Preservative Treatments of Fence Posts

1938 Progress Report on The Post Farm

By
T. J. STARKER

Bulletin Series, No. 9

December 1938

A Project of the School of Forestry

Engineering Experiment Station
Oregon State System of Higher Education
Oregon State College

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TABLE OF CONTENTS

FIGURES

TABLES

Preservative Treatments of Fence Posts

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I. FOREWORD

1. **Introduction.** United States Forest Service estimates indicate that American farmers now use from 400 to 600 million posts each year in building and rebuilding farm fences. Most replacements are necessitated by decay, involving an enormous waste in timber and labor. The national job of fence rebuilding amounts to a quarter of a mile for each farm in the country. The consumption of fence-post material for Oregon and Washington is discussed in more detail in Appendix A of this report.

2. **Objectives.** The "Post Farm" was established in 1927 when the first posts were planted on a south exposure in the Peavy Arboretum of the School of Forestry, Oregon State College. The Post Farm is a plot of ground of uniform character selected to determine the lasting qualities of different species of wood and different preservative treatments when in contact with the soil.

3. **Acknowledgments.** As practically all the material in the farm has been donated the cost to the state of this research undertaking has been practically nothing. Most of the cooperators paid even the freight charges on the material contributed. A list of these cooperators will be found in Appendix D.

Graduate students in forestry have assisted without compensation in making the examinations, and credit is hereby acknowledged to all those who have thus contributed toward this project.

II. PROGRESS REPORT

1. **Handicaps in wood usage.** There are two principal handicaps in the use of wood as a structural material—decay and fire. The usefulness of wood can be improved to a large extent by preservative treatment. If proper treatments are used, the life of the wood can easily be doubled and thus expensive replacement costs reduced or eliminated. Proper choice of species and proper preservative treatments reduce the drain upon our forests.

2. **Conditions for decay.** Four conditions are necessary for decay: warmth, air, moisture, and acceptable food for decay organisms. If any one

of these factors is eliminated, decay cannot take place. The most practical one to eliminate to stop decay is to poison the food supply by the use of a toxic agent in the wood. Under some conditions it is convenient to raise or lower the moisture content of the wood so that wood-destroying fungi cannot live. Wood containing less than 18 to 20 per cent and more than 60

Figure 1. View of the "Post Farm" from the south.

per cent moisture is not satisfactory for the growth of the common wood destroyers.

Wood treated in dry kilns at 135° F. or above usually is free from fungi and needs to be reinfected by the spores in order for decay to start.

3. **Requirements for preservatives.** A preservative to be satisfactory should be available at low cost, permanent, toxic, should enter wood easily, have low electrical conductivity, should not affect metals, should not reduce the strength of the wood, or be injurious to man. In some cases it is important that the wood after treatment shall be able to take paint or other finishes.

4. **Seasoning.** Seasoning does not increase the durability of fence posts, poles, or ties. As they soon absorb moisture from the air or ground decay can set in if other conditions are favorable.

5. **Sapwood.** The sapwood of no species is durable and therefore is an important factor in the life of a piece of wood in contact with the soil. Sapwood, however, is freer of resins, tannins, etc., in the pores and hence is treated more easily by preservatives than is heartwood.

6. **Durability of species.** Species of wood differ widely in their durable qualities. We know that cottonwood, alder, and maple in an untreated condition are perishable. We also know that yew, western red cedar, and redwood are durable in a natural state. In the case of many woods we do not know what their relative standing is. The outstanding object of this test

Figure 2. Close-up view of the test posts from the east side of plot.

farm is to give such authentic information. Generally speaking, it is better to spend money treating the less durable woods than the woods that last a long time in their natural state.

The amount of preservative that is used, its quality, and the method are all important factors influencing the length of life of wood in contact with the soil. In the same species and treatment different posts will take different amounts of preservative per cubic foot and their life expectancies are influenced accordingly.

7. **Size specifications.** The posts are planted in the farm in series of 25 each unless for some reason this number is not practicable. When round posts were used, attempt was made to keep them between 4 and 6 inches in top diameter. If split, approximately the same cross-sectional area was used. For sawed posts, 4 inches by 4 inches has been standard size. The standard length is 5 feet, but some deviation from this length has been made. All posts are planted 2 to 2½ feet in the ground. A metal tag showing the individual number was nailed near the top of each post. Diameters or sizes at ground line are recorded, as most failures occur at or near this point.

8. **Examinations of posts.** Annual examinations have been made since 1932, when the first progress report was issued. The examinations are made annually, usually in October. Failure of a post is determined by applying a 50-pound pull at 2 feet from the ground. A spring balance attached to a loop of wire around the post is used in making this test.

The posts are all in the same type of soil and have received the same general treatment since being planted. An occasional clean-up of weeds and brush on the area has been practiced. This would compare to the treatment afforded on most farms.

9. **Effect of climate on durability.** A variable over which there is no control is the difference in weather conditions over a period of years. This is of interest, as all posts were not planted the same year. The effects of the differences in climatic conditions on durability are not known.

The average annual rainfall in this area is 43 inches with long periods in the summer that approach almost a drought condition.

Temperatures seldom fall below freezing except for short periods. In summer a temperature of 85° F. is considered very warm. A cool afternoon breeze from the Pacific Ocean is frequent.

10. **Recording of data.** In addition to the usual file containing correspondence and miscellaneous records that are part of such an extended test series, all the data were kept in chart form on a sheet 3 feet by 7 feet. Each post is designated by a .4-inch circle, and each species is indicated by a symbol. The date of planting is shown, the number of the post, and its circumference at the ground line. If it has failed, its date of removal is also shown. By this means the status of any post or series of posts is readily obtained.

11. **Annual distribution.** The information obtained in this manner has been given a limited distribution through annual progress reports that have been issued. These reports have received some criticism, largely because of their brevity and lack of detail. Since the form is so condensed and the information so readily observed, this report includes a summary similar in character to the regular annual reports. See Table 1. For details on each series, the reader is referred to the individual records.

12. **Classification and records of post series.** The following paragraphs give more detailed information about each series of posts as to treatment, size, percentage of sapwood, character and amount of preservative, source, etc.:

Records of Post Series

Series 1. These posts of second-growth Douglas fir were cut from the McDonald forest and averaged about 25 years in age. Estimated 60 per cent sapwood, averaging 0.78 inches. This figure would apply to other posts cut from the same place. Planted without any treatment, green with bark on. Of the 25 posts, all have failed in 11 years, the average life being 84 months.

Series 2. Source, size, sap, and age same as Series 1. Treated with one tablespoon of corrosive sublimate and common salt in one $\frac{3}{4}$-inch hole bored at ground line. No failures to date. As this treatment has so far shown rather good results, a special mimeograph report was prepared for distribution. A copy of this is made a part of this bulletin. (See Appendix B.)

Series 3. Same as Series 2 with arsenic added to the mixture and using two holes at ground line. No failures to date.

Series 4. Same as Series 3 except that three holes were used. No failures to date.

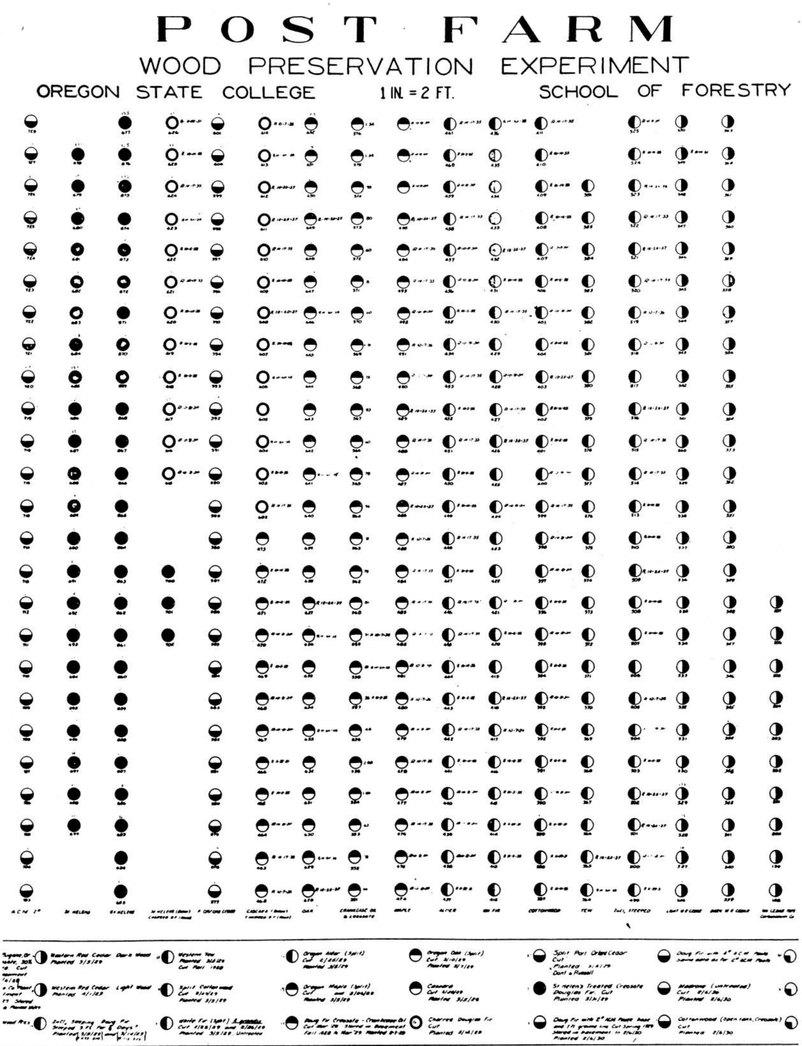

Figure 3. A section of the large record chart showing how records are kept.

Series 5 and 6. Source, size, sap, and age same as Series 1. Series 5 was treated with Anaconda Copper Company treater dust and Series 6 with granulated treater dust according to specifications of the Anaconda Company at that time (3/20/28). No failures in Series 5, one failure in Series 6.

Series 7. These are posts similar in original quality to Series 1. They were cut on December 23, 1927, and planted on March 6, 1929. They were treated by the Southern Pacific Railroad Company at Eugene under pressure, using 70 per cent creosote and 30 per cent fuel oil. The posts retained from 1½ pounds to 16 pounds of this mixture, the exact amount for each post being noted in Table 1. No failures to date. The average moisture content of these posts before treatment was 22.2 per cent.

Series 8. Same quality of original post as Series 7. Cut and planted at same time and given a "B" treatment by the Carbolineum Wood Preserving Company of Springfield, Oregon.* This is an open-tank treatment. Two failures noted in 1937 and five in 1938.

Series 9. This consisted of ten white-cedar tops left over from treating long poles by the above-named company. They were given an open-tank treatment and planted April 20, 1928. Estimated sap 25 per cent. No failures to date.

Series 10 and 11. These consisted of fifty western red-cedar posts purchased from a local lumber yard. They were sorted into light-colored and dark-colored lots and planted in different rows. They were 100 per cent heartwood. One failure occurred in the light cedar in 1933.

Series 12. Quality of original posts equal to Series 1. Steeped in zinc-chloride solution for eight days to a height of three feet. Have had failures in every year including 1931 until 23 of the 25 posts have been removed. The treating mixture consisted of 10 pounds of $ZnCl_2$ in 200 pounds of water.

Series 13. Consists of 23 round yew posts without treatment. One of the smallest posts, 12.5 inches in circumference, failed October 20, 1937, and another small one in 1938. Estimated 90 per cent heartwood.

Series 14. Consisted of 25 split black-cottonwood posts without treatment which have all failed in nine years. In seven years 24 perished. Estimated 80 per cent heartwood. Average life, 55 months.

Series 15. Consists of 25 split lowland white-fir posts of which 16 have failed to date. Estimated 35 per cent heartwood.

Series 16. Consisted of 25 split alder untreated, all of which were removed within a period of seven years. Estimated 75 per cent heartwood. Average life, 69 months.

Series 17. Consisted of 25 big-leaf maple, all of which were removed in a period of nine years. Estimated 75 per cent heartwood. Average life, 76 months.

Series 18. Consists of 25 round Douglas fir of similar quality, origin, age, and size as Series 1. After cutting and peeling, they were stored in the Forestry Building basement over winter and thoroughly seasoned. Treated by means of

* Applies to Series 8 and 9. The treatment consists of immersion in hot oil at a temperature of 225° to 230° F. for four hours and a bath in oil at a temperature of 150° F. for not less than two hours. The dryness of the material treated would determine the penetration. There is no definitely assured penetration in this open-tank treatment.

an open tank with crankcase oil, 50 per cent; creosote, 50 per cent. Only three spotted failures have occurred, one in 1932, another in 1936, and another in 1938.

Series 19. Consists of 25 Oregon-oak split posts with no treatment. Three failures were recorded in the 1936 examinations and five in 1938. Estimated heartwood is 80 per cent.

Series 20. Consists of 12 exceptionally small, round cascara posts of which 11 have been removed. The remaining post is one of the larger ones having a circumference of 9.75 inches. Estimated heartwood is 30 per cent. Another series of cascara posts has been cut and placed in the post farm. (See Series 47.)

Series 21. Consists of 25 Port Orford cedar split posts with no treatment. Estimated heartwood is 100 per cent. Contributed by Dant and Russell, Portland, Oregon.

Series 22. Consists of 25 Douglas fir, charred approximately ¼ inch deep around the entire circumference and 2½ feet up from the butt. The posts are the same character as Series 1. Over a period of nine years 24 of the 25 have been removed.

Series 23. Consists of 50 Douglas-fir round posts of approximately the same character as Series 1 but not cut from Forest-School land. Supplied and treated by the St. Helens Wood Preserving Plant, St. Helens, Oregon. The amount of preservative per post is not known.

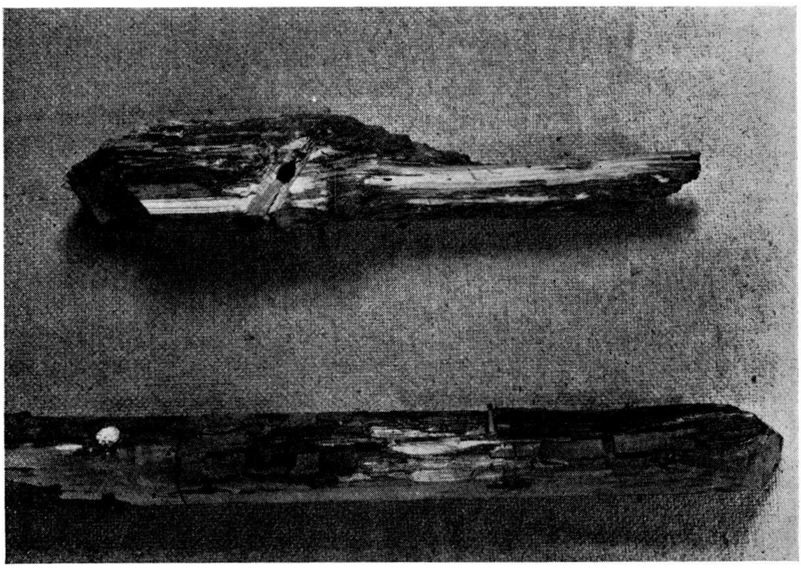

Figure 4. Corrosive-sublimate-treated post not in Post Farm and telephone pole from private installations.
Above: Douglas-fir pole removed after 22 years service near Shedd, Oregon.
Below: Douglas-fir post 3 inches in diameter in ground 15 years—still fairly sound (about ½).

Series 24 and 25. These 50 posts are the same in character as Series 1 and both series are treated with Anaconda treater paste, Series 24 with 2 pounds per post and Series 25 with 4 pounds per post. No failures to date.

The National forests of Region 6 (Oregon and Washington) have installed many miles of telephone line, the poles of which are treated with Anaconda paste. During the year 1937 eleven lines so distributed as to cover the various species used and the climate and soil conditions encountered in the region were established as experimental lines. One hundred poles in each line were numbered, labeled, and completely described. These will be examined and reported upon biennially until sufficient information has been obtained to permit conclusions as to the effectiveness of the treatment and the factors influencing the durability.

Series 26. Consisted of 25 madrone posts, both round and split, containing heartwood estimated at 60 per cent. All of these posts failed within 8½ years. Average life, 69.6 months.

Series 27. Consists of 25 cottonwood posts similar to Series 14 except that these were treated with creosote by the open-tank treatment. In comparison with Series 14, where all the posts failed in nine years, there have been no failures in nine years among posts receiving this treatment. Posts were decaying from the top down. Season checks or very deep splits which held water speeded top decay.

Series 28. Consists of 25 Oregon-ash split posts with no treatment. In nine years 24 posts have failed. Estimated 70 per cent heartwood.

Although not a part of the Post Farm, a study was made on 25 ash posts driven on the State College Farm in December, 1927. Of these posts 25 were tagged in March, 1930, and tested several times thereafter. On January 19, 1938, the date of the last examination, only 3 posts remained standing and these were badly decayed at the ground line. The approximate average life of these posts, largely sapwood, is therefore less than seven years. The area where these posts were located is wet and this may have added somewhat to the life of this set which were 2.4 inches to 5.4 inches in diameter at ground line and made from small timber.

Series 29. Consists of 25 incense cedar split posts with no treatment. Obtained from the Willamette national forest. In eight years 7 posts have failed, which is a higher mortality than would naturally be expected from this species. Estimated 100 per cent heartwood.

Series 30. Consists of 25 round western-juniper posts obtained from the Deschutes national forest. Estimated 60 per cent heartwood. No failures to date.

Series 31. Consists of 26 heartwood 4 inches by 4 inches Sitka spruce posts without treatment. The last three years have seen 16 posts fail. They were contributed by the Pacific Spruce Corporation, Toledo, Oregon. Estimated 100 per cent heartwood.

Series 32. Consists of 26 osage orange posts both round and split, containing heartwood estimated at 90 per cent. They were obtained from a farm about three miles south of Corvallis where a hedge of these trees had been planted many years ago. No failures to date.

Series 33. Consists of 25 Douglas-fir posts treated with ZMA, contributed by the Washington Wood Preserving Company, Spokane, Washington. Average size is 3¾ inches by 3¾ inches sawed. Average retention of dry ZMA salts, 0.207 pounds per cubic foot. The posts were run through the retorts twice in order to get this amount of retention. ZMA is 95 per cent pure arsenic combined with zinc oxide, acetic acid, and water. No failures to date.

Series 34. Consists of 25 western-white-pine posts sawed 4 inches by 4 inches rough, contributed by the Willamette Valley Lumber Company, Dallas, Oregon. All heartwood. Ten failures to date.

Series 35 and 36. Consists of 25 each sugar pine and ponderosa pine sawed 4 inches by 4 inches rough, contributed by the Weyerhaeuser Timber Company, Klamath Falls, Oregon. 100 per cent heartwood. In sugar pine 12 failures have occurred and in ponderosa pine 11.

Series 37. Consists of 25 western larch posts sawed 4 inches by 4 inches, rough, contributed by McGoldrick Lumber Company, Spokane, Washington. Five of the 100 per cent heartwood posts failed in 1937 after only four years in service. In 1938, 9 failed.

Series 38. Consists of 25 western hemlock posts, 100 per cent heartwood, sawed 4 inches by 4 inches rough, contributed by the Willamette Valley Lumber Company, Dallas, Oregon. In the last three years 14 of these posts have failed.

Series 39. Consists of 25 Douglas fir posts of the character of Series 1. They were brush-treated to above ground line using one gallon of asphalt emulsion (Flintkote) contributed by the Copeland Lumber Yards, Corvallis, Oregon. In the last three years 12 of these posts have failed.

Series 40. Consists of 22 black locust split and round posts purchased from a Corvallis home owner who was cutting the tree down (April 13, 1935). Estimated heartwood is 80 per cent. No failures to date.

Series 41. Consists of 25 western hemlock posts sawed 4 inches by 4 inches rough and vacuum-pressure-treated with Wolman salts (Tanalith) securing 0.302 pound of retention per cubic foot. They were treated by the Crossett-Western Company, Wauna, Oregon. The posts were furnished gratis by Bradley-Woodard Lumber Company, Bradwood, Oregon. Estimated 100 per cent heartwood. No failures to date.

Series 42. Same as Series 41 but Douglas fir. Both the hemlock and Douglas fir were of select structural quality and were kiln dried after treatment.

Series 43. Consists of 25 round posts (about 4½ inches in diameter) treated under pressure with chromated zinc chloride in water solution, absorption per cubic foot of wood being 1 pound of dry salts. These posts in treatment were subjected to a maximum temperature of 140° F. and maximum hydraulic pressure of 160 pounds per square inch. Chromated zinc chloride consists of about 85 per cent zinc chloride and 18 per cent sodium dichromate. Estimated 40 per cent heartwood. These posts were furnished by the West Coast Wood Preserving Company, Seattle, Washington.

Series 44 and 45. Consist of 25 western hemlock and 25 Douglas fir 4 inches by 4 inches rough sawed posts treated with Chemonite. The two sets were contributed by the Chemonite Wood Preserving Company, San Francisco, Cali-

Table 1. Summarized Record of Service from Various Treatments

Number and species		Treatment	Date set	Number of posts	Number of posts and date removed								
					Month Day Year	4 22 31	10 5 32	10 14 33	10 4 34	10 17 35	10 7 36	10 20 37	10 20 38
1	Douglas fir	None	1- 7-28	25	----	----	4	5	7	4	2	1	2
2	Douglas fir	$HgCl_2$—1 hole	1- 7-28	25	----	----	----	----	----	----	----	0	0
3	Douglas fir	$HgCl_2$—(2 hole with As_2O_3)	1- 7-28	25	----	----	----	----	----	----	----	0	0
4	Douglas fir	$HgCl_2$—3 hole	1- 7-28	25	----	----	----	----	----	----	----	0	0
5	Douglas fir	ACM treater dust	3- 6-28	25	----	----	----	----	----	----	----	0	0
6	Douglas fir	ACM gran. treater dust	3-20-28	25	----	----	----	1	----	----	----	0	0
7	Douglas fir	S.P. creosote	3- 6-29	25	----	----	----	----	----	----	----	0	0
8	Douglas fir	Carb. Wood Pres. Co.	3- 6-29	22	----	----	----	----	----	----	----	2	5
9	Port Orford cedar	Tops, open tank	4-20-28	10	----	----	----	----	----	----	----	0	0
10	Western Red cedar	Dark—split	3- 6-29	25	----	----	----	----	----	----	----	0	0
11	Western Red cedar	Light—split	4- 1-29	25	----	----	----	1	----	----	----	----	0
12	Douglas fir	$ZnCl_2$ steeped	3-14-29	25	----	1	1	5	4	4	2	5	1
13	Yew	None—round	3- 5-29	23	----	----	----	----	----	----	----	1	1
14	Cottonwood	None—split	3- 5-29	25	----	2	6	6	8	2	0	1	----
15	White fir	None—split	3- 5-29	25	----	1	4	1	3	2	1	3	1
16	Alder	None—split	3- 5-29	25	----	1	6	3	7	8	0	----	----
17	Big-leaf maple	None—split	3- 5-29	25	----	----	----	----	11	8	3	3	----
18	Douglas fir	Crankcase oil and creosote	5- 7-29	25	----	----	1	----	----	----	1	----	1
19	Oregon oak	None—split	5- 7-29	25	----	----	----	----	----	----	----	3	5
20	Cascara	Small posts round	3- 5-29	12	----	1	3	1	4	1	1	----	0
21	Port Orford cedar	None—split	5- 4-29	25	----	----	----	----	----	----	----	----	----
22	Douglas fir	Charred	5- 4-29	25	----	1	3	5	3	4	1	3	4
23	Douglas fir	St. Helens—pressure	5-31-29	50	----	----	----	----	----	----	----	----	0
24	Douglas fir	ACM 2-pound paste	2- 6-30	25	----	----	----	----	----	----	----	----	0
25	Douglas fir	ACM 4-pound paste	2- 6-30	25	----	----	----	----	----	----	----	----	0
26	Madrone	None	2- 6-30	25	----	----	----	3	6	7	3	6	----
27	Cottonwood	Open tank creosote	2- 6-30	25	----	----	----	----	----	----	----	0	0
28	Ash	None—split	3-19-30	25	----	----	1	1	8	4	2	5	3
29	Incense cedar	None—split	3-19-30	25	----	----	----	----	1	5	----	1	0
30	Western juniper	None—round	2-12-30	25	----	----	----	----	----	----	----	----	0
31	Sitka spruce	None—4 x 4	4-15-33	26	----	----	----	----	----	----	4	10	2
32	Osage orange	None	4-15-33	26	----	----	----	----	----	----	----	0	0
33	Douglas fir	ZMA	4-15-33	25	----	----	----	----	----	----	----	0	0
34	Western white pine	None—4 x 4	9-20-33	25	----	----	----	----	----	----	1	2	7
35	Sugar pine	None—4 x 4	9-20-33	25	----	----	----	----	----	----	2	2	8
36	Ponderosa pine	None—4 x 4	9-20-33	25	----	----	----	----	----	----	1	3	7
37	Western larch	None—4 x 4 S4S	9-20-33	25	----	----	----	----	----	----	----	5	9
38	Western hemlock	None—4 x 4 rough	9-20-33	25	----	----	----	----	----	----	3	5	6
39	Douglas fir	Asphalt emulsion	9-20-33	25	----	----	----	----	----	----	2	6	4
40	Black locust	None—split	4-13-35	22	----	----	----	----	----	----	----	0	0
41	Western hemlock	Wolman salts—4 x 4	12-5-36	25	----	----	----	----	----	----	----	----	0
42	Douglas fir	Wolman salts—4 x 4	12-5-36	25	----	----	----	----	----	----	----	----	0
43	Douglas fir	Chr. $ZnCl_4$—round	2-13-37	25	----	----	----	----	----	----	----	----	0
44	Hemlock	Chemonited—4 x 4	5- 1-37	25	----	----	----	----	----	----	----	----	0
45	Douglas fir	Chemonited—4 x 4	5- 1-37	25	----	----	----	----	----	----	----	----	0
46	Alaska cedar	None—split	11-6-37	24	----	----	----	----	----	----	----	----	0
47	Cascara	None—round	1-29-38	26	----	----	----	----	----	----	----	----	0
				1,166									

fornia. Estimated 100 per cent heartwood. Treated to refusal at 150 pounds pressure. The hemlock posts absorbed from 8.5 pounds to 27.5 pounds per post while Douglas fir used 7.0 pounds to 22.5 pounds per piece.

Series 46. Consists of 24 Alaska cedar (Chamaecyparis nootkatensis) posts split from a down tree located on the Willamette National Forest. They are 100 per cent heartwood. The 36-inch tree was felled in 1933 near Elk Lake, Oregon, at an elevation of 4,800 feet. Posts were cut in September, 1937, and hauled to Corvallis on September 21, 1937. Estimated 100 per cent heartwood.

Series 47. Consists of 26 cascara posts contributed by Harold Dahl, senior in forestry, Oregon State College. These posts are untreated except that one had been peeled and was dry. All others were green with the bark retained. Average size, 5.5 inches. Estimated heartwood, 35 per cent.

13. **Future additions.** It is planned to add to the Post Farm from time to time as funds and time permit and as new preservatives or methods develop.

The use of "Permatol", a preservative developed by the Western Pine Association for millwork, has been discussed with Dr. Ernest E. Hubert. Another possibility would be a series of posts treated by the "tire tube" method developed by the United States Forest Products Laboratory.

Anyone having a new method or new preservative may cooperate, as the School of Forestry will set the posts in the farm, make the annual inspections, and mail the annual report.

III. CONCLUSIONS

By way of summary the following conclusions seem warranted:

1. Five series of posts have been removed 100 per cent and afford data for computing average life expectancies. See Figure 5. The life records of cottonwood of 55 months, alder of 69 months, madrone of 69.6 months, big-leaf maple of 76 months, and Douglas fir of 84 months clearly demonstrate that these woods are unsuitable for permanent fence lines in an untreated condition. Douglas fir treated with $ZnCl_2$ also shows too short a life for the same purpose in this climate.

2. Two years after placing in the test plot white fir started to fail, and each year since has developed one or more failures although there are still nine posts remaining after ten years.

3. Set at approximately the same time as the white fir, the charred Douglas fir has shown 24 failures out of the 25. Estimating that the last post will fail next year would give these charred posts an average life of 70 months, compared with 84 months for the untreated Douglas fir. This indicates the futility of the general practice of charring.

4. Ash is another species that apparently will soon be out of the picture, 24 posts having failed over a period of nine years.

5. As many of the species and treatments have no removals or only a few, no definite conclusions can be drawn as to their lengths of life. It is interesting, however, to note the number of failures in western larch, 14

the past two years, and in incense cedar that had 7 failures in eight years. These two species are generally ranked among the more durable woods.

6. The three most important western pines show thus far a rather uniform perishability, western white pine, sugar pine, and ponderosa pine having 10, 12, and 11 failures respectively the past three years.

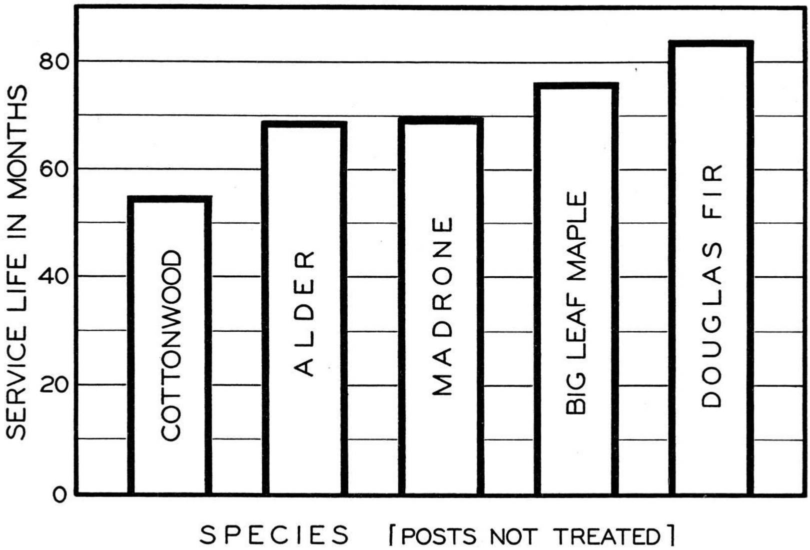

Figure 5. Average service of posts that have failed 100 per cent. All these were without treatment.

Attention should also be called to the lack of removals thus far in all the so-called salt-treated posts. These posts were set in the farm in 1928. Details of this method are given in Appendix B.

Appendix A

WOOD REQUIREMENTS FOR FARM FENCES

The following paragraphs, quoted from the Pacific Northwest Forest Experiment Station, indicate the importance of the post requirements:

1. **Estimate of wood uses.** "One phase of the forest survey of the United States is the estimation of present and future requirements of wood for different purposes. There are certain so-called minor items which should be included in such estimates. Even though individual items comprise but a small proportion of the total requirements, in the aggregate the minor items loom rather large, and may provide outlets for small or rough timber unsuited to major products. Among the minor items are the posts and lumber used in fences on farms. Various estimates of farm

fence requirements have been made, with as many answers as there have been investigations. Consequently, any promising source of more definite data is worth analysis. Such a source was found in the loan applications and appraisals on file in Federal Land banks. Those for Oregon and Washington have been analyzed with interesting results."

2. **Farm size and fencing per acre.** "There is a definite relation between size of farm and the number of rods of fencing per acre. The relation is the same in both Oregon and Washington, indicating that the Pacific Northwest is a rather homogeneous unit insofar as fencing practices are concerned. The fencing-acreage ratio decreased from 14 rods of fencing per acre on 10-acre farms to 8.5 rods on 40-acre farms; to 2.5 rods on 600-acre farms; and to 1.5 rods per acre on farms of over 2,500 acres."

3. **Fencing in the Pacific Northwest.** "By using the above ratios in conjunction with census figures of number and size of farms, the amount of fencing now installed in Oregon and Washington has been estimated as 81,636,170 rods. Under the assumption of one fence post per rod, there are now 81,636,170 posts on farms in the Pacific Northwest."

4. **Annual post requirements.** "Since western red cedar and Douglas fir are the predominant post woods, an average life of 12 years may be expected, making the annual replacements for the region 6,803,014 posts. Under an average volume of 1.08 cubic feet per post, the forests of the region will be called upon to supply 7⅓ million cubic feet of wood annually for farm fence posts. There is no reason to believe that the annual requirements will be greatly modified through the use of steel or concrete posts, through a change in the fencing-acreage ratio, or by an increase in the average post life by preservative treatment."

Appendix B

SALT TREATMENT FOR POSTS AND POLES

1. **History of use.** The use of various salts in treating fence posts to retard decay has been practiced for about 35 years in Oregon. The School of Forestry has been testing this treatment only ten years, and hence cannot state definite conclusions. Posts and poles that have been treated by individuals and companies, however, have been examined and results obtained indicate that the method has much merit and is worthy of use.

2. **Material.** It is important that green material be used, since the efficiency of the treatment depends upon the amount of moisture in the post and that added by absorption. This moisture dissolves the salts and carries them through the fibers of the wood. The bark need not be removed.

3. **Formula.** The material used consists of equal parts, by weight, of corrosive sublimate, arsenic, and common salt. A tablespoon of this mixture is sufficient for a 4-inch post.

4. **Application.** A ¾-inch hole should be bored in the post or pole about 6 inches above the ground line, slanting downward. This hole can best be

bored before the post is set in the ground. After the required amount of mixture is inserted, the hole should be stoppered with a cork or wooden plug to prevent livestock licking the poison. If larger posts or poles are used, two or more holes are suggested. For example: 2 holes for 8-inch and three holes for 10- to 12-inch pieces.

5. **Cost.** The cost will depend upon the charge made for the various salts, but should not be in excess of five cents per 4-inch post. Commercial grades of the chemicals are adequate and are less expensive than the more highly refined products. The above cost figure obviously does not include labor for preparation of the posts for treatment.

6. **Advantages.** The advantages of salt treatment may be listed as follows:

a. The method is inexpensive.

b. A life of 15 years has been obtained with 4-inch Douglas-fir posts treated in this manner. This represents a saving in replacements.

c. In many cases posts can be cut along the fence line, thus saving transportation costs.

d. No time or labor is needed in seasoning material used.

e. No expensive equipment is necessary.

f. No particular skill or experience is required in making the application.

g. Small material and thinnings, which would otherwise be wasted, can be used.

Appendix C

THE OPEN-TANK PROCESS*

1. **Steps in process.** The open-tank process is the most thorough method of treatment that is practicable on the farm. The posts are heated for one or more hours in the preservative (usually coal-tar creosote) at a temperature of from 180° to 220° F. They are then quickly transferred to a tank of the same oil having a temperature of about 100° F., and are left there for one hour or more. In the hot bath the air and moisture in the wood expand and are partly driven out. When the wood is plunged into the cool oil, the air and moisture in it contract and draw the oil into the wood. Except in the case of a few very easily treated woods, there is little absorption of oil by the wood during the hot bath. Instead of a separate tank being used for the cool bath, the heating of the oil in the hot bath may be stopped and the wood and oil allowed to cool together. This accomplishes the same purpose as the cool bath, but a longer time is required because the hot oil cools very slowly.

* For more detailed information on the open-tank treatment consult Farmers' Bulletin 744. Available from Superintendent of Documents, Washington, D. C. Price 5 cents.

2. **Single-tank treatment.** The single-tank treatment is particularly suitable for heavy posts or poles that cannot be transferred easily from one tank to the other. It can sometimes be used to advantage also by heating for two or three hours early in the morning or in the evening and allowing the posts to cool all day or all night. This will make it possible to carry on the treatment without interference with the regular work of the farm. The posts may be treated more rapidly, however, by using the two tanks.

3. **Absorption of oil.** It is desirable in the open-tank treatment to have the oil penetrate the sapwood all the way through. As this is sometimes very difficult to accomplish, however, or requires too much oil, a shallower penetration must then be accepted. A penetration of from ½ to ¾ inch should give very good results. Even lighter penetrations, though they are not recommended, will probably give sufficient protection to pay for the cost of treating. The treatment should extend far enough up the post so that at least six inches of treated wood will be above the ground line when the post is set. During the cooling period the absorption of oil by the posts will lower the height of the oil in the tank. Care should, therefore, be taken to see that there is always enough oil in the tank to submerge the posts to the proper depth.

4. **Determining penetration.** The length of time the wood is held in the hot and cold baths should be regulated by the penetration obtained and the amount of oil absorbed. The best treatment is the one that gives the greatest penetration with the least absorption of oil. The penetration may be determined by boring a small hole at the point where the ground line will be. This hole should be tightly plugged with a creosoted plug before the post is set. The reason for taking the penetration at the ground line is that this is the point at which decay is usually most severe, and thus the point at which depth of treatment is most important.

5. **Duration of bath.** Ordinarily it will not be necessary to leave the posts in the hot bath longer than three hours, and in many cases a much shorter time may give good results. The same is true of the cold bath. If the penetration of oil is not sufficient, either the hot or the cold bath should be lengthened. If the penetration is satisfactory, but too much oil is absorbed, the cold or cooling bath should be shortened. Green or partly seasoned posts, or posts wet from recent rains, require a much longer hot bath than seasoned dry ones. The amount of oil absorbed per post will vary with the kind of wood and the size of the post. In general, it should be between 0.4 and 0.6 gallon for a post of from five to six inches in diameter.

6. **Constant temperature.** During the heating period the temperature of the creosote should be kept as nearly constant as possible, or still better, it should be allowed to increase very slowly. It should not be allowed to fluctuate up and down if this can be avoided. Temperatures between 200° and 220° F. are satisfactory. For timber that treats very easily 180° F. may prove high enough. The temperature should not be allowed to go above 220 F°. as an appreciable amount of the oil is lost by evaporation at high temperatures. There is also danger that the oil will boil over the sides of the tank if the temperature gets too high. The "cold" bath should be

warm enough to liquefy the oil thoroughly. A temperature of 100° F. will usually be found sufficient for this purpose.

7. **Results of experiments.** Various woods differ so in their susceptibility to treatment that a general rule for treating cannot be given. In Table 2, however, are shown the results obtained in some experiments with a number of kinds of wood. It will be noted that most of the posts listed were given a light top treatment in addition to the butt treatment. This is necessary only when the wood is of a species that is known to decay rapidly even above the ground line, or when the climate is warm and moist as in some of the southern states. The tops, however, do not require as heavy treatment as the butts.

8. **Methods of top treatment.** There are two methods of giving the top treatment. In one method the cold tank is made long enough to hold the posts lying full length. In this case, when the posts are transferred to the cold tank they are entirely submerged in the oil. This results in a comparatively heavy absorption in the butts which have been heated, but only a light absorption in the tops. Another method is to complete the butt treatment of the posts first, and then turn them upside down in a tank of hot oil and allow them to remain for a few minutes. The oil should be deep enough in the tank to cover all the post not treated before. If this is not possible, a swab should be used to brush the oil all over the wood not submerged. The swab can be made by tying a piece of burlap on a stick. Particular pains should be taken to fill all checks and cracks with the oil.

9. **Case-hardening.** Sometimes in seasoning, the outer surface of the wood becomes hard and has a glazed appearance. This effect is called "case-hardening", and it may seriously retard penetration by the oil. The remedy is to shave off the hardened surface with a draw-shave for from six to eight inches above and below the ground line. The rest of the butt need not be shaved.

10. **Precautions after treatment.** After treatment it is a good plan to stand the posts upside down. This allows any excess oil in the butts to flow toward the top and remain in the wood, instead of dripping on the ground. Posts should not be left in this position more than a few weeks, especially if the tops are untreated, as decay may start in the part which touches the ground.

11. **Apparatus for open-tank process.** Various forms of apparatus are used in open-tank treatments. The essential parts of the apparatus for general farm use are one or two tanks (depending on whether the hot and cold or hot and cooling method is used), a thermometer, and some means of heating.

12. **Requirements of tanks.** The chief requirements of the tanks are: (1) strong enough to hold the weight of the oil and the posts; (2) must not leak; (3) deep enough so that the top of the oil will be a foot or more below the top of the tank during treatment; and (4) arranged to be readily heated. Any tank of convenient size satisfying these requirements will do. The heating may be accomplished by a fire beneath the tank, or by means of steam coils if steam is available. If an open fire is used, care should be taken to prevent the oil from spilling over the side of the tank and taking

Table 2. RESULTS OBTAINED IN THE TREATMENT OF VARIOUS WOODS
(All posts were round, peeled, and seasoned.)

Species	Absorption per 5-inch post	Penetration		Single-tank treatment			Double-tank treatment			
		2 feet from butt	2 feet from top	Butt—hot oil	Top—cooling oil		Hot oil		Cold oil	
	Gallons	*Inches*	*Inches*	*Hours*	*Hours*		*Hours*	*Minutes*	*Hours*	*Minutes*
Ash, white	0.4	0.4	....	5	12	Dipped*	....	....	....	....
Basswood	.6	.1	0.05	....	....	....	1	....	....	30
Beech	.6	1.0	.4	....	....	....	1	....	....	45
Birch, river	.6	.7	.3	....	....	....	3	....	1	....
Butternut	.4	.5†	....	6	12	....	....	....	....	....
Elm, slippery	.6	.3†	.1	....	....	....	1	30	1	30
Elm, white	.4	.4†	....	6	12	....	....	....	....	....
Gum, black	.6	.6	.3	....	....	....	1	....	1	....
Gum, cotton (tupelo)	.6	.6	.3	....	....	....	1	....	1	....
Gum, sweet (red)	.6	1.0	.3	....	....	....	1	....	....	45
Hickory, bitternut	.4	.5	....	6	12	Dipped*	....	....	....	....
Magnolia, sweet (bay)	.6	.4	.2	....	....	....	1	....	....	30
Maple, red	.6	1.0	.3	....	....	....	4	....	2	....
Maple, sugar	.6	.2	.1	....	....	....	3	....	2	....
Oak, pin	.5	1.0†	.5	....	....	....	1	....	....	45
Oak, red	.4	.5†	.3	....	....	....	1	....	....	45
Pine, loblolly	.5	1.5	1.0	....	....	....	1	30	1	....
Pine, lodgepole	.6	1.2	.6	....	....	....	1	30	1	....
Pine, pitch	.5	1.0	.3	....	....	....	3	....	1	....
Pine, scrub	.5	1.0	.4	....	....	....	3	....	2	....
Pine, shortleaf	.5	1.0	.3	....	....	....	3	....	1	....
Pine, western yellow‡	.5	.7	....	....	....	....	2	30	2	....
Poplar, white	.5	.5	.2	....	....	....	6	....	12	....
Sycamore	.6	1.0	.2	....	....	....	1	....	....	30
Tulip tree	.6	.4	.1	....	....	....	2	....	....	30
Willow, white§	.6	.6	.2	....	....	....	4	....	1	....

* Dipped for 5 minutes or more.
† Width of sapwood. Penetration limited by impenetrable heart.
‡ Average results from 6,000 posts.
§ Requires especially thorough seasoning.

fire. This is the reason for having the top of the oil a foot below the top of the tank. Though the oil is not dangerously inflammable, and ordinary care will prevent trouble, carelessness may result in the loss of the oil and the posts. The treatment should be made, of course, in a situation where an accidental fire would not endanger buildings or other property.

13. **Oil drums.** A plant may be made from oil drums by cutting out one head of each drum. In order to keep the posts from floating in the oil, it is well in a plant of this kind to use a false bottom in each drum. These can readily be made of the heads cut from the drums or other suitable flat pieces of iron by riveting on strips of iron through which several screws protrude $\frac{1}{2}$ to $\frac{3}{4}$ inch. The screws stick into the posts and keep them from moving about and floating in the oil.

14. **Other types of plants.** A more permanent type of plant is that which is made of comparatively heavy metal and is surrounded by a brick firebox. Then there is the plant built for treating the entire post, giving a heavy butt treatment and a light top treatment. The horizontal tank is 8 feet long, 3 feet wide, and 3 feet deep; the round tank, about 3 feet in diameter and 4 feet deep. With the larger tank in which posts are placed horizontally a simple arrangement must be rigged to hold the posts under the oil during the cold bath.

15. **Construction of the tanks.** The details of construction of the tanks used in one portable experimental plant which was heated by steam from the boiler of a threshing engine were as follows: Between the steam pipes placed in the bottom of the tank, strips of 2-inch lumber studded with screws were placed and firmly wired to the pipes. The points of the screws projected about $\frac{3}{4}$ inch above the wood and served to keep the posts from sliding about. Without the screws it would have been impossible to put a full charge of posts into the tank. On both sides of each tank, about 18 inches from the top, planks 2 by 12 inches were suspended by means of shaped irons which hooked over the sides of the tank. This made a very satisfactory working platform. The capacity of the tank was from 40 to 105 posts per charge, depending on the size and shape of the posts.

16. **Character of plant to be used.** The number of posts to be treated should determine the character of the plant used. If only a few posts are to be treated, a simple plant is most suitable. For a large number of posts or timbers of other kinds, more elaborate apparatus is advisable, such as that described, or perhaps a stationary plant with a complete equipment of a steam boiler, storage tanks, oil pumps, a derrick for lifting the timber, etc. In any kind of a plant the ingenuity of the operator will be called upon to provide platforms and other facilities for handling the posts to the best advantage.

17. **Cooperative plant.** It may prove of advantage sometimes for a number of farmers to cooperate in the erection of a permanent plant of this kind or a portable plant as described. Such a plant could either be loaned to each of the cooperators in turn to treat his own timber or it could be placed in charge of an operating crew of two or three men who would make all the treatments.

Appendix D

LIST OF COOPERATORS IN THE POST FARM PROJECT

1. Anaconda Copper Mining Company, Butte, Montana
   Wood preserving department
2. Southern Pacific Company, Eugene, Oregon
   Creosoting plant
3. Carbolineum Wood Preserving Company, Springfield, Oregon
4. Dant & Russell, Portland, Oregon
5. Washington Wood Preserving Company, Spokane, Washington
6. Copeland Lumber Yards, Corvallis, Oregon
7. Western Pine Association, Portland, Oregon
8. Weyerhaeuser Timber Company, Klamath Falls, Oregon
9. McGoldrick Lumber Company, Spokane, Washington
10. Willamette Valley Lumber Company, Dallas, Oregon
11. Charles R. McCormick Lumber Company, St. Helens, Oregon
    Creosoting department
12. Willamette National Forest, Eugene, Oregon
    Supervisor
13. Crossett Western Company, Wauna, Oregon
14. Kirchmann Hardwood Company, San Francisco, California
15. Pacific Spruce Corporation, Toledo, Oregon
16. U. S. Forest Products Laboratory, Madison, Wisconsin
17. West Coast Wood Preserving Company, Seattle, Washington
18. Pacific Northwest Forest Experiment Station, Portland, Oregon
19. Umpqua National Forest, Diamond Lake, Oregon
20. Chemonite Wood Preserving Company, San Francisco, California
21. Bradley-Woodard Lumber Company, Bradwood, Oregon

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EXTENSION

Federal Cooperative Extension (Agriculture and Home Economics)

General Extension Division