations

From the results of this experiment the following conclusions may be drawn:

(1) Pressure treated posts maintain fence lines a sufficient number of years to warrant the higher initial costs over non-durable untreated species.

(2) Butt treatment of fence posts is not to be recommended, since decay of the upper portions renders the fence post unusable in less than seven years.

(3) Butt treatment has the highest cost per year of the variables tested, due to the increased retention and low service life.

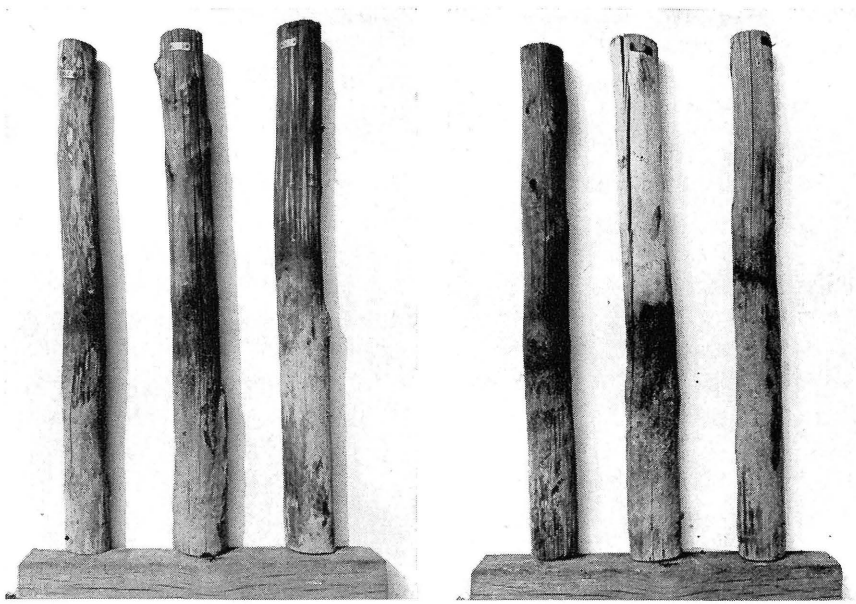

Fig. 5.—After 15 Years.

Pressure Creosote

American elm
Sugar maple
Southern yellow pine

Pressure Copper Naphthenate

American elm
Sugar maple
Southern yellow pine

TABLE 4.—Annual Cost of Posts

	Years of Service	Cost of* Preservative (cents)	Cost† Per Post Per Year
Pressure-Creosote			
American elm	30	6.2	4.2
Sugar maple	30	8.5	4.2
Southern yellow pine	30	7.7	4.2
Pressure-Copper Naphthenate			
American elm	30	8.5	4.2
Sugar maple	30	7.2	4.2
Southern yellow pine	30	9.7	4.2
Hot and Cold Butt-Creosote			
American elm	7	7.5	16.8
Sugar maple	9	4.5	12.6
Southern yellow pine	9	4.5	12.6
Hot and Cold Butt-Copper Naphthenate			
American elm	7	6.1	16.8
Sugar maple	7	5.6	16.5
Southern yellow pine	9	1.6	12.1
Dip-Creosote			
American elm	8.2	0.7	6.1
Sugar maple	8.4	0.4	6.0
Southern pellow pine	5.8	0.5	8.6
Dip-Copper Naphthenate			
American elm	10	2.4	5.0
Sugar maple	7	1.6	6.6
Southern yellow pine	11	1.1	4.9
Untreated			
American elm	5		8.0
Sugar maple	5		8.0
Southern yellow pine	7		5.7

*Cost calculated on test retentions. Creosote @ $1.88 per pound; copper naphthenate @ $2.25 per pound (5%).

†Cost calculated on pressure posts at $1.25 per post. Untreated posts @ $0.40 per post.