Seasoning and Preservative Treatment of Tanoak

by

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OREGON FOREST PRODUCTS LABORATORY
State Board of Forestry and School of Forestry,
Oregon State College Cooperating
Corvallis

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SUMMARY

Tanoak ties were air seasoned from an initial moisture content of 100 per cent on an oven-dry basis to less than 30 per cent in 13 months without excessive checking. Both end checks (which appeared severe) and surface checks were short and overlapping. There was no tendency for the ties to split for any great distance from the ends. Ties placed in the seasoning yard during early spring probably can be seasoned to a moisture content between 30 and 40 per cent by fall. They should not be seasoned for more than one winter because of their thick sapwood and its low durability.

Some tanoak ties were completely penetrated with oil-type preservatives. Incising did not improve penetration in the heartwood, which is very resistant to treatment. The unincised sapwood can be treated uniformly with a wide range of retentions and with little or no danger of bleeding by varying the treating schedules. Low pressures and short pressure periods may be used on well-seasoned material.

SEASONING AND PRESERVATIVE TREATMENT OF TANOAK*

Tanoak, the second most abundant hardwood species in Oregon, is found only in the southwest corner of the State. The bulk of the timber is located in Curry County. Although the volume of tanoak saw timber (11 inch DBH and over) in this area has been estimated at 870 million board feet by a 1951 Forest Service Survey, there is good reason to believe that the actual volume may exceed 1 billion fbm; the combined tanoak sawtimber volume in Oregon and northwest California may well exceed 2 billion fbm.

This species, which ranks between red and white oak in strength properties, grows in mixed stands with Douglas-fir in Oregon, and redwood in California. Many of the trees range from 2 to 4 feet in diameter with clear bole lengths from 25 to 50 feet. At present it is cut for its bark, from which tannin is extracted, and the wood is left to decay on the ground. The sapwood appears to be extremely thick; the sapwood percentage may be as high as 66 per cent. No satisfactory method of differentiating between heart and sapwood has yet been devised.

Its strength properties and availability in large quantities should make tanoak a potential cross tie and shipbuilding material. Lack of information on its seasoning characteristics and treatability with preservative solutions prompted this investigation.

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* The author wishes to express his appreciation to Mr. E. H. Polk, Purchasing Agent, and his assistant, Mr. T. Kachin, who were instrumental in procuring the tanoak ties; and to Mr. Charles Adams, Treating Superintendent (retired) at Eugene, Oregon, Southern Pacific Company, and his assistants whose whole-hearted cooperation was essential in obtaining the seasoning and treating data.

SEASONING OF TANOAK TIES

Freshly sawn 8-foot tanoak ties were purchased by the Southern Pacific Company in June 1949 and trucked to their treating plant at Eugene, Oregon. One hundred twenty 7- by 9-inch ties were seasoned at Eugene (Figure 1) and twenty-three 6- by 8-inch ties were seasoned at Corvallis (Figure 2). Twelve of the smaller ties were incised prior to seasoning.

Twelve of the large ties and all of the small ties were weighed periodically. About half of the ties weighed were end-coated with filled gloss oil. The 7- by 9-inch ties were bored and check-bolted after they had been air seasoned for 4 weeks; the check bolts were retightened twice during the first summer.

Seasoning Results

The green ties seasoned from an initial moisture content of 100 per cent to less than 30 per cent in 13 months without the development of excessive checks or long splits. Decay developed in some ties within this period and became progressively worse with longer yard storage time.

Change in weight and moisture content

The tanoak ties lost weight rapidly during the summer months and continued to lose weight through October (Figure 3). During this period the average moisture content and weight changes were:

Tie size	Weight	Moisture content
Inches	Pounds	Per cent
7 by 9	243-185	105-55
6 by 8	175-133	90-40

The ties remained at a fairly high moisture content over winter, but by the following August the average moisture content of both groups was below 30 per cent.

As shown by Table 1, incising, end-coating, and covering of the ties had no appreciable effect on their seasoning.

Table 1. Change in Weight of Tanoak Ties During Air Seasoning from June 3 to October 4, 1949.

Tie size	Ties	Treatment	Average weight		Weight loss
			June 3	October 4	
Inches	Basis		Pounds	Pounds	Pounds
7 x 9	6	Uncovered, end-coated	243	184	59
	6	Uncovered, not coated	240	182	58
	12	Uncovered, all	-	-	58
	6	Covered, end-coated	248	195	53
	6	Covered, not coated	238	179	59
	12	Covered, all	-	-	56
Total	24	Covered and uncovered	242	185	57
6 x 8	6	Incised, end-coated	174	130	44
	6	Incised, not coated	177	133	44
	12	Incised, all	-	-	44
	4	Unincised, end-coated	167	131	36
	7	Unincised, not coated	180	135	45
	11	Unincised, all	-	-	40
Total	23	Incised and unincised	175	133	42

Physical appearance of ties

The end-checking pattern was well defined on the uncoated ties within two weeks. Although the end-coating did not retard the drying of the ties, it did delay the development of the end-checks. End checking was less severe in the 6- by 8-inch ties than in the 7- by 9-inch ties. This may be attributed to the closer piling of the smaller ties and to the less severe drying conditions that existed in Corvallis. The ties at Eugene were exposed to virtually continuous hot winds during the summer months.

On November 3, 1949, all of the 7- by 9-inch ties were weighed and examined to determine the characteristics of the seasoning defects. These defects are described in Table 2 and illustrated in Figure 4. The end-checking appeared to be severe, yet virtually all of these end-checks and other checks were short (the average maximum length of the checks on the sap face was 15 inches). Their average maximum width was 1/4 inch; only 3 ties had checks over 1/2 inch wide. The checks overlapped, which prevented the development of long splits.

The sap face tended to cup, but this cupping was not severe. Twist developed in 21 per cent of the ties, though in only 10 per cent of the ties was twisting moderate to severe. Twisting might be largely eliminated by the use of a piling method in which the ends of all ties bear the full weight of the ties above them.

Check bolting does not appear to have had any beneficial effect. Even though the check bolts were retightened, subsequent shrinkage provided sufficient freedom for the development of checks. Checks that did develop could not be closed by bolting.

Decay in ties

Sporophores were noticed on some of the 7- by 9-inch ties during the second winter. By October 1951, after 30 months of air seasoning, many of the ties contained sporophores; a thick mycelial mat had formed between a few ties where they were in contact. This fungus was identified as Lenzites betulina. Three of these ties (selected for various amounts of decay) were sectioned and their specific gravities were determined. Tie three (Figure 5), which appeared to contain the greatest amount of decay, had the highest specific gravity.

After 20 months of air seasoning, 80 per cent of the 6- by 8-inch ties were found to contain decay; zone lines generally were present. The decay in most of these ties was confined to small areas extending along the grain (Figure 5).

Table 2. Seasoning Defects in 120 Tanoak Ties after Air Seasoning from June 3 to November 3, 1949*

Characteristic	Dimension	Ties	Proportion of total
	Inches		Per cent
Type of tie			
Free-of-heart-center	--	48	40
Heart-center	--	72	60
Sapwood thickness			
Average of maximums	5	--	--
Range in thickness	1.5-7	--	--
Knot diameter			
Average of maximums	2	--	--
Over 3 inch	--	16	13
Wane	--	43	36
Checks on sap face			
Avg of max lengths	15	--	--
Maximum length	48	--	--
Over 24 inches long	--	12	10
Avg of max widths	1/4	--	--
Maximum width	1	--	--
Over 1/4 inch wide	--	24	20
Over 1/2 inch wide	--	3	2.5
End splits	--	4	3.0
Maximum length	14	--	--
Maximum width	5/8	--	--
Cupping	--	21	17
Over 1/4 inch deep	--	3	2.5
Twist	--	25	21
Slight	--	15	--
Moderate to severe	--	10	--

*Average weight - 184 lbs.

Average moisture content - 53 per cent

Seasoning Conclusions

1. Tanoak ties can be air seasoned without the development of serious checks and splits. The use of a piling method in which each tie bears the full load of the ties above may reduce twisting.
2. Checks are short and overlapping. End checks, though severe in appearance, extend for only a short distance into the ties. There was no tendency for ties to split.
3. Tanoak is not durable and is subject to decay within 1 year. Ties should not remain in the seasoning yard for more than one winter.
4. Incising of green ties, end-coating, and covering ties had little or no influence on either the rate of drying or character of final checking pattern.

PRESERVATIVE TREATMENT OF TANOAK TIES

Incised and unincised tanoak ties and tie sections were treated with both creosote-petroleum and pentachlorophenol in heavy solvent solutions. One group of ties (Charge T-1) was treated with a commercial Douglas-fir charge, while the tie sections were treated in an experimental plant. The treating schedules used are described in Table 3.

Penetration

Full-length ties and short tie sections frequently were penetrated completely by both the Lowry and Rueping processes (Figure 6). Penetration was limited largely to the sapwood, while heartwood penetration was erratic at best. Incising had little or no visible effect on penetration in either the sapwood or heartwood.

Both side and longitudinal penetration in the sapwood were good (as determined by soaking the side surfaces and ends of tie sections with Urac resin adhesive and covering with aluminum foil). Deep side-penetration can be expected in the sapwood of long timbers.

Table 3. Treating Schedules Used for Tanoak

Charge	Conditioning Period				Initial Air		Pressure Period				Final Vacuum		Total time
	Average temp	Total duration	Maximum vacuum	Duration of vac	Pressure	Duration	Average temp	Total duration	Max pressure	Time to max press.	Max vac	Duration	
	Deg F	Hr:min	Inches Hg	Hr:min	psi	Hr:min	Deg F	Hr:min	psi	Hr:min	Inches Hg	Hr:min	Hr:min
T-1**	200	5:00	-	-	40	0:45	200	1:45	150	-	24	2:00	10:40
T-2	180	0:30	-	-	-	-	205	0:30	75	0:30	25	1:00	5:10
							Pumped out Air Press.	2:00	120	0:15			
T-3	200	2:15	15	0:45	-	-	215	1:00	50	1:00	26	0:30	6:10*
T-4	220	2:30	18	2:00	-	-	225	1:15	60	1:15	25	0:30	6:00*
T-5	160	3:00	-	-	50	0:30	175	1:00	150	0:10	26	0:20	6:00

*Includes additional steaming and vacuum period.

**Tanoak treated in a charge of Douglas-fir.

Retention of preservative

Higher retentions (8 - 23 lb per cu ft) were obtained by the Lowry process than by the Rueping process (3 - 10 lb per cu ft) (Table 4). Pressures from 50 to 75 psi for periods of 1/2 to 1-1/4 hours were used with the Lowry treatments, while a pressure of 150 psi for 1 to 1-3/4 hours was used with the Rueping treatments.

Condition of the wood

The treating conditions used had no adverse effect on the tanoak ties. The ties treated by the Rueping process bled slightly; those treated by the Lowry process were dry regardless of the retention. The planed surface of a tie section, treated to a retention of 14 lb per cu ft with a penta solution, was found to be virtually oil-free.

Treating Conclusions

1. Air-seasoned tanoak sapwood can be readily penetrated by oil-type preservative in a wide range of retentions with low pressures and short pressure periods. Both side and longitudinal penetration are good.
2. Tanoak heartwood is very resistant to treatment.
3. Although incising is not required for treating the sapwood and did not obviously improve penetration in the heartwood, it nevertheless appears to be a desirable practice.
4. Tanoak can be treated with oil-type preservatives to produce a dry, non-bleeding product.

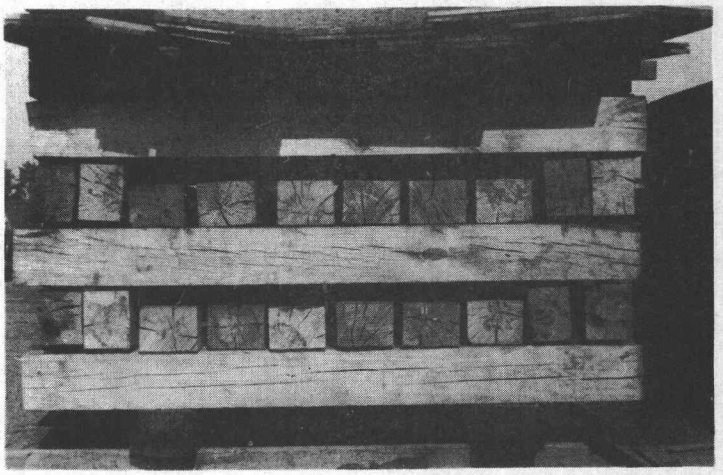
Table 4. Retentions Obtained in the Pressure Treatment of Tanoak.

Charge*	Ties	Size	Moisture content**	Incised or unincised	Retention	
					Average	Range
	Basis	Inches	Per cent		Pounds per cu ft	
T-1-R	6	7 x 8 x 96	26-38	Incised	5.9	2.8-10.5
	6	7 x 9 x 96	21-47	Unincised	6.0	3.9- 9.2
T-2-L	3	4 x 5 x 48	17-19	Both	15.0	12.4-17.3
T-3-L	6	4 x 4 x 60 and 4 x 6 x 60	25-33	Both	14.7	9.8-23.4
T-4-L	6	4 x 6 x 60	15-40	Both	12.9	8.5-16.0
T-5-R	3	6 x 8 x 36 and 6 x 8 x 48	18-24	Both	6.9	4.9- 8.2

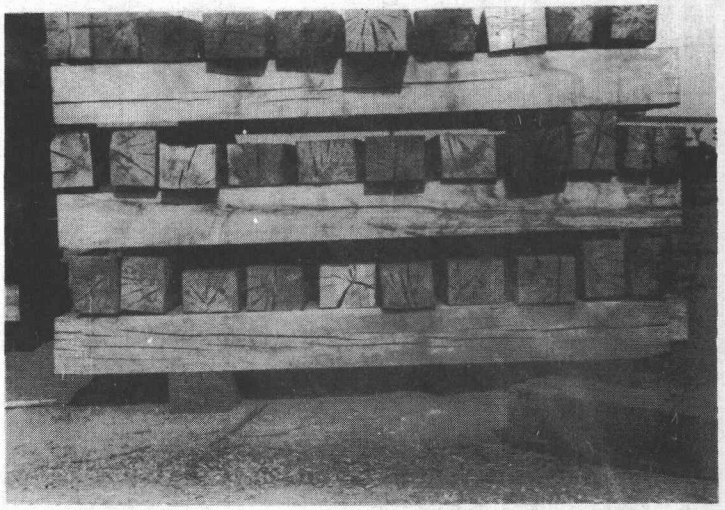
* R - Rueping

L - Lowry

** Using average specific gravity of 0.55, on an ovendry weight and green-volume basis.

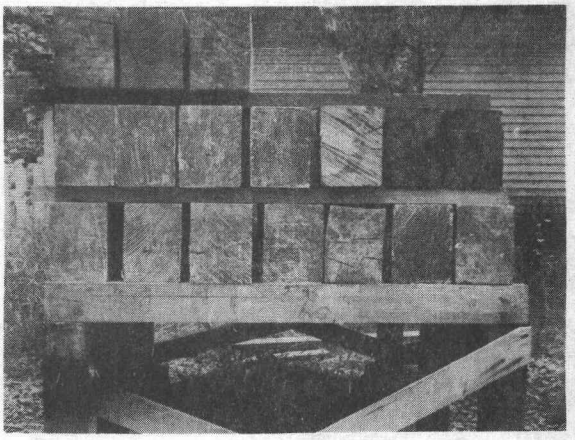


Covered Pile

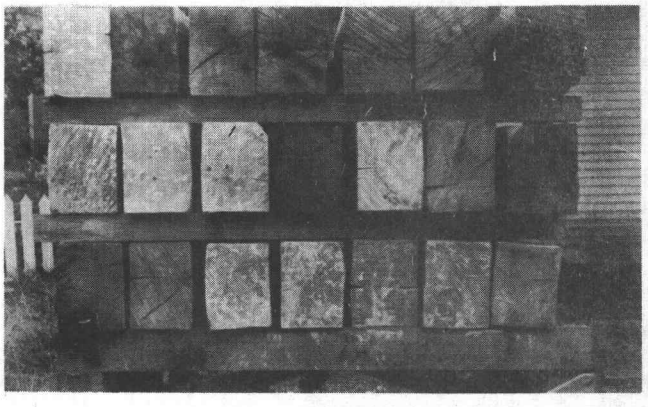


Uncovered Pile

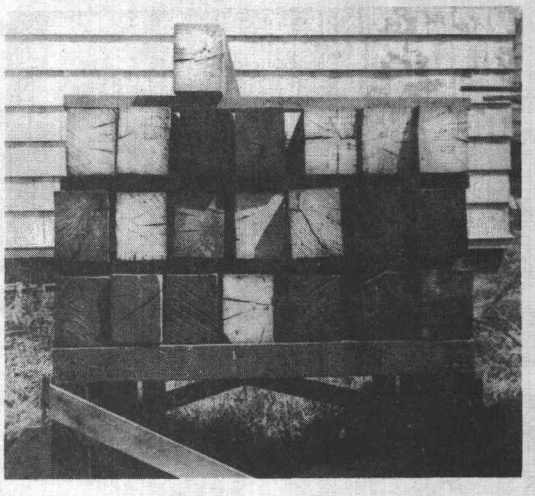
Figure 1. Appearance of 7- by 9-inch tanoak cross ties after air seasoning for 4 months. Average moisture content had changed from 105 to 55 per cent. Ties have been check-bolted.



June 23, 1949
Moisture content - 68 per cent

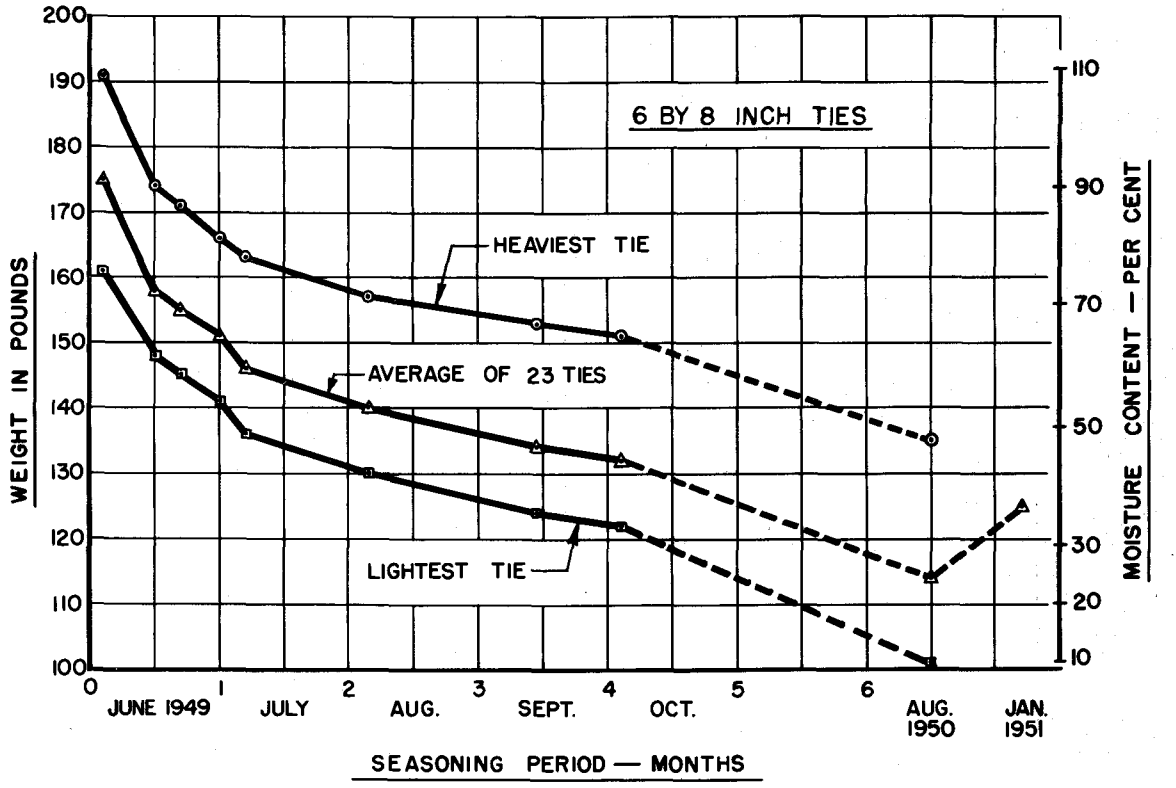


October 3, 1949
Moisture content - 43 per cent



August 15, 1950
Moisture content - 24 per cent

Figure 2. Appearance of 6- by 8-inch tanoak cross ties at different times during air seasoning. Initial moisture content on June 3, 1949, was 90 per cent.



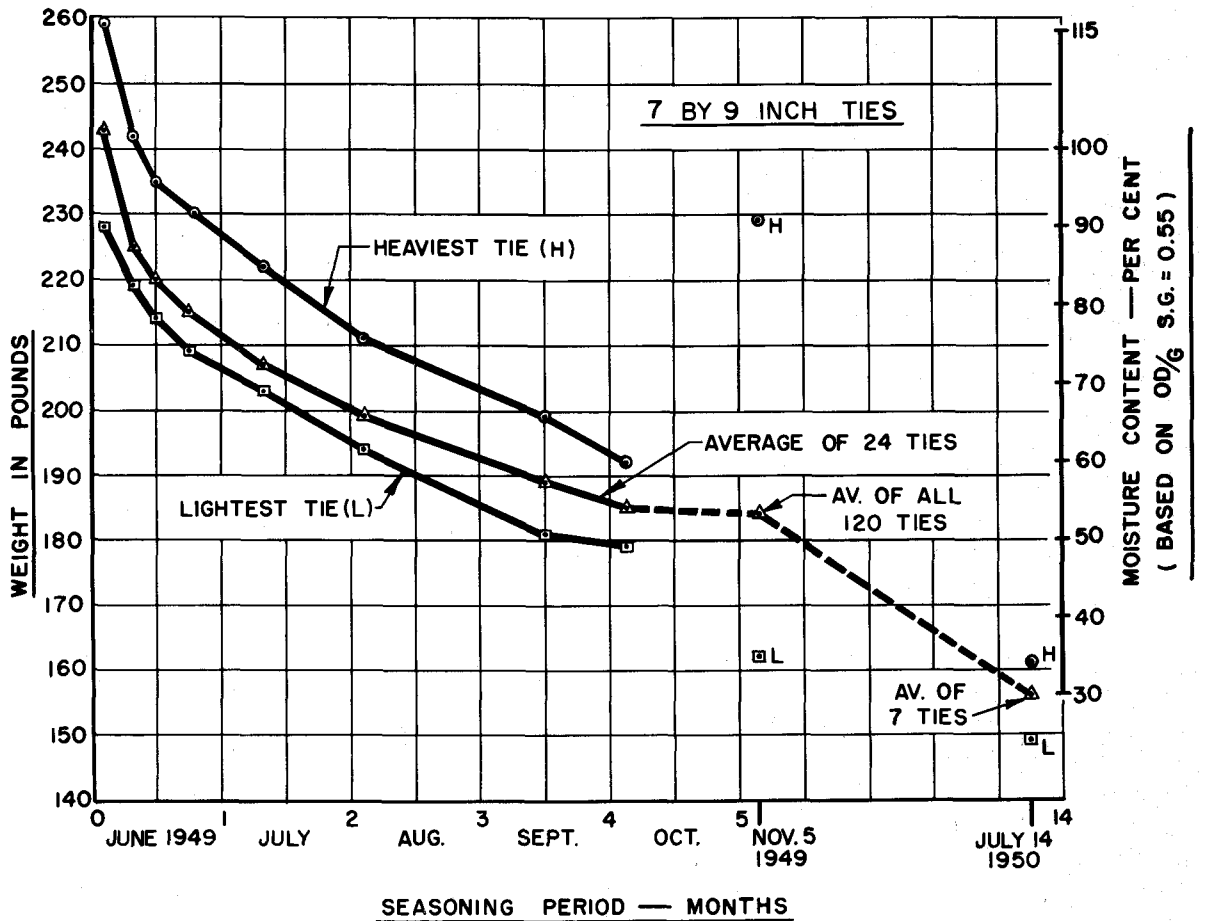
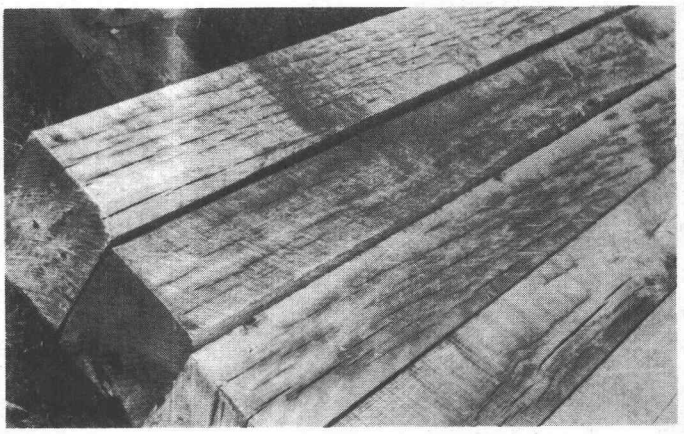
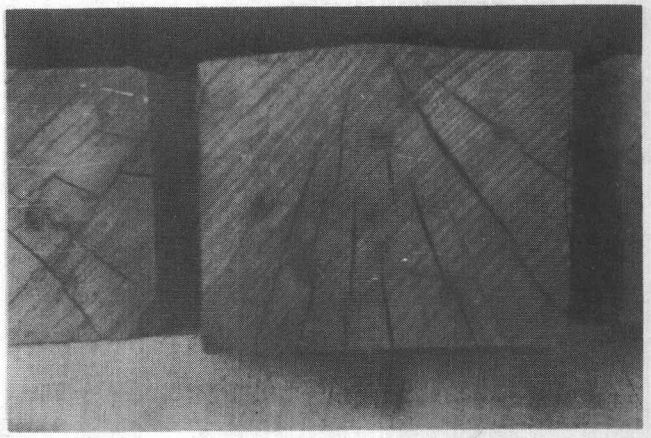


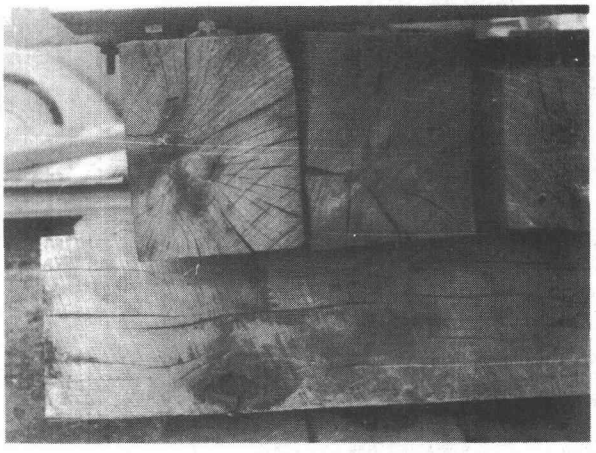
FIGURE 3. CHANGE IN WEIGHT OF TANOAK TIES DURING AIR SEASONING.



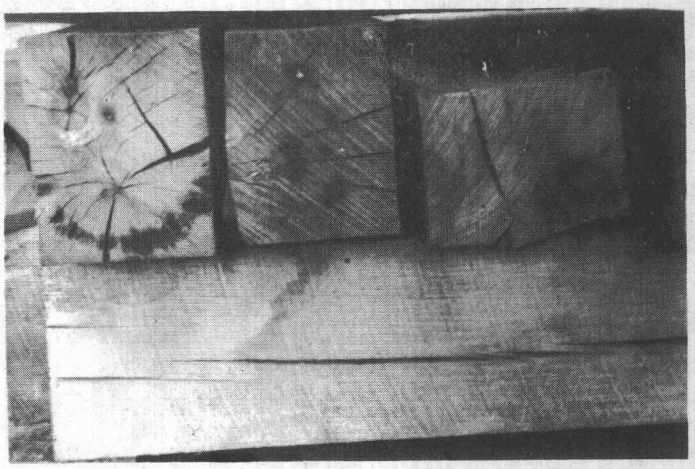
Surface checking on tie faces exposed to the direct rays of the sun.



Checking on end of tie, and small ridge on heart face.

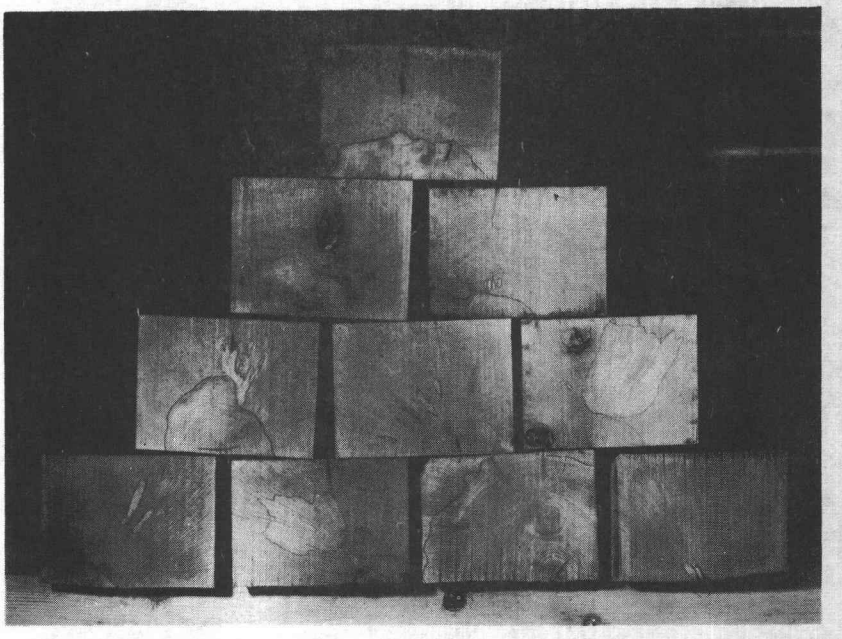


Checking on ends and face of ties. Middle tie, top row, has a slight ridge on heart face and cupping on sap face.



Typical end checks, which are quite short as shown on face of bottom tie.

Figure 4. Typical checking patterns in air-seasoned tanoak cross ties.



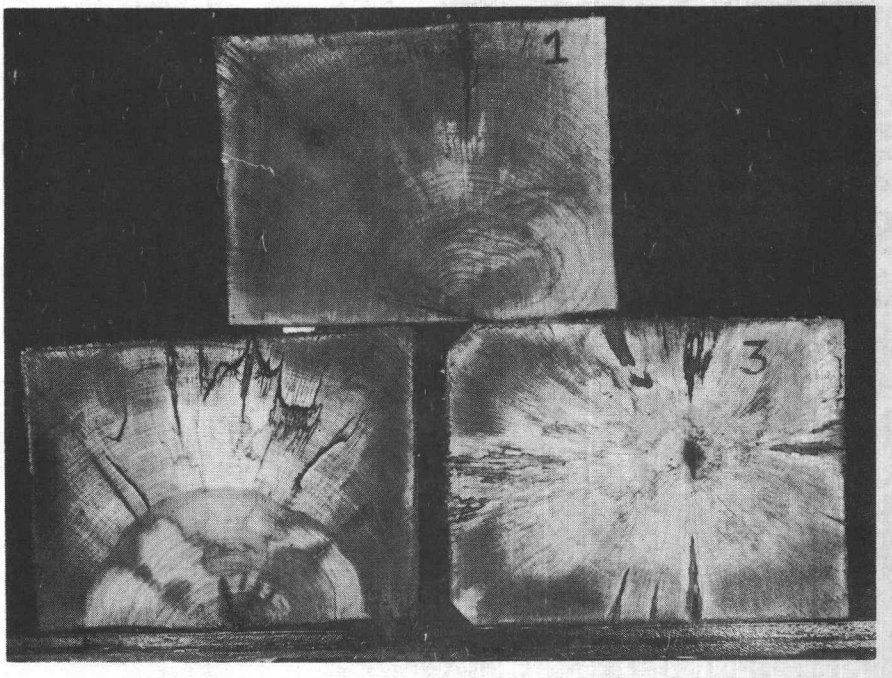
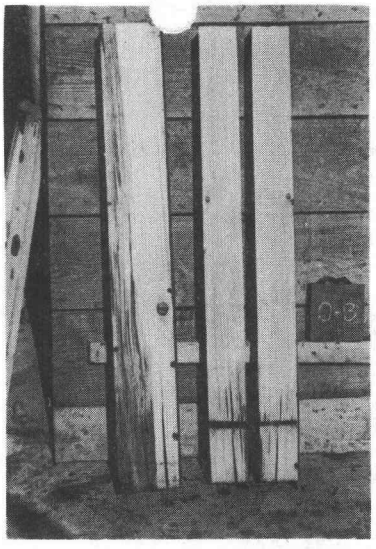


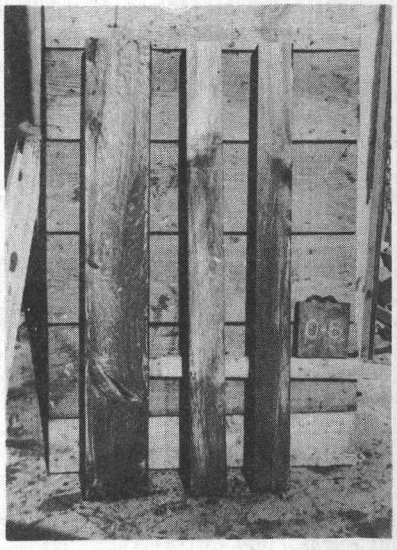
Figure 5. Decay in tanoak ties.

Upper. Decay in 6- by 8-inch ties after 20 months of air seasoning (decay and heartwood are outlined).

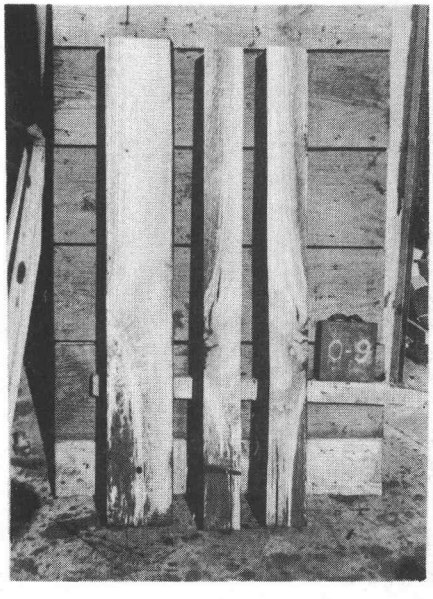
Lower. Decay in 7- by 9-inch ties after 30 months of air seasoning. Average specific values: 1-- 0.53; 2-- 0.52; and 3-- 0.60.



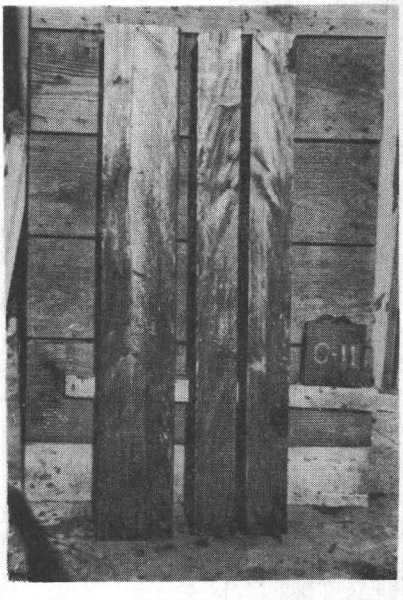
2.8 lb per cu ft



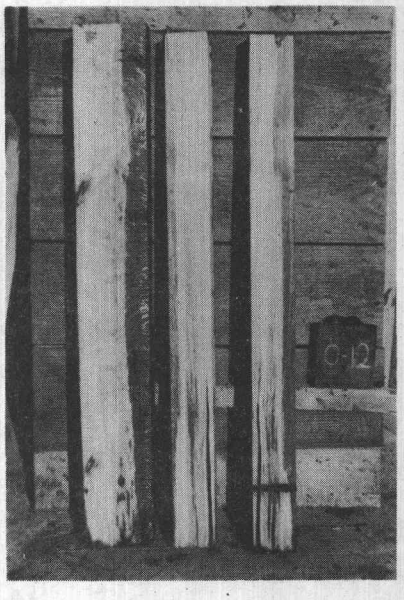
9.2 lb per cu ft



3.1 lb per cu ft



8.7 lb per cu ft



3.9 lb per cu ft

Figure 6. Penetration in incised (3) and unincised (8-12) tanoak ties treated by the Rueping process with a creosote-petroleum solution.