PROGRESS REPORT 6 OCTOBER 1952

Service Life of Treated and Untreated Fence Posts

1952 Progress Report on the T. J. Starker Post Farm

(Project No. 29)

By

Robert D. Graham

OREGON FOREST PRODUCTS LABORATORY

State Board of Forestry and School of Forestry,
Oregon State College Cooperating
Corvallis

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A Research Project of the Oregon Forest Products Laboratory
Corvallis, Oregon

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Summary of 1952 Inspection

Seventy-nine posts were removed from 10 untreated, 12 nonpressure-treated, and 2 pressure-treated series. The remaining 19 cottonwood posts in series 27 (creosote, butt-treated) were removed because of the severely decayed condition of the tops. Although the creosoted portion of the butts was still sound after 22 years service, the service life of the tops probably was less than 10 years. The first failures occurred in the nonpressure-treated Douglas-fir series 65, 67, and 90. Failures also occurred in the pressure-treated series 33 and 43. Causes of post failures were:

	Number of failures	
Cause	*1952*	*1949-1951*
Fungi (decay)	48	51
Termites (damp-wood)	5	7
Fungi and termites	21	24
Fungi and insects other than termites	5	7

Carpenter ants were found in a number of removed posts that apparently had been attacked initially by termites.

The following series, comprising 299 posts, were installed during 1952:

Species	*Series numbers*	*Treatment*
Alder, red	106	None
Alder, red	105, 108	Double diffusion
Douglas-fir	97, 100	None
Douglas-fir	101, 102	Double diffusion
Douglas-fir	96, 98	Pressure, Boliden salts
Pine, lodgepole	103	None
Pine, lodgepole	99, 104	Double diffusion

The T. J. Starker Post Farm

In 1927 the School of Forestry at Oregon State College established and has since maintained a "post farm" to obtain data on the natural durability of native woods and the effectiveness of different preservative treatments for species used as fence-post material. The first posts were set on January 7, 1928, and since the inception of the program, 2,637 posts have been placed in the farm. Three introduced and 24 native species in the untreated condition, and eight Oregon woods that were given various preservative treatments have been or are being tested.

The T. J. Starker Post Farm is located on School of Forestry land in the Peavy Arboretum about seven miles north of Corvallis, Oregon, on the west side of Highway 99W. The soil in the test area, located on an excellently drained south slope, is Olympic silty clay loam. The slightly acid top 8 inches of the soil has a pH of 5.4, an organic matter content of 4.71 per cent, a humus of ½ inch or less in thickness, and a nitrogen content of 0.1415 per cent. A number of old Douglas-fir stumps are present in the test site.

Climatic conditions

The average annual rainfall in the Corvallis area since 1927 has been 35.46 inches, with an average of 130 rainy days per year. Some summer intervals have approached drought conditions. An annual mean relative humidity of 64.5 per cent and temperature of 53.5° F. have prevailed. The temperature occasionally falls below freezing and occasionally exceeds 85° F. Cool afternoon breezes from the Pacific Ocean usually arise daily during the summer months. Table 1 gives climatological data for the Corvallis area for the years 1928 through 1951.

Test specimens

Test posts are usually installed in groups of 25; each group constitutes a test series. Posts in each series are placed 2 feet apart in a row running in a northerly direction up the test plot slope. Test series are spaced 3 feet apart, and all posts are set into the ground to a depth of 2 feet.

Prior to 1947, installed test posts ranged from 4 to 7 feet in length and from 3 to 70 square inches in ground-line cross-sectional area. Test posts are now standardized at a length of 5 feet, and cross-sectional areas of individual posts are limited to 16 ± 8 square inches at a distance of 2 feet from the butt ends. The average cross-sectional area, 2 feet from the butt ends of the posts in each series, must fall within the limits of 16 ± 2 square inches.

Post inspections

Annual inspections are made during the month of October. A 50-pound horizontal pull at a height of 2 feet above the ground is applied to each post to determine failure, and each post that fails to withstand this pull is examined to establish the point and cause of failure. A deterioration rating is made of the top and visible ground-line zone of each post.

Post farm records

Recorded data for each series of posts include the source and species, sizes and types of individual posts, percentage of sapwood, processing prior to installation or preservative treatment, the preservative treatment given (if any), date of installation, dates of individual post failures, the condition of each post at each annual inspection period, and other pertinent facts.

Interpretation of Data

Posts and other wood products used in contact with the ground and exposed to the weather are subject to attack by insects and wood-destroying fungi. The most vulnerable section of a fence post extends from a short distance above to some distance below the ground surface. This post zone usually has a more sustained favorable supply of the moisture and air necessary to the existence of these destructive agents. In areas of abundant rainfall or prolonged periods of high humidity, the tops of fence posts also are subject to deterioration, but normally it proceeds at a slower rate. The ground-line section of a post also is important because preservatives are most subject to leaching action there and, on windy sites, sand erosion often cuts deeply into the wood of this zone. To evaluate intelligently the results of any test of fence post serviceability, these and many other factors must be considered simultaneously.

Limitations of test data

The detailed tabular data presented at the end of this report cannot be applied indiscriminately to every locality and to all fence post service requirements. The data are basically comparative and applicable to one area and one type of use; these data must be adjusted empirically to fit other situations.

Posts tested in the T. J. Starker Post Farm are not subject to the stapling, nailing, ground-line erosion, and physical forces that frequently reduce the service life of posts actually in use; but, on the other hand, these test posts are placed in climatic conditions that are conducive to virtually continuous insect attack and decay. The arbitrary 50-pound horizontal pull to determine post failure is admittedly not comparable to the physical forces that may be exerted on fence posts in actual service.

Influence of climatic conditions

Climate determines to a great extent the proportion of time that suitable conditions for decay exist in a given region. Optimum temperatures for the growth of decay-producing fungi range from 60° to 80° F., but some fungi can develop at temperatures as low as 35° F. or as high as 120° F. If all parts of a wood post have a moisture content of 20 per cent or less (oven-dry basis), there is virtually no possibility of fungus growth. During long periods of extremely dry weather and in periods when the temperature approaches freezing, the rate of decay in posts is retarded. The rate of post deterioration is doubtless much slower in regions where long periods of unfavorable conditions prevail. In western Oregon, for example, where favorable moisture and temperature conditions exist for long periods, untreated tops of posts that have been given adequate butt treatment with a good preservative often decay long before the ground-line sections are seriously weakened.

Consideration of post characteristics

Post service records in this report mean little, if the characteristics of the wood are not taken into consideration. The size, amount of sapwood, and extractive constituents in the wood greatly influence the serviceability of untreated posts. Larger posts may give longer service, not only because of greater gross volume of wood, but also because of the higher proportion of heartwood that they usually contain. The sapwood of no native species is naturally insect- and decay-resistant. Extractive constituents in the heartwoods of a few species promote resistance to insect and fungus attack; with some exceptions, these extractives give heartwood a darker color than that of sapwood.

Equal importance of preservatives and methods of preservation

The service life of treated wood is affected by the nature of the preservative used, the portion of the product treated, the amount of preservative retained by the wood, the method of treatment, and the uniformity of treatment. Most preservatives are effective fungicides and insecticides, but extension of the service life of wood requires the continued presence of the preservative in a concentration that is toxic to the organisms responsible for deterioration. It is important that the preservative be present in the areas subject to attack, principally the ground-line zone and, in some instances, also the top of the post.

The method of treatment and the preservative used are equally important, for poor treatment produces poor results. For this reason, a preservative cannot be condemned until it can be shown that the treatment was unsatisfactory despite application of the preservative by a proper treating method. Although a preservative may fail under one set of climatic conditions, it may prove extremely successful under different conditions. A preservative that is very soluble in water, for example, may leach from wood in a region of abundant rainfall, whereas in a dry climate it may be permanent. Successful treatment provides uniform penetration into the treated area and the retention of a sufficient quantity of preservative within the wood structure adequately to protect the wood under the conditions in which it is to be used. High total retention of preservatives is not necessarily an indication of successful treatment; in some species, the end penetration of the preservative may be very rapid, whereas side penetration may be very slow. This may result in complete protection of the end of the post, with virtually no protection of the groundline zone.

Preliminary Evaluation of Tests

Determination of the service life of a series in which most or all posts have failed is relatively simple; for many of the naturally decay-resistant untreated series and for treated series in which few posts have failed, estimation of average service life cannot be made with accuracy. The estimated service life, when given for any series in this report, is based on the number of posts that have failed and on the service age and condition of the remaining posts. For a few untreated species, the natural decay resistance as determined in other service tests has been taken into consideration in making estimates of service life.

Untreated fence posts

The characteristics, service records, and removal records of untreated fence posts are shown in Tables 2, 3, and 8. Based on the actual and estimated service life for each untreated series of posts, the various species tested or being tested are classified into three broad groups. Numerals in parentheses indicate series numbers for convenience in referring to tabular data.

1. *Average service life of at least 20 years*
   - a. Cedar, Alaska yellow (46)
   - b. Cedar, Port Orford white (21)
   - c. Cedar, western red (10, 11)
   - d. Juniper, Sierra (30)
   - e. Locust, black (40)

f. Osage-orange (32)
g. Redwood (58)
h. Yew, Pacific (13)

2. Average service life of 10 to 15 years

a. Cedar, California incense (29)
b. Oak, Oregon white (19)

3. Average service life of less than 10 years

a. Alder, red (16)
b. Ash, Oregon (28)
c. Cascara (20, 47)
d. Cottonwood, black (14, 82)
e. Douglas-fir (1, 55, 57, 72)
f. Fir, grand (15)
g. Hemlock, western (38)
h. Larch, western (37)
i. Madrone, Pacific (26)
j. Maple, bigleaf (17)
k. Pine, lodgepole (48, 49)
l. Pine, ponderosa (36)
m. Pine, sugar (35)
n. Pine, western white (34)
o. Spruce, Sitka (31)

Initial failures of untreated posts of species showing an average service life of less than 10 years usually occurred at the end of the first 2 or 3 years of service. If such posts must be used, one should expect to replace a few posts after this relatively short time interval, although the average service life of the entire lot may be several times greater than this.

Treated fence posts: nonpressure processes

The characteristics, service records, and removal records for fence posts treated by nonpressure preservation processes are given in Tables 4, 5, and 9. An attempt has been made to evaluate each treatment and, where a treatment has failed to produce a longer average service life than that of untreated material of the same species, the suspected cause of such failure is indicated. Nonpressure preservative treatments have been segregated into two groups on the basis of performance. The names and series numbers of the species receiving these treatments are indicated in parentheses.

1. *Treatments that have not increased the average service life of posts.*

a. BRUSH APPLICATION OF ASPHALT EMULSION (Douglas-fir, 39). Brush application of the most efficient preservative can hardly be considered an effective treatment for fence posts. The preservative cannot penetrate the wood sufficiently, and posts retain very little of the preservative.

b. CHARRING (Douglas-fir, 22). Charring is not a preservative treatment and, if it accomplishes anything, it tends to shorten the average service life of posts by producing seasoning checks that give spores of decay-producing fungi access to interior parts of the post and by reducing the volume of wood in the critical zone.

c. COLD SOAKING IN 5 PER CENT SOLUTION OF ZINC CHLORIDE (Douglas-fir, 12). These posts were not appreciably benefited by this treatment for two possible reasons: (a) inadequate treatment of the ground-line section and (b) leaching of the water-soluble preservative.

d. HOT AND COLD BATH IN CARBOLINEUM "B" (Port Orford white cedar, 9). This treatment seems to have had little effect in increasing the average service life of this species; the service record of untreated Port Orford white cedar is very similar to that of the treated material.

2. *Treatments that have increased the average service life of posts.*

a. A. C. M. Co. treater dust and paste (Douglas-fir, 5, 6, 24, 25).

b. Hot and cold bath using Carbolineum "B" (Douglas-fir, 8).

c. Hot and cold bath using creosote (black cottonwood, 27).

d. Hot and cold bath using 50 per cent creosote and 50 per cent crankcase oil (Douglas-fir, 18).

e. Hot and cold bath using Gasco creosote oil (Douglas-fir, 54).

f. Salt treatment (Douglas-fir, 2, 3, 4, and lodgepole pine, 50).

g. Soaking in Permatol "A" (ponderosa pine, 56).

h. Tire-tube method using Chemonite (Douglas-fir, 59).

Reference to the service records (Table 5) of posts in the latter of the two foregoing groups will reveal that many of these nonpressure treatments have been highly effective in protecting the groundline zone. Serious deterioration in the tops of such posts indicates that some form of top treatment also should be given.

Treated fence posts: pressure processes

The characteristics, service records, and removal records of fence posts treated by pressure processes are shown in Tables 6, 7, and 10. The service records of many pressure-treated series are comparatively short, but there is every reason to expect long service life from posts pressure-treated with the preservatives listed below. The names and series numbers of species treated with these preservatives are indicated in parentheses.

1. Chemonite (Douglas-fir, 45, and western hemlock, 44).
2. Coal-tar creosote (Douglas-fir, 53).
3. Coal-tar creosote and petroleum mixture (Douglas-fir, 51).
4. Creosote (Douglas-fir, 23).
5. Creosote, 70 per cent and fuel oil, 30 per cent (Douglas-fir, 7).
6. Gasco creosote oil (Douglas-fir, 52).
7. Wolman (Tanalith) salts (Douglas-fir, 42, and western hemlock, 41).
8. Zinc-meta-arsenite (Douglas-fir, 33).

Although the service life of Douglas-fir (Series 43) has been increased by chromated zinc chloride treatment, eight post failures have occurred in the series, indicating that this preservative treatment has been less effective than those in the foregoing list.

Methods of Applying Preservatives to Test Posts

BRUSH TREATMENT: Preservatives and preservative solutions are applied to the wood surface with a brush. Brush treatment of fence posts cannot be recommended as an effective treatment.

CHARRING: Although sometimes called a preservative treatment, charring the surface of wood cannot be justly designated a preservative treatment.

DOUBLE DIFFUSION: Green, peeled, or partially peeled posts are placed in a water solution of one chemical for two to three days and then transferred to a second water solution of a different chemical for two to three days. The chemicals diffuse into the wood where they react to form a toxic compound that is relatively insoluble in water. The removal of three or more full-length strips of bark improves the distribution of the chemical. Butt-treated posts should be stacked with the tops down to facilitate movement of the chemicals to the tops.

HOT AND COLD BATH: In this treatment, often called the open tank method, the posts are first soaked in a hot preservative solution for a number of hours; then the posts either are allowed to cool in the preservative or are transferred into a cool solution. Posts to be treated by this method should be peeled and thoroughly seasoned. One end, both ends, or the entire length of the post may be treated by this method.

OSMOPLASTIC BANDAGE: A 9-inch strip of the bark of a green post is removed at the ground line, and the peeled area is coated with a preservative mixture. A water-resistant covering is tightly wrapped around the coated area. The preservative mixture is also applied to the ends of the post.

OSMOSALTS: Osmosalts in a thick water solution are applied to the ends and to the peeled surfaces of green posts, which are then closely piled and covered for varying periods of time to allow the preservative mixture to diffuse into the wood.

PRESSURE TREATMENTS: Prior to treatment, posts are air seasoned, artificially seasoned in the preservative by boiling under vacuum, or conditioned by steaming. Hot preservative is injected into the wood under pressure in a closed container, and a final vacuum is usually applied to remove excess preservative and dry the surface of the wood. The full length of the post receives treatment.

SALT TREATMENT: A $\frac{3}{4}$-inch hole slanting toward the butt is drilled to a depth of about 2 inches just above the ground line of an unpeeled, freshly cut post. One tablespoonful of a dry mixture of equal proportions by weight of salt (sodium chloride) and corrosive sublimate (mercuric chloride) or one tablespoonful of a dry mixture of equal proportions by weight of salt, corrosive sublimate, and arsenous oxide is placed in the hole. A snugly fitting wood plug is then driven into the hole. The holes should be spaced not more than 5 inches apart around the circumference of each post and staggered vertically to prevent weakening the post seriously. **Corrosive sublimate and arsenous oxide are very poisonous chemicals that must be handled with extreme care.**

SOAKING TREATMENT: Posts are placed in the preservative solution to the desired depth and permitted to soak for a number of hours or days. The posts should be peeled and thoroughly seasoned. For many species, that portion of the post 6 inches above and 12 inches below the ground line should be incised to a depth of $\frac{1}{2}$ inch. This treatment has proved to be very successful for some species and much less effective for others. It is primarily a sapwood treatment.

TIRE-TUBE METHOD: One end of a portion of an automobile tire inner tube is slipped over the butt end of an unpeeled, freshly cut post that is laid with the butt end higher than the top end on an inclined rack. The open end of the tire tube is elevated, and the tube is filled with preservative. The preservative, after a period of time, diffuses through the sapwood and finally drips out of the lower end of the post.

Preservative Materials Used for Test Posts

Virtually all preservatives are poisonous. Many may cause irritations when the chemical itself, its solution, or its vapor contacts the skin. Some are extremely poisonous and corrosive. Care should be exercised in handling all preservatives; exposed portions of the body should be washed frequently.

All preservatives should be stored in closed, clearly identified containers. The manufacturer's recommendations should be followed implicitly.

ASPHALT EMULSION: An emulsion or suspension of finely dispersed particles of asphalt in water. Asphalt is a black to dark brown solid or semisolid material composed predominantly of bitumens.

BOLIDEN SALTS: This preservative contains arsenic acid, sodium arsenate, sodium bichromate, and zinc sulfate.

CARBOLINEUM: Carbolineums, or anthracene oils, are coal-tar distillates of higher specific gravity and higher boiling range than ordinary coal-tar creosote. The exact composition of Carbolineum "B" is not known.

CHEMONITE: Chemonite solution consists of copper, arsenic, and ammonium acetate dissolved in ammoniacal solution.

CHROMATED ZINC CHLORIDE: The preservative contains about 82 per cent zinc chloride and 18 per cent sodium bichromate in a water solution.

COPPER NAPHTHENATE: The oil-soluble copper salt of naphthenic acid. Solutions containing 1 per cent copper by weight have been recommended for optimum performance.

CREOSOTE, CREOSOTE OIL, OR COAL-TAR CREOSOTE: A distillate of coal tar produced by high temperature carbonization of bituminous coal. It consists principally of liquid and solid aromatic hydrocarbons, contains appreciable quantities of tar acids and tar bases, and has a continuous boiling point range that begins at about 200° C. and extends to a temperature at least 125° C. higher.

CREOSOTE MIXTURES: Creosote may be mixed in varying proportions with petroleum, crankcase oil, or other diluents that act as carriers for the creosote.

GASCO CREOSOTE: A distillate of tar residue resulting from the cracking of asphaltic-base petroleum oils in which artificial fuel gas is the main product.

OSMOSALTS: A proprietary wood preservative containing sodium fluoride, sodium bichromate, dinitrophenol, and sometimes arsenic. The chemicals are water-soluble.

PENTACHLOROPHENOL: An oil-soluble chemical compound formed from phenol and chlorine. Solutions containing 5 per cent pentachlorophenol by weight are recommended for wood in contact with soil.

PERMATOL "A": A preservative containing pentachlorophenol as its toxic constituent. The name, Permatol, has been copyrighted by the Western Pine Association.

SALT AND CORROSIVE SUBLIMATE: A mixture of equal proportions by weight of the two water-soluble chemicals. Corrosive sublimate (mercuric chloride) is the toxic chemical, and the salt serves to hold moisture. **Corrosive sublimate is an extremely poisonous chemical.**

SALT, CORROSIVE SUBLIMATE, AND ARSENOUS OXIDE: A mixture of equal proportions by weight of the three chemicals. The arsenous oxide is an additional water-soluble toxic agent. The addition of this chemical apparently contributes little, if anything, to the effectiveness of the corrosive sublimate. **Corrosive sublimate is an extremely poisonous chemical.**

SODIUM PENTACHLOROPHENATE: The water-soluble sodium salt of pentachlorophenol.

SODIUM TRICHLOROPHENATE: The water-soluble sodium salt of trichlorophenol.

TREATER DUST, GRANULAR TREATER DUST, AND TREATER PASTE: Preservatives formerly produced by the Anaconda Copper Mining Company as byproducts of its copper smelting operation. Arsenic trioxide is the principal toxic constituent of the preservatives that were sold in dust, granular, and paste forms. The paste form was applied directly to the wood; the dust and granular forms were placed around the posts as earth was backfilled in the post-setting operation. The manufacture of these preservatives has been discontinued.

WOLMAN SALTS (TANALITH): A proprietary wood preservative normally containing sodium fluoride, dinitrophenol, sodium chromate, and sodium arsenate. It is injected in water solution.

ZINC CHLORIDE: A chemical applied to wood in a 2 to 5 per cent water solution.

ZINC-META-ARSENITE: A preservative prepared by dissolving zinc oxide and arsenic trioxide in water that has been acidified with acetic acid.

Table 1. CLIMATOLOGICAL DATA, CORVALLIS, OREGON*

Year	Mean temperature	Maximum temperature	Minimum temperature	Mean relative humidity	Total rainfall	Minimum monthly rainfall	Maximum monthly rainfall	Rainy days
	°F	*°F*	*°F*	*Per cent*	*Inches*	*Inches*	*Inches*	*Number*
1928	53.4	102	20	......	39.86	0.00	9.43	136
1929	52.7	97	16	70.5	24.45	Trace	11.44	98
1930	52.7	98	4	69.2	23.68	0.00	5.07	110
1931	54.4	104	24	68.5	39.13	0.00	9.12	131
1932	53.4	99	9	62.6	36.94	Trace	8.09	135
1933	52.3	96	11	64.3	42.59	0.00	14.15	145
1934	55.2	99	26	62.5	35.42	0.10	9.71	115
1935	52.6	106	15	63.0	26.35	0.10	4.76	105
1936	54.2	93	19	67.6	32.11	Trace	10.82	121
1937	53.6	98	10	66.8	58.06	0.08	11.17	157
1938	54.3	104	21	64.0	32.04	Trace	7.42	139
1939	54.9	104	25	65.6	26.33	0.22	8.53	113
1940	55.7	100	20	67.2	40.36	Trace	9.80	128
1941	55.0	104	26	64.7	32.95	0.00	7.99	131
1942	53.9	104	17	59.9	39.20	Trace	12.69	......
1943	53.1	95	11	58.2	31.53	0.02	5.60	100
1944	53.2	103	21	58.2	22.99	Trace	4.63	97
1945	53.4	98	20	64.4	37.79	0.08	10.08	133
1946	52.2	107	20	61.9	33.42	0.01	6.78	145
1947	53.7	95	18	64.0	33.91	0.16	9.05	141
1948	51.5	97	19	63.6	40.14	0.06	7.46	158
1949	52.5	95	12	61.2	34.84	Trace	11.84	135
1950	53.0	99	—1	68.1	48.58	0.21	12.17	171
1951	53.3	99	18	66.5	38.38	0.02	7.36	136
Average	53.5	100	18	64.5	35.46	......	....	130

* Data from Agricultural Experiment Station, Oregon State College, Corvallis.

Table 2. Characteristics of Untreated Fence Posts

Species	Series number	Number of posts in test	Post description	Sap-wood	Ground-line perimeter: Mini-mum	Ground-line perimeter: Maxi-mum	Ground-line perimeter: Aver-age	Remarks
				Per cent	*Inches*	*Inches*	*Inches*	
Alder, red	16	25	Split	25	15.0	24.0	19.6	
Alder, red	106	25	Round, peeled	100	9.7	18.5	11.9	
Ash	28	25	Split	30	14.4	24.0	19.2	
Cascara	20	12	Round, peeled	70	6.0	13.3	8.9	
Cascara	47	26	Round, unpeeled	35	12.6	30.2	17.3	
Cedar, Alaska yellow	46	24	Split, mostly heartwood	....	13.0	22.5	17.7	From tree down 4 years
Cedar, California incense	29	25	Split	0	15.6	26.4	20.4	
Cedar, Port Orford white	21	25	Split	0	17.0	32.0	24.4	
Cedar, western red	10*	25	Split	0	18.0	23.0	19.9	Selected for dark color
Cedar, western red	11*	25	Split	0	17.0	21.0	19.1	Selected for light color
Cottonwood, black	14	25	Split	20	17.0	28.0	22.4	
Cottonwood, black	82	25	Round, unpeeled	95	9.7	17.6	14.1	
Cypress, Arizona	84	25	Round, unpeeled	100	10.4	14.7	12.6	
Douglas-fir	1	25	Round, unpeeled	60	15.5	22.0	19.1	
Douglas-fir	55	25	Square	0	16.0	16.0	16.0	
Douglas-fir	57	25	Square	0	16.0	16.0	16.0	
Douglas-fir	72	25	Round, unpeeled	48	10.4	16.3	13.5	
Douglas-fir	97	25	Square	5	14.5	14.5	14.5	
Douglas-fir	100	25	Round, 4 strips peeled	80	12.6	19.8	16.3	
Fir, grand	15	25	Split	65	17.5	28.0	22.4	
Hemlock, western	38	25	Square	0	16.0	16.0	16.0	
Juniper, Sierra	30	11	Round, peeled	40	19.0	26.5	22.1	
	30	14	Split	40	17.5	27.5	23.9	
Larch, western	37	25	Square	0	16.0	16.0	16.0	
Locust, black	40	8	Round	20	6.3	17.3	10.4	
	40	14	Split	20	11.3	27.0	15.8	
Madrone, Pacific	26	25	Round and split	40	16.5	27.5	21.2	
Maple, bigleaf	17	25	Split	25	17.5	24.5	20.4	
Metal	60	25	Angle iron, 1.1 lb. per foot	....	......	......	......	Aluminum paint
Metal	61	25	"T" post, 1.2 lb. per foot	....	......	......	......	Red oxide paint
Metal	69	9	H-beam, 4 lb. per foot	....	......	......	......	Green enamel, baked
Metal	70	10	Flanged channel, 1.3 lb. per foot	....	......	......	......	Green enamel, baked
Metal	71	10	"T" post, 1.5 lb. per foot	....	......	......	......	Green enamel, baked
Oak, Oregon white	19	24	Split	20	15.0	23.5	18.5	
Osage-orange	32	11	Round, unpeeled	10	15.8	26.0	20.1	
		15	Split	10	12.6	20.6	17.5	
Pine, lodgepole	48	26	Round, peeled	55	12.6	18.8	15.7	From dead trees
Pine, lodgepole	49	25	Round, peeled	55	12.6	18.8	15.7	From live trees
Pine, lodgepole	103	25	Round, 4 strips peeled	80	9.1	16.7	11.9	
Pine, ponderosa	36	25	Square	0	16.0	16.0	16.0	
Pine, sugar	35	25	Square	0	16.0	16.0	16.0	
Pine, western white	34	25	Square	0	16.0	16.0	16.0	
Redwood	58	25	Square	0	16.0	16.0	16.0	
Spruce, Sitka	31	26	Square	0	16.0	16.0	16.0	
Tanoak	76	25	Round, unpeeled	100	9.1	15.4	12.2	
Yew, Pacific	13	23	Round, peeled	10	9.7	23.2	15.7	

* From same group of posts.

Table 3. SERVICE RECORDS OF UNTREATED FENCE POSTS

Species	Series number	Number of posts in test	Number of posts removed at last inspection	Number of posts remaining	Average service life of removed posts	Service age of remaining posts	Location and extent of deterioration in remaining posts			
							Ground-line zone		Top	
							Little or none	Moderate to severe	Little or none	Moderate to severe
					Years	*Years*	*Number of posts*	*Number of posts*	*Number of posts*	*Number of posts*
Alder, red	16	25	....	0	5.2	......	....	....	....	....
Alder, red	106	25	....	25	......	......	25	0	25	0
Ash, Oregon	28	25	....	0	6.2	......	....	....	....	....
Cascara	20	12	....	0	5.4	......	....	....	....	....
Cascara	47	26	1	1	7.2	14.7	0	1	0	1
Cedar, Alaska yellow	46	24	2	20	13.5	14.9	2	18	19	1
Cedar, California incense	29	25	2	3	12.3	22.6	0	3	3	....
Cedar, Port Orford white	21	25	2	2	19.9	23.6	0	2	2	....
Cedar, western red	10	25	6	10	21.1	23.6	0	10	10	0
Cedar, western red	11	25	4	9	19.8	23.5	0	9	9	0
Cottonwood, black	14	25	....	0	4.8	......	....	....	....	....
Cottonwood, black	82	25	9	13	3.3	3.5	6	7	13	0
Cypress, Arizona	84	25	....	25	......	1.0	25	0	25	0
Douglas-fir	1	25	....	0	7.0	......	....	....	....	....
Douglas-fir	55	25	....	0	6.2	......	....	....	....	....
Douglas-fir	57	25	....	0	4.0	......	....	....	....	....
Douglas-fir	72	25	2	23	3.8	3.8	16	7	23	0
Douglas-fir	97	25	....	25	......	......	25	0	25	0
Douglas-fir	100	25	....	25	......	......	25	0	25	0
Fir, grand	15	25	....	0	8.7	......	....	....	....	....
Hemlock, western	38	25	....	0	5.8	......	....	....	....	....
Juniper, Sierra	30	25	2	15	19.0	22.7	2	13	9	6
Larch, western	37	25	....	0	7.3	......	....	....	....	....
Locust, black	40	22	2	18	16.5	17.5	11	7	18	0
Madrone, Pacific	26	25	....	0	5.8	......	....	....	....	....
Maple, bigleaf	17	25	....	0	6.5	......	....	....	....	....
Metal, Angle iron	60	25	....	25	......	3.9	25	0	25	0
Metal, T-post	61	25	....	25	......	3.9	25	0	25	0
Metal, H-beam	69	9	....	9	......	3.8	9	0	9	0
Metal, Channel	70	10	....	10	......	3.8	10	0	10	0
Metal, T-post	71	10	....	10	......	3.8	10	0	10	0
Oak, Oregon white	19	24	....	9	12.3	23.4	1	8	3	6
Osage-orange	32	26	....	26	......	19.5	26	0	26	0
Pine, lodgepole	48	26	....	0	5.1	......	....	....	....	....
Pine, lodgepole	49	25	....	0	4.0	......	....	....	....	....
Pine, lodgepole	103	25	....	25	......	....	25	0	25	0
Pine, ponderosa	36	25	....	0	6.4	......	....	....	....	....
Pine, sugar	35	25	....	0	7.3	......	....	....	....	....
Pine, western white	34	25	....	0	5.8	......	....	....	....	....
Redwood	58	25	....	23	10.8	12.7	23	0	23	0
Spruce, Sitka	31	26	....	0	5.7	......	....	....	....	....
Tanoak	76	25	....	25	......	1.0	25	0	25	0
Yew, Pacific	13	23	....	17	12.1	23.6	6	11	15	2

Table 4. CHARACTERISTICS OF TREATED FENCE POSTS

Nonpressure processes

Species	Series number	Post description	Sapwood	Ground-line perimeter: Minimum	Ground-line perimeter: Maximum	Ground-line perimeter: Average	Preservative treatment*	Average retention per cubic foot: Butt	Average retention per cubic foot: Top	Average total retention per post
			Per cent	*Inches*	*Inches*	*Inches*		*Pounds*	*Pounds*	*Pounds*
Alder, red	105	Round, peeled, green	100	9.7	18.5	11.9	Double diffusion, butts, 6 per cent copper sulfate—2 days; 8 per cent sodium chromate—2 days	......	......	......
Alder, red	108	Round, green, 4 strips peeled	100	9.4	17.3	13.2	Double diffusion, butts, 4 per cent sodium fluoride—2 days; 6 per cent copper sulfate—2 days	......	......	......
Cedar, Port Orford white	9	Round, peeled	25	18.0	21.5	19.5	Hot-cold bath, carbolineum "B," butt	......	......	......
Cottonwood, black	27	Split, peeled	20	16.5	24.5	21.6	Hot-cold bath, creosote, B-6	......	......	......
Cottonwood, black	68	Round, peeled, incised	89	11.0	17.3	13.5	Soak, 5 per cent pentachlorophenol-diesel oil, B-6, T-1	7.31	4.06	2.86
Cottonwood, black	74	Round, peeled, incised	99	11.0	16.0	13.5	Soak, 5 per cent sodium pentachlorophenate, B-4, T-1	7.66	4.47	2.93
Cottonwood, black	77	Round, peeled, incised	95	11.0	17.3	13.5	Soak, copper naphthenate-diesel oil (1 per cent copper), B-6, T-1	2.71	1.47	1.04
Cottonwood, black	78	Round, ground-line peeled, green	83	11.3	16.6	13.8	Osmoplastic bandage	......	......	......
Cottonwood, black	87	Round, peeled, incised	90	11.0	17.3	14.1	Soak, Gasco creosote oil, B-3, T-2	10.9	10.1	5.80
Douglas-fir	39	Round, peeled	60	15.5	22.0	19.1	Brush, asphalt emulsion, butt	......	......	......
Douglas-fir	79	Round, peeled	40	10.4	17.0	14.1	Brush, 2 coats, 5 per cent pentachlorophenol-diesel oil	......	......	......
Douglas-fir	80	Round, peeled	46	10.4	18.5	13.8	Brush, 2 coats, copper naphthenate-diesel oil	......	......	......
Douglas-fir	81	Round, peeled	44	11.3	17.9	14.8	Brush, 2 coats, coal-tar creosote	......	......	......
Douglas-fir	92	Round, peeled	46	9.4	18.2	14.1	Brush, 2 coats Avenarius carbolineum	......	......	......
Douglas-fir	22	Round, peeled	60	12.5	19.3	14.7	Charred ¼ inch deep, butt	......	......	......
Douglas-fir	101	Round, green, 4 strips peeled	65	12.9	19.2	17.0	Double diffusion, butts, 4 per cent sodium fluoride—2 days; 6 per cent copper sulfate—2 days	......	......	......
Douglas-fir	102	Round, green, 4 strips peeled	65	13.8	18.8	16.3	Double diffusion, butts, 6 per cent copper sulfate—2 days; 8 per cent sodium chromate—2 days	......	......	......

* B (butt) and T (top) are followed by treating time in hours.

Table 4. CHARACTERISTICS OF TREATED FENCE POSTS (*Continued*)

Nonpressure processes

Species	Series number	Post description	Sapwood	Ground-line perimeter: Minimum	Ground-line perimeter: Maximum	Ground-line perimeter: Average	Preservative treatment*	Average retention per cubic foot: Butt	Average retention per cubic foot: Top	Average total retention per post
			Per cent	*Inches*	*Inches*	*Inches*		*Pounds*	*Pounds*	*Pounds*
Douglas-fir	2	Round, unpeeled, green	60	14.0	22.7	18.3	Salt and mercuric chloride, 1 hole, butt	......	......	......
Douglas-fir	91	Round, unpeeled, green	32	10.4	16.6	14.1	Salt and mercuric chloride (2:1), 1 hole, butt	......	......	......
Douglas-fir	3	Round, unpeeled, green	60	15.0	26.0	19.9	Salt, mercuric chloride, and arsenous oxide, 2 holes, butt	......	......	......
Douglas-fir	4	Round, unpeeled, green	60	15.0	22.0	17.5	Salt, mercuric chloride, and arsenous oxide, 3 holes, butt	......	......	......
Douglas-fir	89	Round, unpeeled, green	45	9.4	17.3	14.1	Sodium trichlorophenate, 3 holes, butt	......	......	......
Douglas-fir	90	Round, unpeeled, green	39	11.3	17.3	14.1	Sodium pentachlorophenate, 3 holes, butt	......	......	......
Douglas-fir	5	Round, unpeeled, green	60	13.0	20.5	15.6	A.C.M. Co. treater dust, butt	......	......	......
Douglas-fir	6	Round, unpeeled, green	60	13.0	20.5	16.5	A.C.M. Co. granulated treater dust, butt	......	......	......
Douglas-fir	24	Round, peeled, green	60	12.0	18.5	14.4	A.C.M. Co. treater paste, butt	......	......	2.00
Douglas-fir	25	Round, peeled, green	60	12.5	18.0	15.5	A.C.M. Co. treater paste, butt	......	......	4.00
Douglas-fir	59	Round, unpeeled, green	60	13.6	21.4	17.4	Tire-tube, full-length diffusion, Chemonite	......	......	6.00
Douglas-fir	73	Round, ground-line peeled, green	58	11.0	16.6	14.1	Osmoplastic bandage	......	......	......
Douglas-fir	75	Round, peeled, green	46	11.0	17.3	14.1	Osmosalts, covered 30 days	......	......	......
Douglas-fir	12	Round, peeled	60	11.9	16.7	13.8	Soak, 5 per cent zinc chloride, B-192	......	......	......
Douglas-fir	62	Round, peeled, incised	33	11.3	16.0	13.8	Soak, 5 per cent pentachlorophenol-diesel oil, B-2, T-2	1.02	0.40	0.37
Douglas-fir	63	Round, peeled, incised	26	10.4	17.6	13.5	Soak, copper naphthenate-diesel oil (1 per cent copper), B-48, T-6	1.64	0.26	0.50
Douglas-fir	64	Round, peeled, incised	46	10.4	17.3	14.1	Soak, 5 per cent pentachlorophenol-diesel oil, B-48, T-6	2.22	0.45	0.95
Douglas-fir	65	Round, peeled, incised	40	11.0	16.3	14.1	Soak, copper naphthenate-diesel oil (1 per cent copper), B-2, T-2	0.75	0.30	0.29
Douglas-fir	66	Round, peeled	40	11.0	17.3	14.1	Soak, 5 per cent pentachlorophenol-diesel oil, B-48, T-6	1.03	0.23	0.35

* B (butt) and T (top) are followed by treating time in hours.

Table 4. CHARACTERISTICS OF TREATED FENCE POSTS (*Continued*)

Nonpressure processes

Species	Series number	Post description	Sapwood	Ground-line perimeter			Preservative treatment*	Average retention per cubic foot		Average total retention per post
				Minimum	Maximum	Average		Butt	Top	
			Per cent	*Inches*	*Inches*	*Inches*		*Pounds*	*Pounds*	*Pounds*
Douglas-fir	67	Round, peeled	33	10.7	17.3	13.8	Soak, copper naphthenate-diesel oil (1 per cent copper), B-48, T-6	0.73	0.24	0.25
Douglas-fir	88	Round, butt peeled and incised	40	9.4	18.5	13.8	Soak, Gasco creosote oil, B-168, T-48	3.1	2.2	1.40
Douglas-fir	93	Round, peeled, incised	32	9.4	17.0	14.1	Soak, copper naphthenate-diesel oil (1 per cent copper), B-144, T-48	3.0	1.2	1.20
Douglas-fir	94	Round, peeled, incised	33	11.6	16.3	13.8	Soak, 5 per cent pentachlorophenol-diesel oil, B-144, T-48	3.5	1.5	1.30
Douglas-fir	95	Round, peeled, incised	32	11.3	17.3	14.1	Soak, Gasco creosote oil, B-144, T-48	3.2	1.5	1.30
Douglas-fir	8	Round, peeled	60	10.0	21.2	16.6	Hot-cold bath, butt, Carbolineum "B," B-6	......	......	......
Douglas-fir	18	Round, peeled	60	12.0	18.0	15.8	Hot-cold bath, creosote and crankcase oil (50/50), B-20	......	......	0.88
Douglas-fir	54	Square	0	16.0	16.0	16.0	Hot-cold bath, Gasco creosote, B-6	......	......	0.57
Maple, bigleaf	83	Round, peeled, incised	75	11.0	17.3	14.1	Soak, 5 per cent pentachlorophenol-diesel oil, B-24, T-2	7.49	2.03	2.72
Pine, lodgepole	99	Round, green, 4 strips peeled	75	9.1	15.4	12.3	Double diffusion, butts, 6 per cent copper sulfate—2 days; 8 per cent sodium chromate—2 days	......	......	......
Pine, lodgepole	104	Round, green, 4 strips peeled	80	9.4	18.2	13.5	Double diffusion, butts, 5 per cent zinc sulfate plus 0.7 per cent arsenic acid—2 days; 8 per cent sodium chromate—2 days	......	......	......
Pine, lodgepole	50	Round, unpeeled	55	12.6	19.8	15.5	Salt, mercuric chloride, and arsenous oxide, 1 hole, butt	......	......	......
Pine, lodgepole	85	Round, peeled, incised	65	11.9	16.0	13.5	Soak, Gasco creosote oil, B-43, T-24	4.1	1.8	1.5
Pine, lodgepole	86	Round, peeled, incised	76	9.7	16.3	13.5	Soak, 5 per cent pentachlorophenol-diesel oil. B-43. T-24	4.1	2.5	1.6
Pine, ponderosa	56	Square	0–35	16.0	16.0	16.0	Soak, Permatol "A," 17 hours	......	......	0.61

*B (butt) and T (top) are followed by treating time in hours.

Table 5. Service Records of Treated Fence Posts
Nonpressure processes

Species	Series number	Number of posts in test	Number of posts removed at last inspection	Number of posts remaining	Average service life of removed posts	Service age of remaining posts	Location and extent of deterioration in remaining posts: Ground-line zone, Little or none	Ground-line zone, Moderate to severe	Top, Little or none	Top, Moderate to severe
					Years	*Years*	*Number of posts*	*Number of posts*	*Number of posts*	*Number of posts*
Alder, red	105	25	....	25	....	......	25	0	25	0
Alder, red	108	25	....	25	....	......	25	0	25	0
Cedar, Port Orford white	9	10	2	1	19.4	23.5	0	1	1	0
Cottonwood, black*	27	24	19	0	22.2	......	....	....	....	....
Cottonwood, black	68	25	....	25	......	3.8	25	0	25	0
Cottonwood, black	74	22	....	22	......	3.5	22	0	22	0
Cottonwood, black	77	25	4	21	3.5	3.5	21	0	21	0
Cottonwood. black	78	25	4	21	3.6	3.6	21	0	21	0
Cottonwood, black	87	25	....	25	......	1.9	25	0	25	0
Douglas-fir	39	25	....	0	5.3	......	....	....	....	....
Douglas-fir	79	25	....	25	......	2.9	25	0	25	0
Douglas-fir	80	25	....	25	......	3.0	25	0	25	0
Douglas-fir	81	24	....	24	......	2.9	24	0	24	0
Douglas-fir	92	25	....	25	......	2.9	25	0	25	0
Douglas-fir	22	25	....	0	6.3	......	....	....	....	....
Douglas-fir	101	25	....	25	......	......	25	0	25	0
Douglas-fir	102	25	....	25	......	......	25	0	25	0
Douglas-fir	2	24	....	24	......	24.7	0	24	0	24
Douglas-fir	91	25	....	25	......	2.9	25	0	25	0
Douglas-fir	3	24	....	24	......	24.7	0	24	1	23
Douglas-fir	4	23	....	23	......	24.7	15	8	13	10
Douglas-fir	89	25	2	22	3.3	3.5	5	17	22	0
Douglas-fir	90	25	3	22	3.5	3.5	6	16	22	0
Douglas-fir	5	25	....	22	23.6	24.6	12	10	15	7
Douglas-fir	6	25	3	6	19.1	24.6	0	6	3	3
Douglas-fir	24	25	....	22	19.7	22.7	17	5	19	3

* The average service life of the butts of these posts would have been greater than 22 years, whereas the average service life of the tops probably was less than 10 years.

Table 5. Service Records of Treated Fence Posts (*Continued*)

Nonpressure processes

Species	Series number	Number of posts in test	Number of posts removed at last inspection	Number of posts remaining	Average service life of removed posts	Service age of remaining posts	Location and extent of deterioration in remaining posts: Ground-line zone: Little or none	Ground-line zone: Moderate to severe	Top: Little or none	Top: Moderate to severe
					Years	*Years*	*Number of posts*	*Number of posts*	*Number of posts*	*Number of posts*
Douglas-fir	25	25	....	21	19.2	22.7	20	1	15	6
Douglas-fir	59	12	....	12	......	10.3	12	0	8	4
Douglas-fir	73	25	....	25	......	3.8	25	0	25	0
Douglas-fir	75	25	....	25	......	3.5	25	0	25	0
Douglas-fir	12	25	....	0	7.0	......	....	....	....	....
Douglas-fir	62	25	....	25	......	3.7	25	0	25	0
Douglas-fir	63	25	....	25	......	3.7	25	0	25	0
Douglas-fir	64	25	....	25	......	3.8	25	0	25	0
Douglas-fir	65	25	1	24	3.5	2.5	24	0	24	0
Douglas-fir	66	25	....	25	......	3.5	25	0	25	0
Douglas-fir	67	25	1	24	3.5	3.5	24	0	24	0
Douglas-fir	88	23	....	23	......	2.0	23	0	23	0
Douglas-fir	93	25	....	25	......	2.0	25	0	25	0
Douglas-fir	94	25	....	25	......	2.0	25	0	25	0
Douglas-fir	95	25	....	25	......	2.0	25	0	25	0
Douglas-fir	8	22	....	0	12.2	......	....	....	....	....
Douglas-fir	18	24	2	1	17.3	23.4	0	1	1	0
Douglas-fir	54	25	....	25	......	13.0	25	0	25	0
Maple, bigleaf	83	25	....	25	......	3.5	25	0	25	0
Pine, lodgepole	99	25	....	25	......	......	25	0	25	0
Pine, lodgepole	104	25	....	25	......	......	25	0	25	0
Pine, lodgepole	50	25	1	20	9.8	13.4	0	20	11	4
Pine, lodgepole	85	25	....	25	......	1.9	25	0	25	0
Pine, lodgepole	86	25	....	25	......	1.9	25	0	25	0
Pine, ponderosa	56	25	1	21	10.7	12.3	18	3	21	0

* The average service life of the butts of these posts would have been greater than 22 years, whereas the average service life of the tops probably was less than 10 years.

Table 6. CHARACTERISTICS OF TREATED FENCE POSTS

Pressure processes

Species	Series number	Number of posts in test	Post description	Sapwood	Ground-line perimeter: Minimum	Ground-line perimeter: Maximum	Ground-line perimeter: Average	Type of preservative treatment
				Per cent	*Inches*	*Inches*	*Inches*	
Douglas-fir	52	25	Square, incised	0	16.0	16.0	16.0	Gasco creosote oil, posts incised, absorption 4.23 pounds per post (7.6 pounds per cubic foot)
Douglas-fir	45	25	Square	0	16.0	16.0	16.0	Chemonite, average retention 0.58 pounds of dry salt per cubic foot
Douglas-fir	43	25	Round, peeled	60	12.0	16.7	14.2	Chromated zinc chloride, absorption of 0.78 pounds dry salt per post (1 pound per cubic foot)
Douglas-fir	7	25	Round, peeled	60	12.0	21.0	17.7	70 per cent creosote, 30 per cent fuel oil, absorption 1.5 to 16 pounds (average 7.2 pounds) per post, treated twice
Douglas-fir	51	25	Square, incised	0	16.0	16.0	16.0	Coal-tar creosote and petroleum mixture, average absorption 3.8 pounds per post, (6.2 pounds per cubic foot)
Douglas-fir	53	25	Square, incised	0	16.0	16.0	16.0	Coal-tar creosote, absorption 8.1 pounds per post (13.0 pounds per cubic foot)
Douglas-fir	23	49	Round, peeled	60	11.6	16.7	14.5	Creosote, absorption unknown
Douglas-fir	42	25	Square	0	16.0	16.0	16.0	Wolman salts (Tanalith), dry salt absorption 0.302 pounds per cubic foot, kiln dried after treatment
Douglas-fir	33	25	Square	0	13.9	16.6	14.8	Zinc-meta-arsenite, absorption 0.1 pounds per post, treated twice
Douglas-fir	96	25	Round, peeled	60	14.1	16.9	22.0	Boliden salts, average retention of 0.44 pound dry salt per cubic foot
Douglas-fir	98	24	Square	5	14.5	14.5	14.5	Boliden salts, average retention of 0.40 pound dry salt per cubic foot
Hemlock, western	41	25	Square	0	16.0	16.0	16.0	Wolman salts (Tanalith), dry salt absorption 0.302 pounds per cubic foot, posts kiln dried after treatment
Hemlock, western	44	25	Square	0	16.0	16.0	16.0	Chemonite, average retention 0.75 pounds of dry salt per cubic foot

Table 7. Service Records of Treated Fence Posts

Pressure processes

Species	Series number	Number of posts in test	Number of posts removed at last inspection	Number of posts remaining	Average service life of removed posts	Service age of remaining posts	Location and extent of deterioration in remaining posts: Ground-line zone: Little or none	Ground-line zone: Moderate to severe	Top: Little or none	Top: Moderate to severe
					Years	*Years*	*Number of posts*	*Number of posts*	*Number of posts*	*Number of posts*
Douglas-fir	52	25	....	25	......	13.0	25	0	25	0
Douglas-fir	45	25	....	25	......	15.4	24	1	25	0
Douglas-fir	43	25	1	17	11.2	15.7	16	1	17	0
Douglas-fir	7	25	....	25	......	23.6	25	0	25	0
Douglas-fir	51	25	....	25	......	13.0	25	0	25	0
Douglas-fir	53	25	....	25	......	13.0	25	0	25	0
Douglas-fir	23	49	....	49	......	23.4	49	0	49	0
Douglas-fir	42	25	....	25	......	15.8	25	0	25	0
Douglas-fir	33	25	3	21	19.5	19.5	16	5	21	0
Douglas-fir	96	25	....	25	......	......	25	0	25	0
Douglas-fir	98	24	....	24	......	......	24	0	24	0
Hemlock, western	41	25	....	25	......	15.8	25	0	25	0
Hemlock, western	44	25	....	25	......	15.4	25	0	25	0

Table 8. Removal Records of Untreated Fence Posts

Species	Series number	Date set	Number of posts in test	Total number of posts re-moved	Number of posts removed each annual inspection year																					
					31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Alder, red	16	3- 5-29	25	25	1	6	3	7	8	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Alder, red	106	11- 5-52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Ash, Oregon	28	3-19-30	25	25	....	1	1	8	4	2	5	3	....	....	....	1	....	....	....	....	....	....	....	....	....	....
Cascara	20	3- 5-29	12	12	1	3	1	4	1	1	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....
Cascara	47	1-29-38	26	25	....	....	....	....	....	....	....	....	....	1	4	4	1	2	4	1	6	....	1	....	....	1
Cedar, Alaska yellow	46	11- 6-37	24	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	....	2
Cedar, California incense	29	3-19-30	25	22	....	....	....	1	5	....	1	....	2	....	....	2	2	....	3	....	....	1	3	....	....	2
Cedar, Port Orford white	21	5- 4-29	25	23	....	....	....	....	....	....	....	....	....	1	....	....	....	....	2	....	2	3	10	....	3	2
Cedar, western red	10	3- 6-29	25	15	....	....	....	....	....	....	....	....	1	....	....	....	....	1	....	....	....	....	4	1	2	6
Cedar, western red	11	4- 1-29	25	16	....	....	1	....	....	....	....	....	....	....	....	....	....	1	1	1	1	....	3	1	3	4
Cottonwood, black	14	3- 5-29	25	25	2	6	6	8	2	....	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Cottonwood, black	82	3-24-49	25	12	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	9
Cypress, Arizona	84	10- 6-51	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	1	1- 7-28	25	25	....	4	5	7	4	2	1	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	55	10-11-39	25	25	....	....	....	....	....	....	....	....	....	....	....	1	6	2	7	2	4	....	3	....	....	....
Douglas-fir	57	12- 6-39	25	25	....	....	....	....	....	....	....	....	....	....	....	8	8	8	1	....	....	....	....	....	....	....
Douglas-fir	72	12-17-48	25	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	2
Douglas-fir	97	11-17-52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	100	11-19-52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Fir, grand	15	3- 5-29	25	25	1	4	1	3	2	1	3	1	2	1	3	1	2	....	....	....	....	....	....	....	....	....
Hemlock, western	38	9-20-33	25	25	....	....	....	....	....	3	5	6	6	2	....	1	1	....	....	....	1	....	....	....	....	....
Juniper, Sierra	30	2-12-30	25	10	....	....	....	....	....	....	....	....	....	....	....	1	1	....	....	....	....	2	3	....	1	2
Larch, western	37	9-20-33	25	25	....	....	....	....	....	....	5	9	1	2	2	2	1	....	....	....	....	....	1	....	2	....
Locust, black	40	4-13-35	22	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1	2
Madrone, Pacific	26	2- 6-30	25	25	....	....	3	6	7	3	6	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Maple, bigleaf	17	3- 5-29	25	25	....	....	....	11	8	3	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Metal, angle iron	60	11-13-48	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Metal, T-post	61	11-13-48	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Metal, H-beam	69	12-11-48	9	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Metal, channel	70	12-11-48	10	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Metal, T-post	71	12-11-48	10	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Oak, Oregon white	19	5- 7-29	24	15	....	....	....	....	....	....	2	5	2	....	2	1	....	....	....	....	....	1	1	....	1	....
Osage-orange	32	4-15-33	26	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, lodgepole	48	11- 1-38	26	26	....	....	....	....	....	....	....	....	....	....	4	7	6	5	1	1	1	....	....	1	....	....
Pine, lodgepole	49	11- 1-38	25	25	....	....	....	....	....	....	....	....	....	....	7	11	6	1	....	....	....	....	....	....	....	....
Pine, lodgepole	103	11-15-52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, ponderosa	36	9-20-33	25	25	....	....	....	....	....	1	3	7	7	2	1	1	....	1	2	....	....	....	....	....	....	....
Pine, sugar	35	9-20-33	25	25	....	....	....	....	....	2	2	8	3	2	....	2	....	1	2	2	1	....	....	....	....	....
Pine, western white	34	9-20-33	25	25	....	....	....	....	....	1	2	7	11	3	....	....	1	....	....	....	....	....	....	....	....	....
Redwood	58	12-20-39	25	2	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	....
Spruce, Sitka	31	4-15-33	26	26	....	....	....	....	....	4	10	2	1	4	5	....	....	....	....	....	....	....	....	....	....	....
Tanoak	76	10- 6-51	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Yew, Pacific	13	3- 5-29	23	6	....	....	....	....	....	....	1	1	2	....	1	....	....	....	....	....	....	....	1	....	....	....

Table 9. REMOVAL RECORDS OF TREATED FENCE POSTS

Nonpressure processes

Species	Series number	Date set	Number of posts in test	Total number of posts removed	Number of posts removed each annual inspection year																					
					31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52
Alder, red	105	11– 5–52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Alder, red	108	11–15–52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Cedar, Port Orford white	9	4–20–28	10	9	....	....	....	....	....	....	....	....	....	1	....	....	....	2	....	....	1	....	....	....	3	2
Cottonwood, black	27	2– 6–30	24	24	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	1	1	19
Cottonwood, black	68	12–23–48	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Cottonwood, black	74	4–23–49	22	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Cottonwood, black	77	4– 9–49	25	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Cottonwood, black	78	12–28–48	25	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	4
Cottonwood, black	87	11– 4–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	39	9–20–33	25	25	....	....	....	....	....	2	6	4	12	1	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	79	11– 5–49	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	80	10–17–49	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	81	10– 5–49	24	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	92	11–11–49	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	22	5– 4–29	25	25	1	3	5	3	4	1	3	4	....	1	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	101	11–19–52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	102	11–18–52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	2	1– 7–28	24*	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	91	11–19–49	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	3	1– 7–28	24	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	4	1– 7–28	23	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	89	3–24–49	25	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	2
Douglas-fir	90	4–17–49	25	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3
Douglas-fir	5	3– 6–28	25	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	3	....
Douglas-fir	6	3–20–28	25	19	....	....	1	....	....	....	....	....	....	....	1	....	4	....	1	....	2	2	4	....	1	3
Douglas-fir	24	2– 6–30	25	3	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	1	....	....
Douglas-fir	25	2– 6–30	25	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	1	1	....	....
Douglas-fir	59	6– 3–42	12	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	73	12–22–48	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	75	4–16–49	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	12	3–14–29	25	25	1	1	5	4	4	2	5	1	....	1	....	....	....	....	1	....	....	....	....	....	....	....
Douglas-fir	62	12–29–48	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	63	2–19–49	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	64	12–18–48	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	65	3–20–49	25	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Douglas-fir	66	3–22–49	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	67	3–21–49	25	1	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1
Douglas-fir	88	10–21–50	23	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	93	10–21–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	94	10– 7–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	95	10– 7–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	8	3– 6–29	22	22	....	....	....	....	....	....	2	5	5	2	....	2	....	1	5	....	....	....	....	....	....	....
Douglas-fir	18	5– 7–29	24	23	....	1	....	....	....	1	....	1	1	2	....	2	....	1	3	1	....	1	3	2	2	2
Douglas-fir	54	10–11–39	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Maple, bigleaf	83	3–26–49	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, lodgepole	99	11–15–52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, lodgepole	104	11–15–52	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, lodgepole	50	11– 1–38	25	5	....	....	....	....	....	....	....	....	....	....	....	....	....	1	1	....	1	....	....	....	1	1
Pine, lodgepole	85	11–15–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, lodgepole	86	11–15–50	25	0	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Pine, ponderosa	56	12– 6–39	25	4	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1	....	1	1	....	1

Table 10. REMOVAL RECORDS OF TREATED FENCE POSTS

Pressure processes

Species	Series number	Date set	Number of posts in test	Total number of posts removed	Number of posts removed each annual inspection year										
					42	43	44	45	46	47	48	49	50	51	52
Douglas-fir	52	10–11–39	25	0	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	45	5– 1–37	25	0	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	43	2–13–37	25	8	1	....	2	....	....	1	....	1	....	2	1
Douglas-fir	7	3– 6–29	25	0	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	51	10–11–39	25	0	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	53	10–11–39	25	0	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	23	5–31–29	49	0	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	42	12– 5–36	25	0	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	33	4–15–33	25	4	....	....	....	....	....	....	....	....	1	....	3
Douglas-fir	96	11–17–52	25	0	....	....	....	....	....	....	....	....	....	....	....
Douglas-fir	98	11–18–52	24	0	....	....	....	....	....	....	....	....	....	....	....
Hemlock, western	41	12– 5–36	25	0	....	....	....	....	....	....	....	....	....	....	....
Hemlock, western	44	5– 1–37	25	0	....	....	....	....	....	....	....	....	....	....	....

T. J. Starker Post Farm Cooperators

Anaconda Copper Mining Co., Wood Preserving Department, Butte, Montana
Bolidens Gruvaktiebolag, Stockholm, Sweden
Bradley-Woodard Lumber Co., Bradwood, Oregon
Carbolineum Wood Preserving Co., Milwaukee, Wisconsin
Chemonite Wood Preserving Co., San Francisco, California
J. W. Copeland Yards, Corvallis, Oregon
Corvallis Lumber Co., Corvallis, Oregon
Harold Dahl, Troutdale, Oregon
Dant & Russell, Portland, Oregon
Dow Chemical Co., Midland, Michigan
Holmes-Eureka Lumber Co., Eureka, California
The Hunt Co., 3700 West Six Mile Road, Detroit, Michigan
C. D. Johnson Lumber Corp., Toledo, Oregon
Kirchmann Hardwood Co., San Francisco, California
McGoldrick Lumber Co., Spokane, Washington
Nuodex Products Co., Inc., Elizabeth, F, New Jersey
Osmose Wood Preserving Co. of America, Inc., Buffalo, New York
Pope & Talbot, Inc., St. Helens, Oregon
Portland Gas & Coke Co., Portland, Oregon
R. H. Rawson, Portland, Oregon
Southern Pacific Co., Eugene, Oregon
U. S. Department of Agriculture, Forest Service
    Deschutes National Forest, Bend, Oregon
    Forest Products Laboratory, Madison, Wisconsin
    Pacific Northwest Forest and Range Experiment Station, Portland, Oregon
    Umpqua National Forest, Roseburg, Oregon
    Willamette National Forest, Eugene, Oregon
Warren Southwest, Inc., Wilmington, California
Washington Wood Preserving Co., Spokane, Washington
West Coast Wood Preserving Co., Seattle, Washington
West Oregon Lumber Co., Portland, Oregon
Western Pine Association, Portland, Oregon
Weyerhaeuser Timber Co., Klamath Falls, Oregon
Willamette Valley Lumber Co., Dallas, Oregon

List of Publications

1. An Inventory of Sawmill Waste in Oregon, by Glenn Voorhies. Oregon State Engineering Experiment Station Bulletin Series, No. 17. 1942.
2. Saving Fuel in Oregon Homes, by E. C. Willey. Oregon State Engineering Experiment Station Circular Series, No. 7. 1942.
*3. Production and Transportation of Fuel from Sawmill Refuse, by G. Eugene Tower, School of Forestry, Oregon State College Leaflet No. 4. 1942.
*4. Cork from Douglas Fir Bark, by Leo Friedman and A. I. Ezell. Reprint from *The Timberman,* Vol. 43, No. 11. September 1942.
*5. Composition Cork from Douglas Fir, by Leo Friedman and A. I. Ezell. Reprint from *The Timberman,* Vol. 44, No. 4. February 1943.
*6. Sawdust Plaster Project, by Leo Friedman, Albert I. Ezell, and Robert D. Englert. Reprint from *The Timberman,* Vol. 45, No. 2. December 1943.
7. Report of Investigation of Emergency Fuels for Domestic Sawdust Burners, by Earl C. Willey and G. Eugene Tower. Oregon Forest Products Laboratory Research Leaflet No. 1. 1943. (Slightly revised October 1948).
*8. The Essentials of Kiln Drying Oregon Hardwood Lumber, by Glenn Voorhies. Oregon Forest Products Laboratory Research Leaflet No. 2. 1944.
*9. Industrial Fuel from Controlled Pyrolysis of Sawmill Wood Waste: Part I, by H. George Rieck, Jr., Edward G. Locke, and Eugene Tower. Reprint from *The Timberman,* Vol. 46, No. 2. December 1944.
*10. Industrial Fuel from Controlled Pyrolysis of Sawmill Wood Waste: Part II, by H. George Rieck, Jr., Edward G. Locke, and Eugene Tower. Reprint from *The Timberman,* Vol. 46, No. 4. February 1945.
*11. Industrial Tars from Controlled Pyrolysis of Sawmill Wood Waste: Part III, by Paul G. Schrader, Bert E. Christensen, and Leo Friedman. Reprint from *The Timberman,* Vol. 46, No. 5. March 1945.
12. The Effect of Storage on Douglas-Fir Hogged Wood and Sawdust, by Leo Friedman, Eugene Tower, and R. B. Boals. Oregon Forest Products Laboratory Research Leaflet No. 3. 1945.
13. Recovery of Forest Waste: Part I, by J. B. Grantham. Reprint from *The Timberman,* Vol. 46, No. 8. June 1945.
14. Recovery of Forest Waste: Part II, by J. B. Grantham. Reprint from *The Timberman,* Vol. 46, No. 10. August 1945.
15. The Production of Poles from Lodgepole Pine in Oregon, by John B. Grantham. Reprint from *West Coast Lumberman,* Vol. 72, No. 9. September 1945.
16. Testing of Plastics from Scholler Lignin, by Robert D. Englert and Leo Friedman. Reprint from *Pacific Plastics,* Vol. 3, No. 10. October 1945.
*17. Industrial Alcohol from Wood Waste, by Paul M. Dunn. *Chemical Products,* Vol. 9, No. 1-2, November-December 1945.
18. Yeasts from Wood Sugar Stillage, by E. F. Kurth. Reprint from *Industrial and Engineering Chemistry,* Vol. 38, No. 2. February 1946.

* No longer available.

*19. Wood Utilization Research in Oregon, by Paul M. Dunn. *Proceedings of the American Wood Preservers' Association,* Vol. 42, 1946.
20. Feeding Yeasts from Wood Sugar Stillage, by E. F. Kurth and V. H. Cheldelin. Reprint from *Industrial and Engineering Chemistry,* Vol. 38, No. 6. June 1946.
*21. The Oregon Forest Products Laboratory, by Phimister B. Proctor. *Wood,* Vol. 2, No. 1. January 1947.
22. Wood Waste Carbonization: Part I, by H. O. Ervin. Reprint from *Wood,* Vol. 2, No. 2. February 1947.
23. Western Relogging, by John B. Grantham. Reprint from *Wood,* Vol. 2, No. 3. March 1947.
24. Wood Carbonization: Part II, by H. O. Ervin. Reprint from *Wood,* Vol. 2, No. 4. April 1947.
25. Hard Pressed Board Utilizes Wood Waste, by Hugh Wilcox. Reprint from *Wood,* Vol. 2, No. 5. May 1947.
26. Salvage Logging in the Douglas-Fir Region of Oregon and Washington, by Elmer E. Matson and John B. Grantham. Oregon Forest Products Laboratory Bulletin 1, 1947.
27. Salvage Operations in the Douglas-Fir Region: Their Present and Future, by John B. Grantham. Oregon Forest Products Laboratory Information Circular 1, 1947.
28. The Utilization of Wood Waste by Fermentation Processes, by E. F. Kurth. Reprint from *Chemurgic Digest,* Vol. 6, No. 24. December 31, 1947.
*29. Byproducts from the Lignin Residue in Ethanol Manufacture, by E. F. Kurth. Reprint from *Chemurgic Digest,* Vol. 6, No. 24. December 31, 1947.
*30. Die-molding Wood Products: Part I, by Mortimer D. Macdonald. *Pacific Plastics,* Vol. 5, No. 12. December 1947.
*31. Die-molding Wood Products: Part II, by Mortimer D. Macdonald. *Pacific Plastics,* Vol. 6, No. 1. January 1948.
32. Utilization of Oregon Hardwoods, by Dan D Robinson. Oregon Forest Products Laboratory Information Circular 2, 1948.
33. Chemical Analysis of Western Woods: Part I, by E. F. Kurth. Reprint from *Paper Trade Journal,* Vol. 126, No. 6. February 5, 1948.
*34. Carbonization of Douglas Fir Sawdust, by J. D. Ross. *Proceedings of the Forest Products Research Society,* Vol. 2. 1948.
35. Wax from Wood-sugar Lignin Residue, by E. F. Kurth. Paper presented at the May 19, 1948 meeting of the Pacific Northwest Section, Forest Products Research Society, Portland, Oregon.
36. Utilization of Douglas Fir Bark, by E. F. Kurth, Harry J. Kiefer, and James K. Hubbard. Reprint from *The Timberman,* Vol. 49, No. 8. June 1948.
37. The Constituents of Sierra Juniper Wood (*Juniperus occidentalis* Hooker), by E. F. Kurth and Homer B. Lackey. Reprint from *Journal of the American Chemical Society,* Vol. 70, No. 6. June 1948.
*38. The Oregon Forest Products Laboratory, by William J. Baker. Oregon Forest Products Laboratory Information Circular 3, 1948.
39. Forest Products Research in Oregon, by Paul M. Dunn. Reprint from *Iowa State College Journal of Science,* Vol. 22, No. 4. July 1948.

* No longer available.

40. Investigation of Methods of Alleviating the Pollutional Effects of Douglas-Fir Ethanol Stillage, by W. B. Bollen. Oregon Forest Products Laboratory Bulletin 2, September 1948.

41. Service Life of Treated and Untreated Fence Posts (1947 Progress Report on the T. J. Starker Post Farm), by R. D. Graham and W. J. Baker. Oregon Forest Products Laboratory Report 1, October 1948.

*42. The Chemical Composition of Barks, by E. F. Kurth. *Chemical Reviews,* Vol. 40, No. 1. 1947. Reprinted in Northeastern Wood Utilization Council Inc., Bulletin No. 25, 1949.

*43. New Developments in Wood Utilization, by P. B. Proctor. *Proceedings of the 39th Annual Meeting, Western Forestry and Conservation Association,* December 1948.

44. The Constituents of the Extractives from Douglas Fir, by H. M. Graham and E. F. Kurth. Reprint from *Industrial and Engineering Chemistry,* Vol. 41. 1949.

45. The Chemical Analysis of Western Woods: Part II, Douglas Fir Bark Analysis, by E. F. Kurth. Reprint from *Tappi,* Vol. 32, No. 5. April 1949.

46. Defects Developed in Kiln Drying and Their Control, by W. J. Baker and L. D. Espenas. *Proceedings of the Fourth Annual Northwest Wood Products Clinic,* April 1949.

47. Chemical Composition of Ponderosa and Sugar Pine Barks, by E. F. Kurth, J. K. Hubbard, and J. D. Humphrey. *Proceedings of the Forest Products Research Society,* Vol. 3, 1949. *Paper Trade Journal,* Vol. 130, No. 17. April 1950.

48. Service Life of Treated and Untreated Fence Posts (1948 Progress Report on the T. J. Starker Post Farm), by R. D. Graham. Oregon Forest Products Laboratory Progress Report 2, May 1949.

49. Dielectric Properties of Douglas-Fir at High Frequencies, by J. J. Wittkopf and M. D. Macdonald. Oregon State Engineering Experiment Station Bulletin 28, July 1949.

50. Douglas-Fir Bark Tannin, by J. K. Hubbard and E. F. Kurth. Reprint from *Journal of the American Leather Chemists Association,* Vol. 44, No. 8. August 1949.

51. Dielectric Properties of Ponderosa Pine at High Frequencies, by J. J. Wittkopf and M. D. Macdonald. Oregon State Engineering Experiment Station Bulletin 29, September 1949.

52. Extraction of Tannin from Douglas-Fir Bark and Concentration of the Tan Liquor, by E. F. Kurth, J. K. Hubbard, and Maurice Gekeler. Reprint from *Leather and Shoes,* November 5 and November 19, 1949.

53. Service Life of Treated and Untreated Fence Posts (1949 Progress Report on the T. J. Starker Post Farm), by R. D. Graham. Oregon Forest Products Laboratory Progress Report 3, December 1949.

*54. The Influence of Depth of Immersion on End Penetration in Douglas-fir Heartwood when Cold-soaked in Pentachlorophenol, by H. J. Raphael. *Journal of Forestry,* Vol. 48, No. 1. January 1950. (Abstract of thesis).

55. Wood-sugar Molasses as a Feed for Livestock and Poultry, by J. R. Stillinger. *Proceedings Eighth Annual Nutrition Conference, Oregon Feed & Seed Dealers Association and Oregon State College, Cooperating,* February 3, 1950.

---

* No longer available.

56. The Soaking Method for the Preservative Treatment of Fence Posts, by R. D. Graham. Oregon Forest Products Laboratory Information Circular 4, February 1950.
*57. Tannin from Pine Bark, by E. F. Kurth. Reprint from *Leather and Shoes,* Vol. 119, No. 5. 1950.
58. The Composition of the Wax in Douglas-Fir Bark, by E. F. Kurth. Reprint from *Journal of the American Chemical Society,* Vol. 72. April 1950.
59. Wax from Douglas-Fir Bark, by E. F. Kurth and H. J. Kiefer. Reprint from *Tappi,* Vol. 33. April 1950.
60. Manufacture of Consolidated Products from Wood Residues, by M. D. Macdonald. *Proceedings of the Forest Products Research Society,* Vol. 4. 1950.
61. Resin Coated Electrodes, by Robert D. Graham. Reprint from *Wood,* Vol. 5, No. 9. September 1950.
62. The Chemical Analysis of Western Woods: Part III, by E. F. Kurth. Reprint from *Tappi,* Vol. 33. October 1950.
63. Products Obtained by Destructive Distillation of Douglas-Fir Bark, by E. F. Kurth and C. V. S. Ratnam. Reprint from *Tappi,* Vol. 33. October 1950.
64. The Utilization of No. 3 Douglas-Fir Lumber for Prefabricated Panels, by M. D. Macdonald. Oregon Forest Products Laboratory Information Circular 5, October 1950.
65. Service Life of Treated and Untreated Fence Posts (1950 Progress Report on the T. J. Starker Post Farm), by R. D. Graham. Oregon Forest Products Laboratory Progress Report 4, October 1950.
66. Methyl Ester of Dihydroperillic Acid, an Odoriferous Constituent of Western Red Cedar, by E. F. Kurth. Reprint from *Journal of the American Chemical Society,* Vol. 72. December 1950.
67. Some Factors Involved in the Promotion of Alder-using Industries in Tillamook, Oregon, by W. J. Baker. Oregon Forest Products Laboratory Special Report 1, January 1951.
68. Chemicals from Douglas-Fir Bark, by E. F. Kurth. Paper presented at the February 6, 1951 meeting of the Pacific Northwest Section, Forest Products Research Society, Corvallis, Oregon. Published in *Journal of the Forest Products Research Society,* Vol. 1, No. 1. September 1951.
69. Levulinic Acid from Wood Cellulose, by T. R. Frost and E. F. Kurth. Reprint from *Tappi,* Vol. 34, No. 2. February 1951.
70. Compression of Douglas Fir Veneer During Pressing, by M. D. Macdonald. Reprint from *The Timberman,* Vol. 52, No. 4, February 1951, and Vol. 52, No. 5, March 1951.
71. Extractives from Ponderosa Pine Bark, by E. F. Kurth and J. K. Hubbard. Reprinted from *Industrial and Engineering Chemistry,* Vol. 43, No. 4. April 1951.
72. Some Strength and Related Properties of Old-growth Douglas Fir Decayed by *Fomes pini,* by J. R. Stillinger. Reprint from *American Society for Testing Materials Bulletin,* No. 173. April 1951.
73. The Longitudinal Penetration of Petroleum Oils in Douglas Fir Heartwood after a Fifteen-minute Immersion, by H. J. Raphael and R. D. Graham. *American Wood-Preservers Association Proceedings,* Vol. 47. 1951.

* No longer available.

74. Round Timber Peeling and Incising Machine, by Robert D. Graham. Reprint from *Chemurgic Digest,* Vol. 11, No. 6. June 1951.
75. The Effects of Machine Head Speed and Specimen Span on Modulus of Rupture Values Obtained in Static Bending Tests of a Nominal 5/32-inch Douglas-Fir Hardboard, by Hugh Wilcox. Reprint from *Tappi,* Vol. 34, No. 7. July 1951.
76. Dihydroquercetin as an Antioxidant, by E. F. Kurth and Frank L. Chan. Reprint from *The Journal of the American Oil Chemists' Society,* Vol. 28, No. 10. October 1951.
77. Service Life of Treated and Untreated Fence Posts (1951 Progress Report on the T. J. Starker Post Farm), by R. D. Graham. Oregon Forest Products Laboratory Progress Report 5, October 1951.
78. The Seasoning of Oregon Hardwoods, by Leif D. Espenas. Oregon Forest Products Laboratory Information Circular 6, December 1951.
79. The Chemical Nature of the Cork from Douglas-fir Bark, by Herbert L. Hergert and E. F. Kurth. Reprint from *Tappi,* Vol. 35, No. 2, February 1952.
80. The Oregon Forest Products Laboratory, Oregon Forest Products Laboratory Information Circular 3, revised June 1952.
81. The Effects of Pressing Temperatures and Heat Treatments on the Relationships between Head Speed, Span, and Modulus of Rupture of Hardboard, by Hugh E. Wilcox. (In process of printing.)
82. The Interrelationships of Temperature, Pressure, and Pressing Time in the Production of Hardboard from Douglas-fir Fiber and the Effects of These Variables on Hardboard Properties, by Hugh E. Wilcox. (In process of printing.)
83. Chemical Composition of the Bast Fibers of Douglas-fir Bark, by Harry J. Kiefer and E. F. Kurth. (In process of printing.)
84. The Chemical Nature of Cedar Barks, by James E. Smith and E. F. Kurth. (In process of printing.)
85. Extractives of Tannin and Dihydroquercetin from Douglas-fir Bark, by E. F. Kurth and Frank L. Chan. (In process of printing.)
86. The Infrared Spectra of Lignin and Related Compounds, by Herbert L. Hergert and E. F. Kurth. (In process of printing.)
87. The Isolation and Properties of Catechin from White Fir Bark, by Herbert L. Hergert and E. F. Kurth. (In process of printing.)
88. The Seasoning of One-inch Tanoak Lumber, by Leif D. Espenas. (In process of printing.)
89. Western Hardwoods, by J. R. Pfeiffer. (In process of printing.)