Service Life of Treated and Untreated Fence Posts

1963 PROGRESS REPORT ON THE POST FARM

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Forest Products Research

FOREST RESEARCH LABORATORY

OREGON STATE UNIVERSITY

Corvallis

FOREST RESEARCH LABORATORY

The Forest Research Laboratory is part of the Forest Research Division of the Agricultural Experiment Station, Oregon State University. The industry-supported program of the Laboratory is aimed at improving and expanding values from timberlands of the State.

A team of forest scientists is investigating problems in forestry research of growing and protecting the crop, while wood scientists engaged in forest products research endeavor to make the most of the timber produced.

The current report stems from studies of forest products.

Purpose . . .

Fully utilize the resource by:

- developing more by-products from mill and logging residues to use the material burned or left in the woods.
- expanding markets for forest products through advanced treatments, improved drying, and new designs.
- directing the prospective user's attention to available wood and bark supplies, and to species as yet not fully utilized.
- creating new jobs and additional dollar returns by suggesting an increased variety of salable products. New products and growing values can offset rising costs.

Further the interests of forestry and forest products industries within the State.

Program . . .

Identify and develop uses for chemicals in wood and bark to provide markets for residues.

Improve pulping of residue materials.

Develop manufacturing techniques to improve products of wood industries.

Extend service life of wood products by improved preserving methods.

Develop and improve methods of seasoning wood to raise quality of wood products.

Create new uses and products for wood.

Evaluate mechanical properties of wood and wood-based materials and structures to increase and improve use of wood.

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SUMMARY

Eleven series of untreated posts, 33 series of nonpressure-treated posts, and 13 series of pressure-treated posts remain in test. Series in which all posts have failed now number 34 for untreated, and 18 for nonpressure-treated. Causes of failures since 1949 were: fungi, 77 per cent of failures; fungi and termites, 16 per cent; fungi and insects, 5 per cent; termites, 2 per cent.

Preservative treatment of the entire post apparently is needed for longest service of nondurable woods at this test site.

Untreated posts

Remaining posts of western red cedar and mountain hemlock have failed, after average service lives of 23 and 3 years. Average service of untreated Douglas fir posts has been 6 years. All posts of Osage-orange have been in service 30 years without failure.

Nonpressure-treated posts

Double-diffusion treatment with solutions of copper sulfate and sodium chromate has not increased life of posts. Other chemical combinations have been more effective, but after 11 years tops of these butt-treated posts are beginning to decay.

Most brushed-on preservatives added only a few years to the life of Douglas fir posts. Osmosalts treatment appears promising, but Osmoplastic has been less effective. Average life of failed posts that were butt-treated with ACM Co. paste has reached 27 years.

Treatment with sodium pentachlorophenate or sodium trichlorophenate in holes at the ground line has not been effective. Similar treatment with salt and mercuric chloride has remained effective, but tops of posts are decayed.

Incised posts of Douglas fir and lodgepole pine soaked 48 hours or more in a 5 per cent solution of pentachlorophenol have not failed after 13 and 15 years. Incised posts of black cottonwood soaked only 3 hours in creosote or 6 hours in pentachlorophenol solution have given similar service. All ponderosa pine posts that were soaked in Permatol failed after an average life of 19 years.

There have been no failures in 24-year-old posts butt-treated with creosote by a hot-cold bath, but tops have decayed severely.

Pressure-treated posts

All creosote-treated posts have been without failure since installation from 24 to 35 years ago. Failed posts treated with water-borne preservatives had an average service life of 10-25 years. Treated tops of all posts were sound when inspected.

SERVICE LIFE OF TREATED AND UNTREATED FENCE POSTS

1963 Progress Report

by

Robert D. Graham

Donald J. Miller

THE POST FARM

In 1927, Professor T. J. Starker of the School of Forestry at Oregon State University established a "post farm" to obtain data on natural durability of native woods and effectiveness of different preservative treatments for species used as fence posts. The first posts were set on January 7, 1928, and, since inception of the program, 2,662 posts have been placed in the farm. Three introduced and 25 native species, in untreated condition, and 8 Oregon woods that were given various preservative treatments, have been, or are being, tested.

The post farm is located on land of the School of Forestry in the Peavy Arboretum about 7 miles north of Corvallis, Oregon, on the west side of Highway 99W. Soil in the test area, located on an excellently drained south slope, is Olympic silty-clay loam. The slightly acid top 8 inches of soil have pH of 5.4, organic-matter content of 4.71 per cent, humus of one-half inch or less in thickness, and nitrogen content of 0.1415 per cent. Old Douglas fir stumps are present in the test site.

Climatic conditions

The temperate climate of Corvallis typically has dry summers and rainy winters. During the past 72 years, average annual precipitation was 38 inches. Most of this precipitation (81 per cent) fell during the months of October through March, when monthly average temperatures ranged from 39 to 54 F. Only 2 per cent fell during July and August, which had an average temperature of 66 F. Occasionally, the temperature falls below freezing, or rises above 85 F. Cool afternoon breezes from the Pacific Ocean usually arise daily during summer months.

These mild climatic conditions favor growth of wood-destroying organisms throughout the year.

Wood-destroying organisms

Since 1949, an attempt has been made to determine the various organisms responsible for deterioration of posts installed in the test site. Although decay-producing fungi and damp-wood termites are primary causes of failure, carpenter ants and wood-boring beetles frequently contribute to general deterioration of posts. Damp-wood termites swarm during late summer and early fall. At time of annual inspection in early October, discarded wings of reproductives have been found at bases of many posts. Entry holes have been made at or below ground line. In only a few instances have termites been the primary cause of failure.

Although carpenter ants have been found in many failed posts, there is evidence to indicate galleries were constructed initially by termites. After destroying the termites, ants usually enlarge the galleries to some extent.

Many failed posts have been attacked by wood-boring larvae of beetles, although damage seldom approaches that caused by fungi or termites.

Causes of failure in posts:

Primary agent	Failures from 1950 to 1963	
	Number	Per cent
Fungi	743	77.0
Fungi and termites	152	15.7
Fungi and other insects	50	5.2
Termites	18	1.9
Other insects	2	0.2
All	965	

Test specimens

Test posts usually are 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 cross-sectional area at the ground line. Test posts now are 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 posts in each series, must fall within the limits of 16 ± 2 square inches.

Post inspections

Annual inspections are made during October. A moderate pull is applied to the top of each post, and each post that breaks is examined to establish the point and cause of failure. Deterioration of the top is rated by visual inspection. Inspection at the ground line was discontinued in 1959. Each post that fails is examined to determine nature and probable cause of failure.

Post-farm records

Recorded data for each series of posts include source and species, sizes and type of individual posts, percentage of sapwood, processing prior to installation or preservative treatment, preservative treatment given (if any), date of installation, and other pertinent facts.

INTERPRETATION OF DATA

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

Limitations of test data

The detailed tabular data presented in this report cannot be applied indiscriminately to every locality and to all service requirements for posts. 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 post farm usually are not subject to 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 conducive to virtually continuous attack by insects and decay. The arbitrary method used to determine failure is admittedly not comparable to physical forces that may be exerted on 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 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 fungal growth.

In western Oregon, where favorable conditions of moisture and temperature exist for long periods, untreated tops of posts that have been given adequate treatment at the butts with a good preservative often decay long before ground-line sections are weakened seriously. Deterioration of tops of posts doubtlessly is retarded in eastern Oregon where long periods of dry, cold conditions prevail.

Consideration of post characteristics

Service records of posts in this report mean little, if characteristics of the wood are not taken into consideration. Size, amount of sapwood, and extractive constituents in the wood greatly influence serviceability of untreated posts. Large posts may give long service, not only because of great gross volume of wood, but also because of the high proportion of heartwood they usually contain. The sapwood of no native species is naturally insect- and decay-resistant. Extractive constituents in heartwood of a few species promote resistance to attack by insects and fungi. With some exceptions, these extractives give heartwood a color darker than that of sapwood.

Equal importance of preservatives and methods of preservation

The service life of treated wood is affected by nature of preservative applied, portion of the product treated, amount of preservative retained by the wood, method of treatment, and uniformity of treatment. Most preservatives are effective fungicides and insecticides, but extension of the service life of wood requires continued presence of preservative in a concentration toxic to organisms responsible for deterioration.

Although a preservative may fail under one set of climatic conditions, it may prove extremely successful under different conditions. A preservative that is readily soluble in water, for example, may leach from wood in a region of abundant rainfall, but in a dry climate it may be permanent. Successful treatment provides uniform penetration into the treated area and retention of a sufficient quantity of preservative within the wood structure to protect the wood under conditions in which it is to be used. High total retention of preservatives is not necessarily an indication of successful treatment. In some species, rapid penetration of the preservative into end grain, but slow penetration into side grain, may result in complete protection of the end of the post, but virtually no protection of the ground-line zone.

EVALUATION OF TESTS

Determining the service life of a series in which most or all posts have failed is simple, but for many naturally decay-resistant untreated series and for treated series in which few posts have failed, average service life cannot be estimated accurately. Estimated service life, when given for any series in this report, is based on number of posts failed and on service age and condition of remaining posts. For a few untreated species, natural resistance to decay as determined in other service tests has been considered in making estimates of service life.

Untreated posts

Characteristics and service records of untreated posts are shown in Table 1. Service records of posts remaining in test are summarized in Table 2. Average service life of untreated posts varies greatly because of differences in durability of heartwood and amount of sapwood, which is not durable. Posts from durable species that are largely of heartwood can be expected to have an average service life of 14 years or longer; durable species include the cedars, juniper, black locust, white oak, Osage-orange, redwood, and yew. Posts from nondurable-heartwood species, or posts that are largely sapwood, can be expected to have an average service life of 4-7 years; these posts should be treated with a preservative prior to use. A few early failures can be expected in all untreated woods because of great variation in natural durability.

Treated posts: nonpressure processes

Characteristics and service records for posts treated by nonpressure processes are given in Table 3. Service records of posts remaining in test are summarized in Table 4. Estimated increases in service life resulting from preservative treatments of Douglas fir posts are shown in Table 7. An attempt has been made to evaluate these treatments and, when possible, recommendations have been made concerning their use.

Bore Hole (chemicals placed in holes drilled in undried, unpeeled posts). Combinations of salt and mercuric chloride with or without arsenous oxide have increased the service life of pine and Douglas fir posts. Effectiveness has increased with number of holes used. Tops of the posts are not protected adequately by this method. The chemicals used are very poisonous and should be handled with extreme care.

Brushing Treatment. Brushing posts with preservatives did little or nothing to increase the service life of posts in 2 series and was somewhat more effective in 3 series. The posts were air-dried thoroughly and two coats were applied on a hot day. Brushing is not recommended for posts regardless of the preservative applied, for penetration of preservative is low, and amount of preservative retained by posts is small, even under optimum conditions.

Charring. Charring is not a preservative treatment. If anything, it shortens the life of posts by reducing the size of the post in the critical ground-line area.

Double Diffusion. Treatments with copper sulfate and sodium chromate have not been effective; those with sodium fluoride and copper sulfate were not effective with alder, but are increasing the life of Douglas fir posts. Treatment of lodgepole pine posts with zinc sulfate, arsenic acid, and sodium chromate is proving effective. Full-length treatment, which undoubtedly would have increased the service life of these posts, is recommended with this process.

Hot and Cold Bath. Hot-cold baths with various creosotes are effective treatments. However, full-length treatment of posts by this method is recommended to provide protection for tops of the posts.

Osmose Bandage and Salts. The ground-line-bandage treatment was not effective for cottonwood, but was of some value to Douglas fir. It is not recommended for posts of nondurable heartwood species.
Osmosalts is proving effective for Douglas fir posts. This treatment for freshly cut and peeled posts is promising and merits further study.

Soaking. Soaking air-seasoned posts in a 5 per cent solution of pentachlorophenol is proving to be an effective treatment, as is Gasco creosote, which no longer is available. A 1 per cent solution of copper naphthenate was effective in increasing the service life of Douglas fir posts when soaked 144 hours. A 5 per cent solution of sodium pentachlorophenate increased the service life of cottonwood posts about 5 years. A 5 per cent zinc chloride solution was not effective for Douglas fir posts.

Full-length treatment of well-seasoned posts is recommended for this treating process.

Tire Tube with Chemonite. This end-diffusion treatment for undried posts has increased the life of Douglas fir posts, although most tops contain moderate-to-severe decay. The method is slow; each post must be treated individually.

Treater Dust or Paste. Application of dust or paste containing a high percentage of arsenic trioxide to freshly cut, peeled, and unpeeled Douglas fir posts as they were installed, and then adding the chemical to the back-fill greatly increased their service life. These pastes and dusts no longer are available.

Treated posts: pressure processes

Characteristics and service records of posts treated by pressure processes are shown in Tables 5 and 6. Estimated increases in the service life of Douglas fir posts because of preservative treatment are given in Table 7. All but two series have been in service at least 24 years. Boliden Salt-treated series 96 and 98 have been in service for only 11 years. Chromated zinc chloride and zinc-meta-arsenite (estimated increase in service life of 15 and 21 years, respectively) have been less effective than other preservatives shown in Table 6, which are estimated to have increased the service life of posts by at least 25 years (Table 7).

Pressure treatments have been consistently effective in greatly increasing the service life of posts of nondurable woods.

METHODS OF APPLYING PRESERVATIVES TO TEST POSTS

Brush Treatment. Preservatives are brushed on the wood surface. Such treatment of fence posts is not recommended.

Bore Hole. A 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 pole. One tablespoonful of a dry mixture of equal proportions by weight of salt (sodium chloride) and corrosive sublimate (mercuric chloride), or one tablespoonful of dry mixture of equal proportions by weight of salt, corrosive sublimate, and arsenous oxide is placed in the hole. A snugly fitting wood plug then is driven into the hole. Holes should be spaced not more than five 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. Handle with extreme care!

Charring. Charring the surface of wood is not a preservative treatment.

Double Diffusion. Undried, peeled posts are placed in an aqueous solution of one chemical for 2 or 3 days and then transferred to a solution of a different chemical for 2 or 3 days. The chemicals diffuse into the wood, where they react to form a toxic compound difficultly soluble in water. Full-length treatment is desirable.

Hot and Cold Bath. In this treatment, often called the open-tank method, posts first are soaked in a hot preservative solution for a number of hours; then 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, thoroughly seasoned, and treated full length.

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

Osmosalts. Osmosalts in a thick slurry of water are applied to ends and to peeled surfaces of undried posts, which then are piled closely and covered for 3 weeks or longer to allow the preservative mixture to diffuse into the wood.

Pressure Treatments. Prior to treatment, posts are air-dried, 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 usually is applied to remove excess preservative and dry the surface of the wood. The full length of the post receives treatment.

Salt Treatment. See Bore-Hole Method.

Soaking Treatment. Posts are placed in preservative solution to the desired depth and permitted to soak for a number of hours or days. Posts should be peeled and thoroughly seasoned before treatment with oil-type preservatives. For many species, that portion of the post 6 inches above and 12 inches below ground line should be incised to a depth of 1/2 inch. This treatment has proved successful for some species and much less effective for others. It is primarily a treatment of sapwood.

Tire-Tube Method. One end of a portion of an automobile inner tube is slipped over the butt end of an unpeeled, freshly cut post laid with butt end higher than top end on an inclined rack. The open end of the tire tube is elevated, and the tube is filled with a water-soluble preservative. The preservative diffuses through the sapwood and finally drips out the low end of the post.

PRESERVATIVE MATERIALS USED FOR TEST POSTS

Virtually all preservatives are poisonous. Many may cause irritations when the chemical itself, its solutions, or its vapor contact 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. 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 predominately of bitumens. This material has little or no preservative value.

Boliden Salts. This preservative contains arsenic acid, sodium arsenate, sodium bichromate, and zinc sulfate.

Carbolineum. Carbolineum, or anthracene oils, are coal-tar distillates of specific gravity and boiling range higher than for 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 2 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 beginning about 200 C and extending to at least 325 C.

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 from 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 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 two water-soluble chemicals. Corrosive sublimate (mercuric chloride, extremely poisonous) is the toxic chemical, and the salt serves to hold moisture.

Salt, Corrosive Sublimate, and Arsenous Oxide. A mixture of equal proportions by weight of the three chemicals. Arsenous oxide is an additional water-soluble toxic agent. Addition of this chemical apparently contributes little, if anything, to effectiveness of the highly poisonous corrosive sublimate.

Sodium Pentachlorophenate. The water-soluble sodium salt of pentachlorophenol.

Sodium Trichlorophenate. The water-soluble sodium salt of trichlorophenol.

Tanalith. A proprietary wood preservative normally containing sodium fluoride, dinitrophenol, sodium chromate, and sodium arsenate. It is injected in water solution.

Treater Dust, Granular Treater Dust, and Treater Paste. Preservatives formerly produced by the Anaconda Copper Mining Company as byproducts of copper smelting. 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 wood; the dust and granular forms were placed around posts as earth was backfilled in setting posts. Manufacture of these preservatives has been discontinued.

Zinc Chloride. A chemical applied to wood in a 2-5 per cent water solution.

Zinc-Meta-Arsenite. A preservative prepared by dissolving zinc oxide and arsenic trioxide in water acidified with acetic acid.

Table 1. Average Characteristics and Service Life of Untreated Posts.

Species	Series number	Number of posts	Post description	Sapwood	Ground-line perimeter	Average service life**
				Per cent	Inches	Years
Alder, red	16	25	Split	25	20	5
Alder, red	106	25	Round, peeled	100	12	3
Ash, Oregon	28	25	Split	30	19	6
Cascara buckthorn	20	12	Round, peeled	70	9	5
Cascara buckthorn	47	26	Round, unpeeled	35	17	8
Cedar, Alaska	46	24	Split, mostly heartwood, same tree	--	18	--
Cedar, incense	29	25	Split	0	20	14
Cedar, Port Orford	21	25	Split	0	24	20
Cedar, western red	10*	25	Split, dark colored	0	20	24
Cedar, western red	11*	25	Split, light colored	0	19	22
Cottonwood, black	14	25	Split	20	22	5
Cottonwood, black	82	25	Round, unpeeled	95	14	4
Cypress, Arizona	84	25	Round, unpeeled	100	13	4
Douglas fir	1	25	Round, unpeeled	60	19	7
Douglas fir	55	25	Square	0	16	6
Douglas fir	57	25	Square	0	16	4
Douglas fir	72	25	Round, unpeeled	48	14	7
Douglas fir	97	25	Square	5	15	4
Douglas fir	100	25	Round, 4 strips peeled	80	16	4
Fir, grand	15	25	Split	65	22	9
Hemlock, mountain	109	25	Square, dry	--	15	3
Hemlock, West Coast	38	25	Square	0	16	6
Juniper, western	30	25	14 split, 11 round,	40	23	--
Larch, western	37	25	Square	0	16	7
Locust, black	40	22	8 round, 14 split	20	14	--
Madrone, Pacific	26	25	Round and split	40	21	6
Maple, Oregon	17	25	Split	25	20	7
Metal, aluminum paint	60	25	Angle iron, 1.1 lb a foot	--	--	--
Metal, red oxide paint	61	25	"T" post, 1.2 lb a foot	--	--	--
Metal, green enamel	69	9	H-beam, 4 lb a foot	--	--	--
Metal, green enamel	70	10	Flanged channel, 1.3 lb a foot		--	--
Metal, green enamel	71	10	"T" post, 1.5 lb a foot	--	--	--
Oak, Oregon white	19	23	Split	20	19	18
Osage-orange	32	26	15 split, 11 round,	10	19	--
Pine, lodgepole	48	26	Round, peeled, dead trees	55	16	5
Pine, lodgepole	49	25	Round, peeled, live trees	55	16	4
Pine, lodgepole	103	25	Round, 4 strips peeled	80	12	3
Pine, ponderosa	36	25	Square	0	16	6
Pine, sugar	35	25	Square	0	16	7
Pine, Idaho white	34	25	Square	0	16	6
Redwood	58	25	Square	0	16	--
Spruce, Sitka	31	26	Square	0	16	6
Tanoak	76	25	Round, unpeeled	100	12	4
Yew, Pacific	13	23	Round, peeled	10	16	--

*Series 10 and 11 were from the same group of posts.

**Series in which all posts have failed. Series with posts remaining are described further in Table 2.

Table 2. Service Records of Untreated Posts Remaining in Test in 1963.

Species	Series number	Posts remaining	Age	Avg life of failed posts	Remarks
		Per cent	Years	Years	
Cedar, Alaska	46	8	26	18	Moderate top decay
Juniper, western	30	20	34	22	Slight-mod. top decay
Locust, black	40*	27	28	20	None to slight top decay
Steel, L-section	60	100	15	--	Tops rusty
Steel, T-section	61	100	15	--	Tops rusty
Steel, I-section	69	100	15	--	Tops rusty
Steel, U-section	70	100	15	--	Tops rusty
Steel, T-section	71	100	15	--	Tops rusty
Osage-orange	32	100	30	--	Tops sound
Redwood	58*	24	24	20	None to slight top decay
Yew, Pacific	13	13	35	23	Slight top decay

*Failure at last inspection.

Table 3. Average Characteristics and Service Life of Nonpressure-Treated Posts.

Species	Series number	Number of posts	Description	Sapwood	Groundline perimeter	Preservative treatment*	Retention: In a cu ft wood, Butt	Retention: In a cu ft wood, Top	Retention: In a post	Average service life**
				Per cent	Inches		Lb	Lb	Lb	Years
Alder, red	105	25	Round, peeled, undried	100	12	Double diffusion, butts, 6 % copper sulfate--2 days; 8% sodium chromate--2 days	--	--	--	6
Alder, red	108	25	Round, undried, 4 strips peeled	100	13	Double diffusion, butts, 4 % sodium fluoride--2 days; 6% copper sulfate--2 days	--	--	--	--
Cedar, Port Orford	9	10	Round, peeled	25	20	Hot-cold bath, carbolineum "B", butt	--	--	--	21
Cottonwood, black	27	24	Split, peeled	20	22	Hot-cold bath, creosote, B-6	--	--	--	22
Cottonwood, black	68	25	Round, peeled, incised, dry	89	14	Soak, 5 per cent pentachlorophenol-diesel oil, B-6, T-1	7.3	4.1	2.86	--
Cottonwood, black	74	22	Round, peeled, incised, dry	99	14	Soak, 5% sodium pentachlorophenate, B-4, T-1	7.7	4.5	2.93	--
Cottonwood, black	77	25	Round, peeled, incised; dry	95	14	Soak, copper naphthenate-diesel oil (1% copper), B-6, T-1	2.7	1.5	1.04	--
Cottonwood, black	78	25	Round, ground line peeled, undried	83	14	Osmoplastic bandage	--	--	--	5
Cottonwood, black	87	25	Round, peeled incised, dry	90	14	Soak, Gasco creosote oil, B-3, T-2	10.9	10.1	5.80	--
Douglas fir	2	23	Round, unpeeled, undried	60	18	Salt and mercuric chloride, 1 hole; butt	--	--	--	28^+

Douglas fir	3	22	Round, unpeeled, undried	60	20	Salt, mercuric chloride and arsenous oxide, 2 holes; butt	--	--	--	28+
Douglas fir	4	22	Round, unpeeled, undried	60	18	Salt, mercuric chloride, and arsenous oxide, 3 holes; butt	--	--	--	28+
Douglas fir	5	25	Round, unpeeled, undried	60	16	ACM Co. treater dust; butt	--	--	--	26+
Douglas fir	6	25	Round, unpeeled, undried	60	17	ACM Co. granulated treater dust; butt	--	--	--	21
Douglas fir	8	22	Round, peeled	60	17	Hot-cold bath, butt, Carbolineum "B", B-6	--	--	--	12
Douglas fir	12	25	Round, peeled	60	14	Soak, 5% zinc chloride, B-192	--	--	--	7
Douglas fir	18	24	Round, peeled	60	16	Hot-cold, creosote and crankcase oil (50:50), B-20	--	--	0.88	18
Douglas fir	22	25	Round, peeled	60	15	Charred 1/4 inch deep; butt	--	--	--	6
Douglas fir	24	24	Round, peeled, undried	60	14	ACM Co. treater paste; butt	--	--	2.00	--
Douglas fir	25	25	Round, peeled, undried	60	16	ACM Co. treater paste; butt	--	--	4.00	--
Douglas fir	39	25	Round, peeled	60	19	Brush, asphalt emulsion; butt	--	--	--	5
Douglas fir	54	25	Square	0	16	Hot-cold bath, Gasco creosote, B-6	--	--	0.57	--

Table 3. (Continued)

Species	Series number	Number of posts	Description	Sapwood	Groundline perimeter	Preservative treatment*	Retention: In a cu ft wood, Butt	Retention: In a cu ft wood, Top	Retention: In a post	Average service life**
				Per cent	Inches		Lb	Lb	Lb	Years
Douglas fir	59	12	Round, unpeeled, undried	60	17	Tire-tube, full-length diffusion, Chemonite	--	--	6.00	--
Douglas fir	62	25	Round, peeled, incised, dry	33	14	Soak, 5% pentachlorophenol-diesel oil, B-2, T-2	1.0	0.4	0.37	--
Douglas fir	63	25	Round, peeled, incised, dry	26	14	Soak, copper naphthenate-diesel oil (1% copper), B-48, T-6	1.6	0.3	0.50	--
Douglas fir	64	25	Round, peeled, incised, dry	46	14	Soak, 5% pentachlorophenol-diesel oil, B-48 T-6	2.2	0.4	0.95	--
Douglas fir	65	25	Round, peeled, incised, dry	40	14	Soak, copper naphthenate-diesel oil (1% copper,) B-2 T-2	0.7	0.3	0.29	--
Douglas fir	66	25	Round, peeled, dry	40	14	Soak, 5% pentachlorophenol-diesel oil, B-48, T-6	1.0	0.2	0.35	--
Douglas fir	67	25	Round, peeled, dry	33	14	Soak, copper naphthenate-diesel oil (1% copper), B-48, T-6	0.7	0.2	0.25	--
Douglas fir	73	25	Round,ground line peeled, undried	58	14	Osmoplastic bandage	--	--	--	--
Douglas fir	75	25	Round, peeled, undried	46	14	Osmosalts, covered 30 days	--	--	--	--
Douglas fir	79	24	Round, peeled, dry	40	14	Brush, 2 coats, 5% pentachlorophenol-diesel oil	--	--	--	--

Douglas fir	80	24	Round, peeled, dry	46	14	Brush, 2 coats, copper naphthenate-diesel oil	--	--	--	--
Douglas fir	81	24	Round, peeled, dry	44	15	Brush, 2 coats, coal-tar creosote	--	--	--	--
Douglas fir	88	23	Round, butt peeled and incised, dry	40	14	Soak, Gasco creosote oil, B-168, T-48	3.1	2.2	1.40	--
Douglas fir	89	25	Round, unpeeled, undried	45	14	Sodium trichlorophenate, 3 holes; butt	--	--	--	--
Douglas fir	90	25	Round, unpeeled, undried	39	14	Sodium pentachlorophenate, 3 holes; butt	--	--	--	--
Douglas fir	91	25	Round, unpeeled, undried	32	14	Salt and mercuric chloride (2:1), 1 hole; butt	--	--	--	--
Douglas fir	92	23	Round, peeled, dry	46	14	Brush, 2 coats Avenarius carbolineum	--	--	--	7
Douglas fir	93	25	Round, peeled, incised, dry	32	14	Soak, copper naphthenate-diesel oil (1% copper), B-144, T-48	3.0	1.2	1.20	--
Douglas fir	94	25	Round, peeled, incised, dry	33	14	Soak, 5% pentachlorophenol-diesel oil, B-144 T-48	3.5	1.5	1.30	--
Douglas fir	95	25	Round, peeled, incised, dry	32	14	Soak, Gasco creosote oil, B-144, T-48	3.2	1.5	1.30	--
Douglas fir	101	25	Round, undried, 4 strips peeled	65	17	Double diffusion, butts, 4% sodium fluoride--2 days; 6% copper sulfate--2 days	--	--	--	--
Douglas fir	102	25	Round, undried, 4 strips peeled	65	16	Double diffusion, butts, 6% copper sulfate--2 days; 8% sodium chromate--2 days	--	--	--	6

Table 3. (Continued)

Species	Series number	Number of posts	Description	Sapwood	Groundline perimeter	Preservative treatment*	Retention: In a cu ft wood, Butt	Retention: In a cu ft wood, Top	Retention: In a post	Average service life**
				Per cent	Inches		Lb	Lb	Lb	Years
Maple, Oregon	83	25	Round, peeled, incised, dry	75	14	Soak, 5% pentachlorophenol-diesel oil, B-24, T-2	7.5	2.0	2.72	--
Pine, lodgepole	50	25	Round, unpeeled	55	16	Salt, mercuric chloride, and arsenous oxide, 1 hole; butt	--	--	--	--
Pine, lodgepole	85	25	Round, peeled, incised, dry	65	14	Soak, Gasco creosote oil, B-43, T-24	4.1	1.8	1.5	--
Pine, lodgepole	86	25	Round, peeled, incised, dry	76	14	Soak, 5% pentachlorophenol-diesel oil, B-43, T-24	4.1	2.5	1.6	--
Pine, lodgepole	99	25	Round, undried, 4 strips peeled	75	12	Double diffusion, butts, 6% copper sulfate--2 days; 8% sodium chromate--2 days	--	--	--	5
Pine, lodgepole	104	25	Round, undried, 4 strips peeled	80	14	Double diffusion, butts, 5% zinc sulfate plus 0.7% arsenic acid--2 days; 8% sodium chromate--2 days	--	--	--	--
Pine, ponderosa	56	25	Square	0-35	16	Soak, Permatol "A", 17 hours	--	--	0.61	19

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

** Series in which all posts have failed. Series having posts remaining are described further in Table 4.

+ Removed from test 1955. See Appendix to 1955 Progress Report on Post Farm for details on condition of these series.

Table 4. Service Records of Nonpressure-Treated Series Remaining in Test in 1963.

Species	Series number	Posts remaining	Age	Avg life, failed posts	Remarks
		Per cent	Years	Years	
Alder, red	108*	24	11	8	Slight-mod. top decay
Cottonwood, black	68	100	15	--	Tops sound
Cottonwood, black	74*	14	14	11	Most tops sound
Cottonwood, black	77*	4	14	7	Tops sound
Cottonwood, black	87	100	13	--	Tops sound
Douglas fir	24*	21	34	27	Mod.-severe top decay
Douglas fir	25*	36	34	26	Tops severely decayed
Douglas fir	54	100	24	--	Most tops severely decayed
Douglas fir	59	100	21	--	Most tops decayed
Douglas fir	62*	68	16	15	Most tops sound
Douglas fir	63*	20	15	10	Tops sound
Douglas fir	64	100	15	--	Tops sound
Douglas fir	65*	12	14	8	Tops sound
Douglas fir	66*	52	14	12	Tops sound
Douglas fir	67	12	14	8	Tops sound
Douglas fir	73*	16	15	9	Most tops sound
Douglas fir	75	100	14	--	Tops sound
Douglas fir	79*	29	14	12	Tops sound
Douglas fir	80*	12	14	10	Tops sound
Douglas fir	81*	4	14	9	Tops sound
Douglas fir	88*	78	13	11	Tops sound
Douglas fir	89*	8	15	10	Tops severely decayed
Douglas fir	90*	8	14	7	Tops severely decayed
Douglas fir	91	68	14	8	Tops severely decayed
Douglas fir	93	96	13	10	Tops sound
Douglas fir	94	100	13	--	Tops sound
Douglas fir	95*	92	13	13	Tops sound
Douglas fir	101	92	11	6	Most tops decayed
Maple, Oregon	83	92	14	10	Tops sound but split
Pine, lodgepole	50*	8	25	17	Tops severely decayed
Pine, lodgepole	85	100	13	--	Tops sound
Pine, lodgepole	86	100	13	--	Tops sound
Pine, lodgepole	104*	56	11	9	Most tops decayed

*Failure at last inspection

Table 5. Average Characteristics of Pressure-Treated Posts.

Species	Series number	Number of posts	Description	Sapwood	Ground-line perimeter	Preservative treatment
				Per cent	Inches	
Douglas fir	7	25	Round, peeled	60	18	70% creosote, 30% fuel oil, 1.5 to 16 lb (average 7.2 lb) a post, treated twice
Douglas fir	23	47	Round, peeled	60	15	Creosote, absorption unknown
Douglas fir	33	25	Square	0	15	Zinc-meta-arsenite, 0.1 lb a post, treated twice
Douglas fir	42	25	Square	0	16	Wolman salts (Tanalith) 0.302 lb dry salt a cu ft, kiln dried after treatment
Douglas fir	43	25	Round, peeled	60	14	Chromated zinc chloride, 0.78 lb dry salt to a post (1 lb a cu ft)
Douglas fir	45	25	Square	0	16	Chemonite, 0.58 lb of dry salt to a cubic foot
Douglas fir	51	25	Square, incised	0	16	Coal-tar creosote and petroleum mixture, 3.8 lb a post (6.2 lb a cu ft)
Douglas fir	52	25	Square, incised	0	16	Gasco creosote oil, 4.23 lb a post (7.6 lb a cu ft)
Douglas fir	53	25	Square, incised	0	16	Coal tar creosote, 8.1 lb a post (13.0 lb a cu ft)
Douglas fir	96	25	Round, peeled	60	22	Boliden salts, 0.44 lb dry salt a cu ft
Douglas fir	98	24	Square	5	15	Boliden salts, 0.40 lb dry salt a cu ft
Hemlock, West Coast	41	25	Square	0	16	Wolman salts (Tanalith) 0.302 lb dry salt a cu ft, posts kiln dried after treatment
Hemlock, West Coast	44	25	Square	0	16	Chemonite, 0.75 lb of dry salt a cu ft

Table 6. Service Records of Pressure-Treated Posts Remaining in Test in 1963. All Tops of Posts Remaining Were Sound.

Species	Series number	Posts remaining	Age	Avg life of failed posts
		Per cent	Years	Years
Douglas fir	7	100	35	--
Douglas fir	23	100	34	--
Douglas fir	33	24	30	22
Douglas fir	42*	84	27	25
Douglas fir	43*	12	27	18
Douglas fir	45*	68	26	23
Douglas fir	51	100	24	--
Douglas fir	52	100	24	--
Douglas fir	53	100	24	--
Douglas fir	96	100	11	--
Douglas fir	98*	87	11	10
Hemlock, West Coast	41	96	27	24
Hemlock, West Coast	44	92	26	24

*Failure at last inspection.

Table 7. Estimated Increase in Service Life of Douglas Fir Posts Attributed to Preservative Treatment.

Treatment	Series	Age without failure	Failures	Estimated increase*
		Years	Per cent	Years**
Bore hole				
Salt + $HgCL_2$	2+, 91	--, --	4, 32	22+, 11
Salt + $HgCL_2$ + As_2O_3	3+, 4+	28, 28	0, 0	22+, 22+
Sodium pentachlorophenate	90	--	92	5
Sodium trichlorophenate	89	--	92	5
Brushing				
Asphalt	39	--	100	0
Carbolineum	92	--	100	1
Copper naphthenate	80	--	87	6
Creosote	81	--	96	4
Pentachlorophenol	79	--	71	7
Charring	22	--	100	0
Double diffusion				
NaF-$CuSO_4$	101	--	8	12
$CuSO_4$ -Na_2CrO_4	102	--	100	0
Hot-cold bath				
Carbolineum	8	--	100	6
Creosote-petroleum	18	--	100	12
Gasco creosote	54	24	0	--
Osmose				
Bandage	73	--	84	7
Salts	75	14	0	--
Soaking				
Pentachlorophenol	62, 64, 66, 94	--, 15, --, 13	32, 0, 48, 0	12, --, 9, --
Copper naphthenate	63, 65, 67, 93		80, 88, 88, 4	6, 6, 6, 18
Gasco creosote	88, 95	--, --	22, 8	11, 15
Zinc chloride	12	--	100	1
Tire tube				
Chemonite	59	21	0	--
Treater dust or paste As_2O_3	5+, 6, 24, 25	--, --, --, --	28, 100, 79, 64	20+, 15, 23, 26
Pressure processes				
Boliden salts	96, 98	11, --	0, 13	--, 10
Chemonite	45	--	32	25
Chromated zinc chloride	43	--	88	15
Creosote	23, 53	34, 24	0, 0	--
Creosote-petroleum	7, 51	34, 24	0, 0	--
Gasco creosote	52	24	0	--
Tanalith	42	--	16	33
Zinc-meta-arsenite	33	--	76	21

*Estimated increase is based on actual or estimated average service life of a treated series minus average service life of untreated series of 6 years. Estimated average service life was determined by the method explained in Percentage Renewal and Average Service Life of Railway Ties, Report R886, Forest Products Laboratory, U. S. Department of Agriculture, Madison, Wisconsin.

**No estimate could be made of service life of series in which no posts have failed.

+Removed before all posts failed.

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