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# Serviceability of Farm-Treated Fence Posts

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## Summary

A STUDY was begun in 1947 on the cutting, preservative treatment, and serviceability of fence posts from six species—shortleaf pine and red maple, and post, white, scarlet, and blackjack oaks. None of the posts treated with pentachlorophenol (5% solution in diesel oil) had failed after 8 to 13 years in service. After 8 years in service, several posts of four species treated with copper naphthenate (0.5% metallic copper in diesel oil) had failed.

Observations on time required for cutting and peeling under selected conditions are included.

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COVER PHOTO:

Tight chain post peeler developed by TVA and used as the mechanized peeler in the peeling test. The machine was also used on insect-peeled posts to remove bark after insects had loosened it.

(TVA photo)

# Contents

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## Introduction

MILLIONS of pine trees have been planted by Tennessee land owners in the past 20 years. Most of these trees were planted at a rather close spacing and will need to be thinned for more rapid saw timber production. The thinning operation should provide stems which would make serviceable fence posts if they are treated with preservatives to insure a satisfactory length of service. Some of the poor quality hardwoods in woodlots might also provide stems that would be of suitable size for use as fence posts. With this utilization of pine and hardwood cuttings in mind, the University in 1947 initiated studies of fence post treatment methods suitable for use on the farm, and the serviceability of posts.[1]

## Procedure

Records were kept on all of the fence post handling operations including cutting, peeling, and treating, as an aid in estimating the cost of treated posts.

**Species** used in the study included shortleaf pine, blackjack oak, scarlet oak, post oak, white oak, and red maple.

**Cutting.** The first posts were cut in the late summer and early fall of 1947. Additional posts were cut in the spring of 1948 and the spring of 1949. In 1950, a group of shortleaf pine were cut. Another group of 480 shortleaf pine posts were cut in 1951, and at the same time 25 posts each of blackjack oak, scarlet oak, and red maple were cut.

**Peeling.** Posts cut in 1947, 1948, and 1949 were hand-peeled with a spade, a mall, and the back of an axe. They were then stacked in a shed for drying. The shortleaf pine posts cut in 1950 were peeled on a chain peeler owned by TVA.[2] The 480 shortleaf pine posts cut in 1951 were divided into four groups according to diameter. One-half of the posts were crib-piled and the other half dead-piled for so-called "bug peeling" (6)[3]. At the same time 25 posts of each

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1 The author is indebted to John A. Odom, Superintendent of Plateau Experiment Station, for his assistance in helping to carry out this work.

2 Appreciation is expressed to TVA for use of chain peeler.

( ) Numbers in parenthesis refer to References.

of the three hardwood species were stacked to determine if insects would loosen the bark enough to aid in peeling.

A study of chemical debarking (8) was carried out by treating 25 post oak and 25 scarlet oak trees with sodium arsenite each week, beginning in March and running through September. This operation involved a total of 325

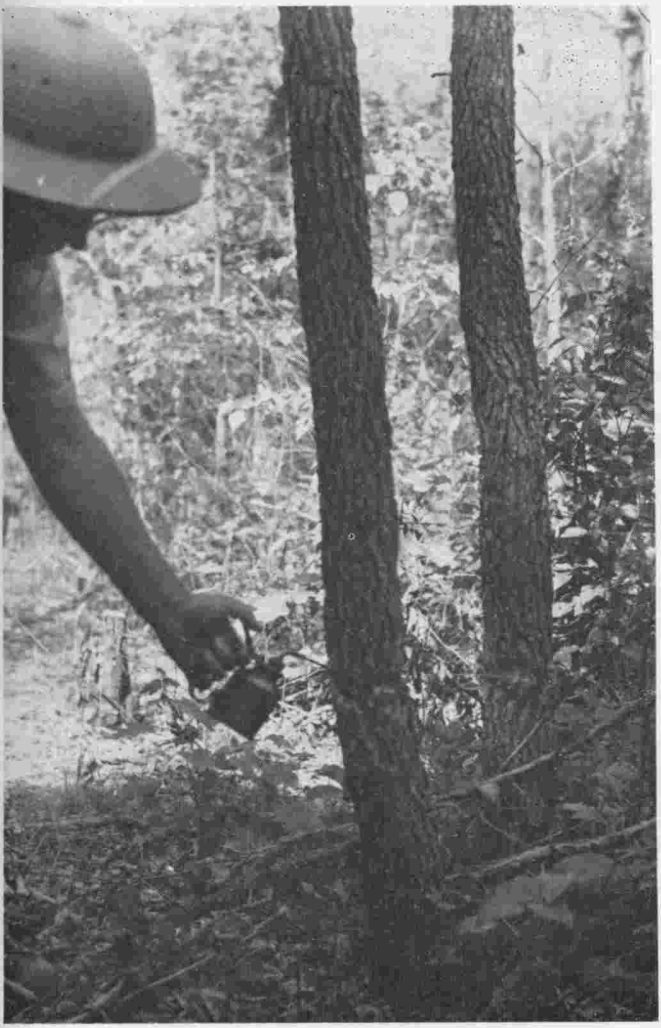

Figure 1. Sodium arsenite was applied with a pressure oil can to a single frill girdle around a hardwood tree species.

trees of each species. A frill girdle was made around each tree and a 40% arsenite solution applied with an oil can. After treatment, the trees were left on the stump until late April or May of the following year at which time they were cut and stacked for drying. These posts were stacked loosely above-ground so there would be good air circulation around them. Some were in the open and others were under a shed.

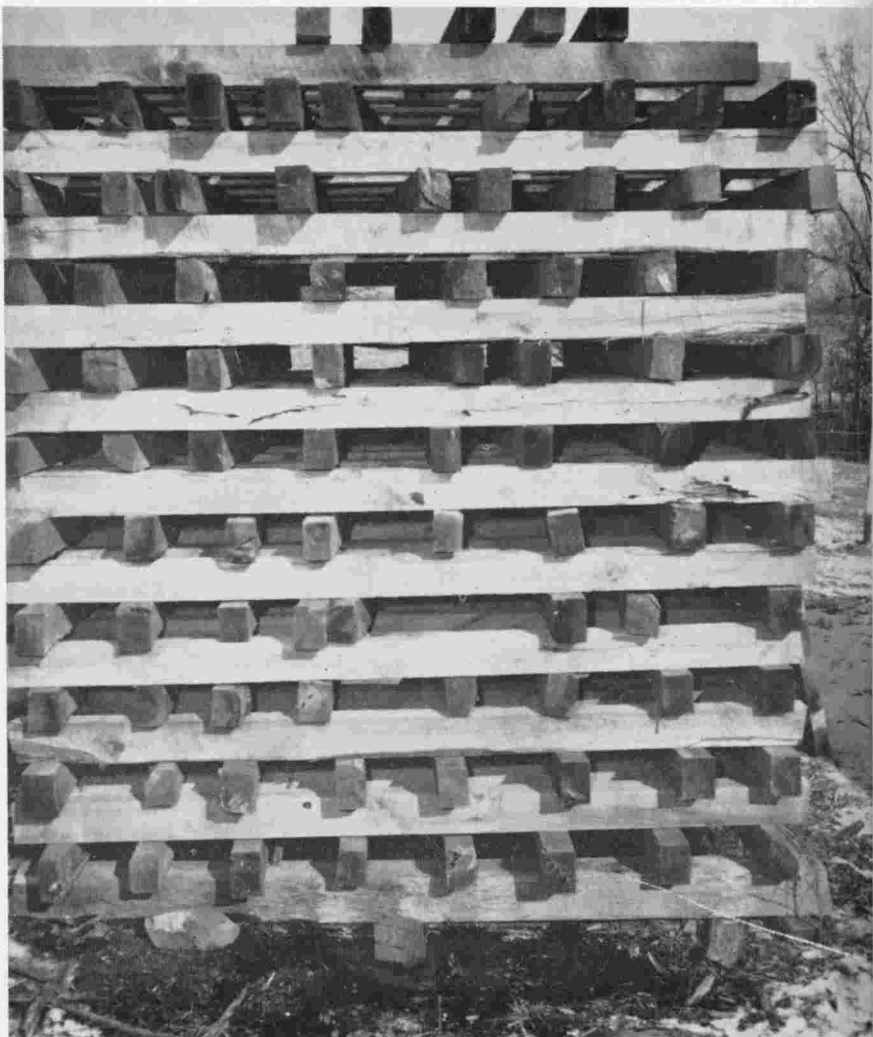

Figure 2. These sawed posts have been properly stacked for efficient drying.

**Preservation treatment.** Two preservative solutions were used: a) 5% pentachlorophenol, made up by diluting 1 part of the concentrated pentachlorophenol with 10 parts of diesel oil, and b) 5% copper naphthenate in diesel oil. The 5% solution of the copper compound contained 0.5% metallic copper. The copper naphthenate concentrate contained, in some cases, 6% metallic copper and in other cases 8%.

The posts were dried to a moisture content of 20% or less before treating, as determined with a moisture meter. All treating was done by the cold-soaking method (9). The posts were weighed before and after treatment to determine absorption quantity. The volume of each post was computed by using the mid-diameter area in square feet and length, in order that the absorption of treating solution per cubic foot could be calculated.

The treating solutions, enough to completely cover the posts, were put in a tank which measured 3 x 3 x 9 feet. The posts were divided into large diameter (4½-6 inches at top) and small diameter (2½-4½ inches) groups. About 12-15 of the large or 25 of the small posts were chained together to constitute one batch for treatment (Fig. 6).

**Field testing.** Treated posts were installed in fences at several locations on the Plateau Experiment Station, Crossville. In some cases, control posts receiving no treatment were placed in the ground also, but not in the fence line because of their expected short life.

## Results

**Labor for cutting posts.** Two time studies were made. One study involved the 480 shortleaf pine posts cut in 1951. These posts were cut from short-bodied, tapering trees growing in an old field. The average time per post was 6.8 minutes. In the other study, 298 posts were cut from tall, slender pines in a natural stand. The average time per post was 3.9 minutes. Other observations also indicated that the time required to cut a post was more dependent on the character and quality of the tree than on the diameter of post being cut.

**Peeling.** As mentioned, shortleaf pine posts that were cut in March 1950 were peeled on a chain peeler borrowed from TVA. It took an average of 2.8 minutes to peel a small diameter post and 4.1 minutes to peel a large post. Hand-peeling averaged 6.6 and 6.9 minutes, respectively, for the small- and large-size posts. The machine did a more thorough job than was done by hand, particularly in removing the brown inner bark.

The 480 shortleaf pine posts cut in 1951 for the study of "bug peeling" were first inspected in March, one month after stacking. No evidence of insect activity was observed. Slight insect action was noted in early May, the next inspection period. Posts peeled at this time by machine required 1.7 minutes for small and 3.2 minutes for large diameters, respectively (see Table 1). This was about

Table 1. Average Peeling Time, Minutes Per Post, by Post Size, Exposure Period, and Type of Pile.

| | | | 2.5—4.5 in. | | 4.6—6.0 in. | |
|---|---|---|---|---|---|---|
| Species | Exposure period (days) | Peeled by | Crib piled | Dead piled | Crib piled | Dead piled |
| | | | | | Time in minutes | |
| Shortleaf Pine | 60 | Machine | 1.9 | 1.4 | 2.9 | 3.4 |
| | 90 | " | 1.7 | 1.2 | 2.0 | 1.9 |
| | 120 | " | 1.1 | 1.2 | 1.3 | 1.8 |
| | 150 | " | 0.7 | 0.8 | 0.8 | 1.0 |

the same time required for machine peeling of posts immediately after cutting.

The next inspection in early June indicated more insect activity. It was estimated that about 60% of the surface area of the post had been attacked by insects; but this insect activity had relatively little effect on loosening the bark. It took an average of 1.5 minutes to machine-peel a small post and 1.9 minutes for a large post.

Figure 3. These large-diameter posts were dead-piled for 90 days and exposed to insect action. Pine sawyer larvae have attacked the posts. (TVA photo)

At the third inspection in July, it was estimated that about 90% of the post surface had been affected by insects. By this time, most of the Ips beetles had left the posts. Pine sawyer larvae had bored into the wood on some of the posts and numerous other larvae were present under the bark. The condition of the bark was such that it could be easily removed with hand tools. Most of the cambium had been eaten or decayed. At this time it took 1.2 minutes to machine-peel small posts and 1.6 minutes for large posts.

The last inspection was in August, 150 days after cutting. By this time some of the bark had either fallen off the posts, or fell off as the posts were moved from the piles. A hard rap on the ground would usually knock off most of the bark. Heavy blue stain and considerable pine sawyer damage were evident, but very little decay was found. The pine sawyers had not made any of the posts unserviceable. At this time it took 0.8 minutes to machine-peel small posts and 0.9 minutes for large posts (see Table 1).

Figure 4. Two entrance holes of pine sawyer larvae are visible in a strip about 1 foot long, on the upper side of a bug-peeled post that was crib-piled for 150 days in the bottom layer. The insects were not very active in the warmer and drier upper side of the post. (TVA photo)

It was noted that very small posts, which have thin bark, dry so quickly that insects will not aid materially in bark removal.

The hardwood posts were first examined 60 days after cutting. This 60-day period was in the early summer when insect activity should be at a maximum. However, little or no insect activity was observed. The posts were hand-peeled

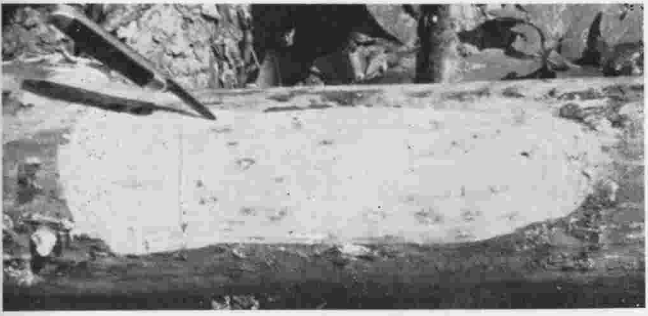

Figure 5. The underside of a post section—also about 1 foot long—shows 38 holes. Insects were more active on the cooler and more moist underside of the posts. (TVA photo)

and required about as much time and effort as would have been required had they been peeled green immediately after cutting. Observations indicate that such hardwood posts will start to decay before insects produce any appreciable loosening of the bark.

The trees treated with sodium arsenite died as soon as 48 hours after treatment. The bark showed evidence of loosening about 30 days later. Observations indicate that sodium arsenite treatment gives better results when applied during the early part of the growing season. Trees treated during the late summer months died as quickly, but the bark did not loosen as well as on the trees treated earlier.

At the time of post cutting the following spring, a color change was noted in the heart wood of the trees treated early the previous season with sodium arsenite. This color change may have been due to incipient decay. However, the wood was hard and not easily cut across the grain with a knife.

**Seasoning.** It was found that a period of 3-4 months in the summer was adequate for reduction of wood moisture to the desired level of 20%. Posts stacked in the open showed more checking, mold, and stain than did the posts dried under a shed.

**Absorption of preservative solutions.** The data on absorption and penetration are presented in Table 2. There did not seem to be any consistent difference in behavior between the two solutions. Since both consist of a diesel oil base, this result might well be expected.

The average weight of solution absorbed per cubic foot of wood ranged from 3.4 pounds for one lot of large blackjack oak posts to 10.3 pounds for one lot of large shortleaf pine. These values are somewhat higher than those reported by Blew (1). In general, pines absorbed more solution than hardwoods. There was much variation among posts within a given lot, especially

Table 2. Absorption of Preservative Solutions by Posts from the Different Tree Species.

| Species | Preserv-ative | No. posts in test | Av. diam. mid-point (inches) | Av. moisture content (Percent) | Av. temp. of treat. sol. (°F) | Soaking Time (Hours) | Absorption Lb. per cu. ft. Min. | Max. | Av. | Av. penetration, inches |
|---|---|---|---|---|---|---|---|---|---|---|
| So. Pine (small) | Penta | 25 | 4.0 | 16 | 89 | 2.00 | 2.0 | 21.3 | 9.3 | 1.5 |
| So. Pine (large) | Penta | 25 | 5.3 | 16 | 85 | 15.25 | 2.5 | 17.9 | 10.3 | 2.0 |
| So. Pine (small) | Penta | 25 | 4.1 | 12 | 82 | 1.50 | 3.2 | 23.8 | 10.0 | — |
| So. Pine (large) | Penta | 25 | 5.3 | — | 44 | 1.75 | 1.4 | 18.3 | 6.8 | — |
| So. Pine (small) | CuNaph. | 25 | 3.6 | 15 | 64 | 22.25 | 5.6 | 15.3 | 9.5 | — |
| So. Pine (large) | CuNaph. | 25 | 4.8 | 16 | 55 | 104.25 | 4.2 | 12.5 | 6.3 | — |
| So. Pine-Bug Peel-small | CuNaph. | 216 | 3.2 | 17 | 68 | 13.50 | 2.2 | 26.0 | 9.3 | — |
| So. Pine-Bug Peel-large | CuNaph. | 235 | 4.7 | 17 | 66 | 11.78 | 3.3 | 19.4 | 8.3 | — |
| Red Maple (small) | Penta | 25 | 3.5 | 16 | 75 | 53.50 | 3.3 | 7.7 | 5.6 | 0.2 |
| Red Maple (large) | Penta | 25 | 4.8 | 17 | 86 | 24.00 | 2.8 | 8.8 | 4.7 | 0.1 |
| Red Maple (small) | CuNaph. | 25 | 3.5 | 16 | 40 | 46.50 | 1.2 | 6.7 | 4.3 | 0.3 |
| Red Maple (large) | CuNaph. | 25 | 5.5 | 15 | 45 | 58.25 | 2.5 | 6.8 | 4.4 | 0.3 |
| Blackjack Oak (small) | Penta | 25 | 3.9 | — | — | 195.00 | 3.0 | 6.9 | 4.5 | 0.3 |
| Blackjack Oak (large) | Penta | 24 | 4.6 | — | — | 152.00 | 1.9 | 8.8 | 4.1 | — |
| Blackjack Oak (small) | CuNaph. | 25 | 4.7 | 11 | 46 | 47.00 | 2.8 | 6.7 | 4.4 | 1.8 |
| Blackjack Oak (large) | CuNaph. | 25 | 5.3 | 14 | 48 | 48.00 | 2.1 | 6.3 | 3.4 | 2.6 |
| Scarlet Oak (large) | Penta | 25 | 5.3 | 16 | 81 | 44.00 | 2.9 | 6.3 | 3.9 | — |
| Scarlet Oak (small) | CuNaph. | 25 | 3.1 | 16 | 38 | 48.00 | 1.6 | 10.1 | 4.7 | 0.2 |
| Scarlet Oak (large) | CuNaph. | 25 | 5.4 | 12 | 41 | 55.00 | 3.7 | 7.8 | 5.7 | 0.5 |
| Black Oak* | CuNaph. | 25 | 3.4 | 17 | 86 | 20.00 | 3.2 | 6.8 | 4.8 | 0.2 |
| Scarlet Oak* | CuNaph. | 25 | 3.5 | 15 | 76 | 46.50 | 3.6 | 8.1 | 5.2 | 0.3 |
| White Oak* | CuNaph. | 25 | 3.2 | 16 | 71 | 71.00 | 3.2 | 27.9 | 6.9 | 0.1 |
| Post Oak* | CuNaph. | 25 | 3.4 | 14 | 91 | 123.25 | 3.4 | 15.4 | 7.1 | 0.1 |

* Chemically peeled

**Figure 6. Posts were chained together before immersion in the sheltered treating vat.**

those of shortleaf pine, scarlet oak, and post oak; within-lot variation was less for longer periods of soaking. However, some of the shortleaf pine posts had taken up nearly as much solution in 1-2 hours as they did in 15-20.

After treating, several posts were cut into one-foot sections and split. It was observed that average lateral penetration was less than an inch in 11 of the 15 lots measured; the maximum penetration in any lot was 2.6 inches (see Table 2). Penetration on the ends varied from a few to 18 inches. Differences in "end" penetration may account for much of the post-to-post variation in absorption. Also, the longer the posts were exposed to weathering and fungus attack, the more readily they absorbed the preservative.

Temperature of the solutions during soaking varied from 38° to 91°. No consistent relation was observed between absorption or penetration and temperature.

**Service life.** Data on the posts installed in actual fence lines at the Plateau Experiment Station are presented in Table 3. Average life of the untreated posts ranged from 2.3 years for red maple to 2.8 years for shortleaf pine and black oak. In computing average life, a group of test posts was considered to have terminated its useful period of service when 60% of the posts had failed. The small pine posts failed first and the large oak posts lasted the longest. Failure was due to decay and termites, in most cases a combination of both. Most rapid decay took place 6 inches below to 6 inches above the ground. Termites started below ground level and advanced rapidly into the upper part of the posts.

None of the posts treated with pentachlorophenol had failed at the time of the last inspection in 1962, after 13 years of service. After 8 years of service,

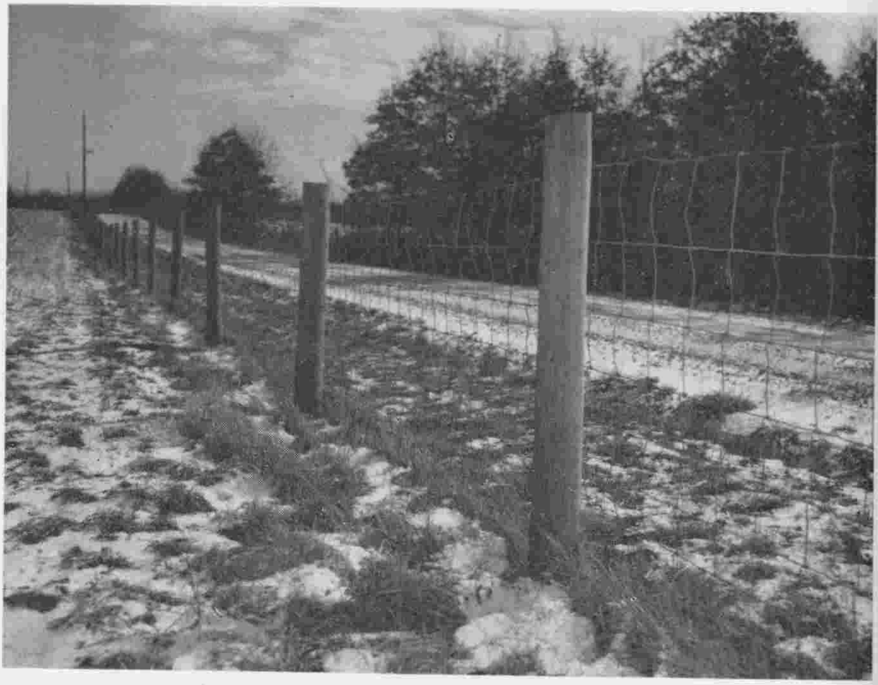

Figure 7. This fence was constructed with copper-naphthenate-treated posts that are now 10 years old. The fence is located on the Grassland Farm unit of the Plateau Experiment Station, Crossville.

several posts of pine, maple, blackjack, and scarlet oaks treated with copper naphthenate had failed. About 90% of the small red maple posts had failed; the average life was 8 years. Over half of the large red maple posts were decayed and probably will fail in the near future.

Table 3. Service Life of Treated and Untreated Fence Posts at the Plateau Experiment Station, Crossville, Tennessee. Record as of Last Inspection in 1962

| Species | Preserv-ative | Average retention | Years in service | No. posts in test | Failures up to and including 1962 inspection | | Seasoning time | Av. Life | Av. solution in cost/post[1] |
|---|---|---|---|---|---|---|---|---|---|
| | | Lb. per cu. ft. | | | No. | Percent | Months | Years | Cents |
| So. Pine (small) | Penta | 9.3 | 13 | 25 | 0 | 0 | 9 | — | 46 |
| So. Pine (large) | Penta | 10.3 | 13 | 25 | 0 | 0 | 9 | — | 51 |
| So. Pine (small) | Penta | 10.0 | 13 | 25 | 0 | 0 | 11 | — | 50 |
| So. Pine (large) | Penta | 6.8 | 13 | 25 | 0 | 0 | 12 | — | 34 |
| So. Pine (small) | CuNaph | 9.5 | 9 | 25 | 0 | 0 | 7 | — | 47 |
| So. Pine (large) | CuNaph | 6.3 | 9 | 25 | 2 | 8 | 7 | — | 31 |
| So. Pine-Bug Peel | CuNaph | 8.8 | 10 | 451 | 24 | 5 | 4 | — | 44 |
| So. Pine | Untreated | — | | 50 | 50 | 100 | 9 | 2.8 | |
| Red Maple (small) | Penta | 5.7 | 13 | 25 | 0 | 0 | 3 | — | 28 |
| Red Maple (large) | Penta | 4.7 | 13 | 25 | 0 | 0 | 3 | — | 23 |
| Red Maple (small) | CuNaph | 4.3 | 9 | 25 | 23 | 92 | 21 | 7 | 21 |
| Red Maple (large) | CuNaph | 4.5 | 9 | 25 | 7 | 28 | 21 | — | 22 |
| Red Maple | Untreated | — | | 50 | 50 | 100 | 3 | 2.3 | |
| Blackjack Oak (small) | Penta | 4.5 | 13 | 25 | 0 | 0 | 13 | — | 22 |
| Blackjack Oak (large) | Penta | 4.1 | 13 | 24 | 0 | 0 | 13 | — | 20 |
| Blackjack Oak (small) | CuNaph | 4.4 | 9 | 25 | 17 | 68 | 23 | 8 | 22 |
| Blackjack Oak (large) | CuNaph | 3.4 | 9 | 25 | 5 | 20 | 23 | — | 17 |
| Blackjack Oak | Untreated | — | | 50 | 50 | 100 | 13 | 2.5 | |
| Scarlet Oak (large) | Penta | 3.9 | 13 | 25 | 0 | 0 | 3 | — | 19 |
| Scarlet Oak (small) | CuNaph | 4.7 | 9 | 25 | 14 | 56 | 22 | 9 | 23 |
| Scarlet Oak (large) | CuNaph | 5.7 | 9 | 25 | 7 | 28 | 22 | — | 28 |
| Scarlet Oak | Untreated | — | | 50 | 50 | 100 | 3 | 2.8 | |
| Black Oak* | CuNaph | 4.8 | 8 | 25 | 0 | 0 | 11 | — | 24 |
| Post Oak* | CuNaph | 7.1 | 8 | 24 | 0 | 0 | 11 | — | 35 |
| Scarlet Oak* | CuNaph | 5.2 | 8 | 25 | 0 | 0 | 11 | — | 26 |
| White Oak* | CuNaph | 6.9 | 8 | 25 | 0 | 0 | 11 | — | 34 |

* Chemically peeled.

[1] Cost based on 35¢ per gallon for treating solution.

After 8 years' service, none of the posts from trees killed with sodium arsenite and treated with copper naphthenate had failed; the species included were black, post, scarlet, and white oaks.

## Discussion

This study indicates that very serviceable fence posts will result from pentachlorophenol cold soak preservative treatment of trees harvested from the farm woodlot. Costs of the preservation solution as listed in Table 3 do not include any allowance for labor or equipment needed for the treatment. Detailed descriptions of treatment procedures with helpful illustrations are given by Blew and Champion (2).

Some of the species treated with copper naphthenate had an average life of only 7 years. The solution used contained 0.5% metallic copper. More recently, a concentration of 1.0% metallic copper had been recommended (2). This higher concentration of preservative might well result in a longer serviceable life.

Other species than those used in this study might also prove satisfactory. Information on serviceability of additional species is included in recent reports from Mississippi (3) and the Coordinated Wood Preservation Council (7).

In "bug peeling" of pine, insect activity would be expected to start earlier at lower elevations where temperatures are higher than on the Cumberland Plateau. The posts to be peeled probably should not be stacked near a pine plantation in order to avoid the danger of insect migration to the living trees.

Although no data are reported on square-sawed oak posts, many of these are being used at the Plateau Experiment Station. These posts, 3 x 4 inches x 7 feet, were made from low quality heartwood centers after the better grade lumber had been sawed from the log. The posts were stacked and dried as described above for round posts. When treating, (small) sticks were put between the post layers so the preservative solution could readily penetrate. They were left in the solution three days. Observations of treated sawed posts in field service indicate that their useful life is at least equal to that of treated peeled round posts of the same species.

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