NEW ZEALAND STATE FOREST SERVICE.

CIRCULAR No. 19

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PRESERVATIVE TREATMENT OF FENCING-POSTS.

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Extract from the *New Zealand Journal of Agriculture*, April, 1925.

W. A. G. SKINNER, GOVERNMENT PRINTER, WELLINGTON.

[Reprinted from the *New Zealand Journal of Agriculture*, April, 1925.]

PRESERVATIVE TREATMENT OF FENCING-POSTS.

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FENCING-COSTS have risen to such heights during the last few years that they now form one of the major expenses of farm maintenance and improvement. Post and other timber prices have led the general upward tendency in the prices of construction materials, and reflect the serious depletion of our forest resources. Hitherto farmers have procured their fencing-posts from timber growing on the farm or in the immediate vicinity, but they are now becoming increasingly alive to the scarcity of naturally durable woods.

Many non-resistant species are available at comparatively low prices from the native forests and the farm plantations. Labour costs, however, form such a large proportion of the total fencing-charges that the use of these posts is a poor investment except for fences of a purely temporary character. This disadvantage may be overcome by so treating the posts with an approved wood-preservative that they are able to compare favourably and economically with posts of the more durable timbers. The treatment is a relatively simple one, and its principles easily understood. For those methods available to the farmer the equipment required is cheap and easily procurable. The use of ordinary care in its operation will render a high degree of efficiency in the treatment.

A similar position exists with reference to other farm timbers, such as service telephone and electric-power poles, foundation timbers, barn timbers, bridge timbers, wooden gates, windmill-frames, well-kerbing, &c. For the up-to-date and progressive farmer the preservative treatment of such material will conserve his wood-supplies and render a substantial saving in expenditure.

NATURAL DURABILITY OF TIMBER.

The destruction of wood by decay is due to low forms of plant-life known as fungi which use as food certain substances of the wood. These fungi consist for the most part of fine thread-like filaments which penetrate the wood-cells, disintegrating the wood substance and leaving behind the punky powdery residue so characteristic of decayed wood. In places the filaments grow out to the surface of the wood to form compact bodies, such as the bush fungus of commerce, frequently found growing on the trunks of both living and dead rimu, beech, tawa, mahoe, and other trees. They are an indication of advanced decay, and function as spore-producers, spores corresponding to the seeds of the higher orders of plant-life. Like these latter, they are distributed principally by the wind. Certain conditions of air, moisture, temperature, and food are necessary for their germination and the subsequent growth of the fungi. According to the control exercised over these factors, either by the nature of the wood itself or by the conditions under which it is used, will the natural durability be affected.

As the sap-wood of all trees contains a large amount of protoplasm, starch, and other essential plant-foods, it exhibits poor durability, seldom exceeding four years when in contact with the ground. The natural durability of heart-wood varies with the timber. It is considered to be determined largely by the presence of certain vital oils which prevent the growth of fungi.

DURABILITY OF NEW ZEALAND TIMBERS.

New Zealand has been fortunate in its supplies of durable fencing-timbers. Totara ranks first in importance, but is becoming increasingly scarce. Table 1 has been prepared to show the comparative durability of the chief commercial timbers, including both native and introduced woods. The figures given refer to posts cut from the heart-wood of sound and healthy mature trees grown and used under average conditions of soil and climate. The woods in Class 3 are generally used for temporary fences only.

Table 1.—Durability of the Principal Fencing-timbers used in New Zealand.

Class 1: Very durable—Puriri, silver-pine, totara, broadleaf, kowhai, hinau, kawaka, black-locust.

Class 2: Durable—Hard red and black beech, matai, jarrah, maire, kauri, *E. botryoides*, *E. eugenioides*, *E. Macarthuri*, *E. viminalis*.

Class 3: Not durable—Pukatea, rata, manuka, mangeao, mountain and silver beech, tanekaha, tawhero, kamahi, rimu, white-pine, rewarewa, taraire, tawa, miro, *E. amygdalina*, *E. coriacea*, *E. obliqua*, *E. globulus*. All thinnings and immature timber of the eucalypts in Class 2, and of pines, spruces, larches, and softwoods usually planted.

Users of posts are warned against drawing rash conclusions from these summarized data. The conditions of growth, the quality of the timber, and the conditions of use to which the figures apply must all be considered in studying the table.

CONDITIONS OF GROWTH.

Posts cut from immature and fast-growing trees generally exhibit little resistance to decay. The average range of life of even the durable species, such as ironbark, is only eight to twelve years. That of the remaining woods is reduced proportionately.

Late autumn and winter are the best seasons for felling trees. The timber then dries slowly and evenly, minimizing splits and checks, in which insects and fungi usually commence their destructive work. Insects are noticeably absent at this time of the year, and by late spring the wood will have dried sufficiently to resist the attack of these pests. Almost equal durability is obtainable from wood cut at other seasons of the year, but rigid precautions must be observed if excessive splitting and checking, and insect and fungal attack, are to be avoided.

INFLUENCE OF CLIMATE AND SOIL.

Climatic conditions in New Zealand are conducive to decay throughout the year. The climate is typically a temperate one. Except in a few localities there is a copious and well-distributed rainfall and a high atmospheric humidity, both of which produce conditions favourable to decay. Shrimpton (1) reports that the average life of Australian hardwood poles is greater in the dry localities on the east coast of the South Island than in wetter and more humid districts. Crawford (2) confirms this statement, finding that the same species give a higher average life in the dry, far west of New South Wales than in the wetter coastal regions.

Decay is most active near the ground-line, where the wood is continually damp through contact with the wet ground. In damp clayey soils the decay extends only 2 ft. to 3 ft. below the surface, but in loose and sandy soils, where the air-supply is better, it may reach to depths of 5 ft. to 6 ft. Post-tops, joints in framed timbers, and other points where water collects also exhibit serious decay. In the presence of excessive moisture, however, decay cannot proceed, as illustrated by the kauri and silver-pine logs which are being recovered from swamps in which they have been buried for hundreds of years.

RELATIVE DURABILITY OF GREEN AND SEASONED TIMBER.

Hicks (3) and other authorities (4) report that the natural durability of untreated wood is slightly greater for timbers set green than for those placed after seasoning, a view which is supported by Shrimpton (1) as a result of his experience with poles in New Zealand. This may be explained by the fact that whatever the moisture content of the timber when first placed, that portion below the ground-line must ultimately come into equilibrium with the moisture content of the surrounding soil. By placing the post or timber when green, splits and checks will be largely eliminated at the ground-line, thus avoiding a condition favourable for decay.

PRINCIPLES OF WOOD-PRESERVATION.

In commercial timber - treating practice natural durability is improved by injecting antiseptics to poison the wood substance upon which the fungi live. Except in the case of a few porous woods it is impracticable to impregnate the wood throughout, it being the usual practice to create an outer protective envelope around the untreated interior wood. It is generally assumed that the increased durability due to any treatment will be in approximate ratio to the depth of penetration and to the amount and permanency of the preservative employed. Since it is difficult to treat the heart-wood of most timbers, the natural round post is the most satisfactory form of timber for treatment. Where the heart-wood is naturally durable, however, split and sawn posts containing a proportion of sap-wood may be treated with advantage. The financial saving due to a preservative treatment is obviously greater when applied to a non-durable wood than to a durable timber.

The important wood-preservatives fall into two general classes—coal- and wood-tar derivatives, such as creosote, carbolineum, &c.; and mineral salts, such as zinc chloride, sodium fluoride, &c. The latter, being water-soluble salts, are not suitable for fencing-post work in New Zealand unless employed in conjunction with creosote oil, crude petroleum, &c., which will resist the natural tendency of our rainfall to leach out the preservative and render the wood non-resistant to decay. The two factors governing the value of a preservative are toxicity and permanency, but these are not often possessed by the same material. For this reason, and on account of the rising costs of creosotes, increasing attention is being paid to the use of such mixtures as creosote and crude petroleum, and zinc chloride and crude petroleum.

PREPARATION OF WOOD FOR TREATMENT.

Except for pressure processes all timber should be thoroughly seasoned before treatment. Care must be exercised to prevent insect and fungal attack during this period. The primary objects of seasoning are to facilitate the penetration of the preservative and to prevent the exposure of untreated wood by checking and splitting after the timber has been treated. All framing—that is, cutting, notching, boring, &c.—of timbers should be done before treatment, otherwise subsequent framing will expose untreated wood, which will require further protection.

METHODS OF APPLYING PRESERVATIVES.

Impregnation under pressure is the most satisfactory method of treating wood with preservatives. Pressure plants are seldom available for farm use, but, where possible, should be used, as they give a more efficient and economical treatment.

The open-tank process is the most effective method of treatment for farm use. Although referred to as a non-pressure process, it uses atmospheric pressure to secure impregnation of the wood. The posts are heated for a certain period in a hot bath of the preservative maintained at a temperature of 180° to 200° F. This has the effect of partially expanding and driving out the air and moisture in the wood. On transferring the posts to a cold bath of the preservative maintained at a temperature of 90° to 100° F., or on allowing the hot bath to cool, the air and moisture in the wood contract and the atmospheric pressure forces the preservative into the timber. Except in the case of a few easily treated woods, there is little absorption of the preservative during the hot bath. The periods of immersion in the hot and cold baths vary with the species.

A few porous woods such as *Pinus radiata (insignis)* and *P. muricata* may be successfully impregnated by soaking in a bath of the preservative at ordinary air-temperatures, but the timber must be particularly well seasoned.

In the dipping process the wood is immersed for a period of from five to fifteen minutes in a hot bath of creosote maintained at a temperature of 180° to 200° F. For this treatment the timber requires to be not only thoroughly seasoned but also free of any surface moisture due to rain, dew, &c. Some porous woods are impregnated to a depth of 1 in. by the dipping process, but generally the penetration is small, although most checks and splits are well covered with the preservative.

A brush application of hot creosote or carbolineum is the simplest treatment available for the farmer. The treatment should be in the nature of a swabbing or mopping of the preservative over the wood, rather than a mere painting application. This tends to fill checks and splits which are otherwise unprotected. The presence of superficial moisture is fatal to the process. Two coats are usually applied, the first being allowed to dry before the application of the second.

ABSORPTION AND PENETRATION.

The amount of preservative absorbed by the sap-wood varies with the timber, the pines absorbing as much as 30 lb. per cubic foot of wood, and the eucalypts only 15 lb. per cubic foot. A minimum absorption of 20 lb. per cubic foot for pines and of 10 lb. per cubic foot for eucalypts is recommended for the butt treatment of posts. For the upper portion of the posts the minimum absorption should be at least half that recommended for the butt treatment.

For posts and other timbers in contact with the ground it is preferable that the whole of the sap-wood and as much of the heart-wood as possible be impregnated, but this is sometimes difficult to accomplish, and impossible on the score of economy. The minimum penetration recommended by the Forest Service is 1 in.

HOW TO PRESERVE FENCING-POSTS AND OTHER FARM TIMBERS.

Only sound wood free from decay is suitable for treatment. Once started, decay is not necessarily stopped by the preservative, but may continue to destroy the interior of the wood beneath the treated portion. It is necessary to bark or peel all round forms of timber immediately after felling, preferably in the winter, otherwise fungi and wood-boring insects quickly commence their destructive activities beneath the loose pieces of bark, where the moisture tends to collect, and where conditions are favourable for rapid decay. The removal of the thin inner bark of the wood is important, as comparatively small particles prevent penetration of the preservative, and their removal after treatment exposes a surface of untreated wood through which decay enters.

Fence-posts are best seasoned by open piling, as shown in Fig. 1, in a shady yet exposed locality where there is ample circulation of air both beneath and through the whole pile. Damp ground and both living and rotting vegetation are to be avoided. Too rapid seasoning damages timber by excessive splitting, &c. This applies particularly to locally grown Australian hardwoods.

Poles and large structural timbers which show a tendency to split are best protected by the use of S-shaped irons, which are driven into the wood across the incipient splits to hold the timber in place. They are to be purchased for a few pence each. End coatings, such as coal-tar, pitch, and petroleum residue, effectively prevent end-checking.

Under favourable conditions posts season sufficiently for treatment in from 60 to 180 days, according to the species and to the period of the year. Only the sap-wood or that portion to be treated requires to be thoroughly seasoned. By weighing a few specimen posts at regular intervals the state of seasoning is obtainable with fair accuracy. When the weights remain fairly constant during two weeks of good seasoning-weather the posts are dry enough to treat. A glazed appearance on the surface of the posts is a sign of case-hardening, which seriously retards penetration. It is remedied by shaving off the hardened surface for a distance of 6 in. above and below the ground-line.

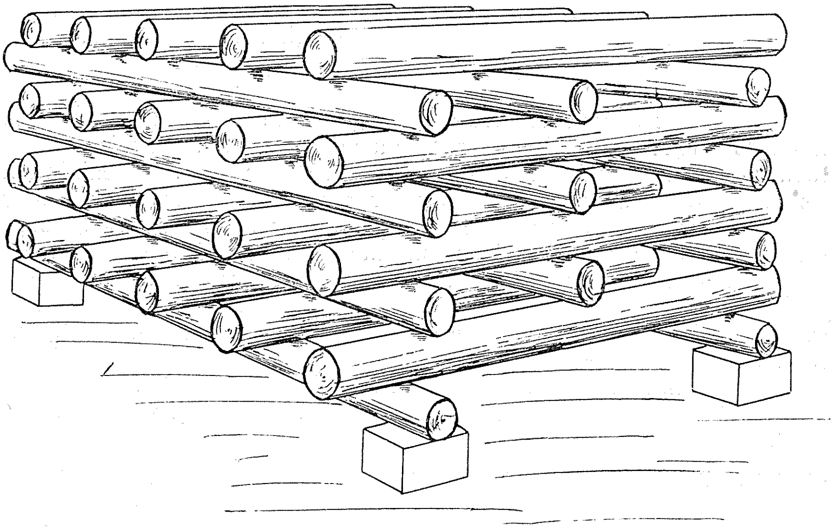

FIG. I. SHOWING METHOD OF OPEN PILING OF POSTS FOR SEASONING.

PRESERVATIVES. (SEE APPENDICES FOR SPECIFICATIONS.)

For general farm-work a good grade of creosote containing a low percentage of low-boiling oils is recommended. Either the British Standard Specification or any of the three grades specified by the American Wood-preservers' Association can be used with confidence.

Carbolineums are generally proprietary preservatives containing higher-boiling oils than the creosotes. They are invariably higher in price, but only for brush or spray treatments are they superior to creosote. The American Wood-preservers' Association's specification is recommended to consumers of this class of preservative.

A number of vertical-retort creosotes are now available on the New Zealand markets, and in the absence of a standard specification the Forest Service will shortly issue a tentative specification. These preservatives are superior to both ordinary creosote and carbolineum, both from the point of view of toxicity and of permanence.

Coal-tar is not recommended as a wood-preservative, as more harm than good is likely to be done if the timber is not thoroughly dry. Nevertheless Bradley (5) has successfully treated *Pinus radiata* posts by soaking them in a hot solution of this material.

CONSTRUCTION OF TREATING PLANTS.

The same plant may be used for the open-tank, soaking, dipping or painting process. The simplest equipment consists of a 90-gallon steel oil-drum measuring approximately 3 ft. 4 in. in height and 2 ft. 4 in. in diameter. These drums may be purchased from benzine companies at an approximate cost of 30s. One end is knocked out, and the drum filled with about 40 gallons of creosote or other preservative. In order to keep the posts from floating in the creosote it is well in a plant of this type to use a false bottom in each drum. This can be readily made out of the heads cut from the drums or any flat piece of iron, by riveting on strips of iron through which several screws protrude. The screws stick into the posts and prevent them from moving about in the creosote. The drum is placed over a fire-trench in the ground, a fire lighted, and the preservative heated up to a temperature of 200° F. The posts are placed with the butt ends in the tank and given the requisite hot bath, at the conclusion of which the fire is withdrawn and the posts allowed to cool off until the desired penetration and absorption have been obtained. The posts are next upended and the tops given a somewhat lighter treatment. If two of these drums are provided, one for the hot bath and one for the cold bath, the process can be carried on continually, without the necessity of waiting for the cooling of the hot bath.

Much economy of time, effort, and material is secured by the use of a long open tank in which the complete post can be immersed. The tank is constructed either of wood or of steel, according to the way in which the equipment is to be used. If it is to be employed for the cold bath alone, then it can be constructed of wood throughout, as shown in Fig. 4, the heating of the bath to 90° F. being secured by the addition of quantities of heated creosote, &c. On the other hand, if it is desired to use the tank for both hot and cold baths, then it is impossible to use this construction unless steam heating from a traction or other boiler is available. An alternative construction uses framing-quality timber and a soldered galvanized-iron lining. Where only direct heating is available the tank is constructed of iron plate.

For the treatment of boards and scantling a tank of this description 18 ft. long is of the greatest value on the farm. The handling of the material is greatly facilitated by the provision of some form of overhead gear whereby posts, timbers, &c., may be loaded and unloaded in cages into the tanks. This is a matter best left to the ingenuity of the operator. A handy arrangement for the handling of small quantities of timber consists of a number of wire ropes. One end of each rope is attached to one side or other of the tank, the other end remaining free. By laying these wires across the tank the timbers may be raised or lowered at will. In a similar manner a number of iron or wood straps are required to keep the wood below the surface of the preservative.

Unless covers are provided the tank should be deep and narrow rather than shallow and wide. An adequate drainage-platform or tank economizes the use of the preservative. It is a necessary adjunct to the simplest plant, even with the brush treatment, where swabbing is preferable to mere painting. A portable plant operated on the co-operative principle by a number of farmers appears to be the most economical type of equipment for this work.

An 18 ft. tank similar to those shown in Fig. 4 costs approximately £20. In $\frac{1}{8}$ in. iron the cost is approximately £30. Suitable substitutes will naturally suggest themselves to the farmer. Old boilers, water-troughs, hydraulic piping, and other such articles have all been pressed into the service of the wood-preserver.

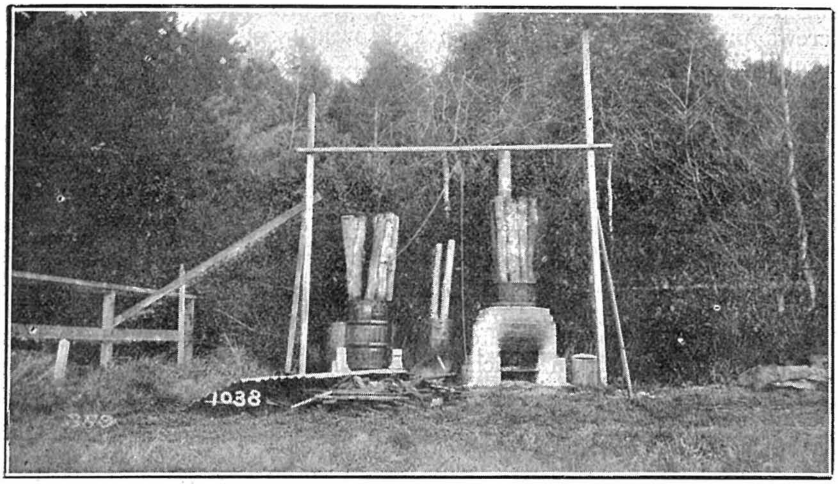

FIG. 2. OPEN TANK FOR BUTT TREATMENT.

A fire-trench in the ground can be used in place of the brickwork, as described in the text.

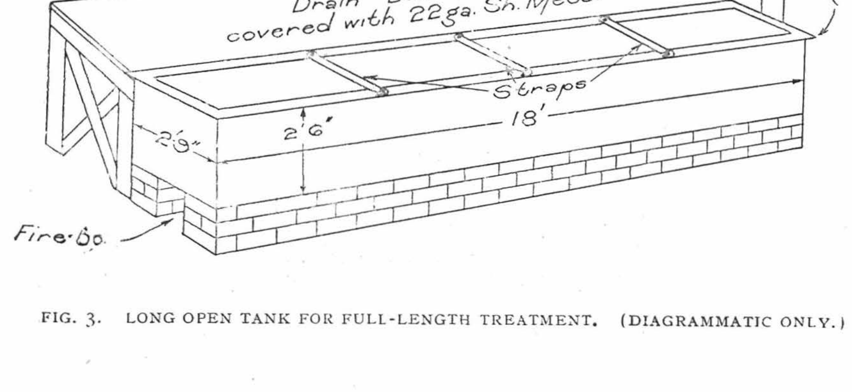

FIG. 3. LONG OPEN TANK FOR FULL-LENGTH TREATMENT. (DIAGRAMMATIC ONLY.)

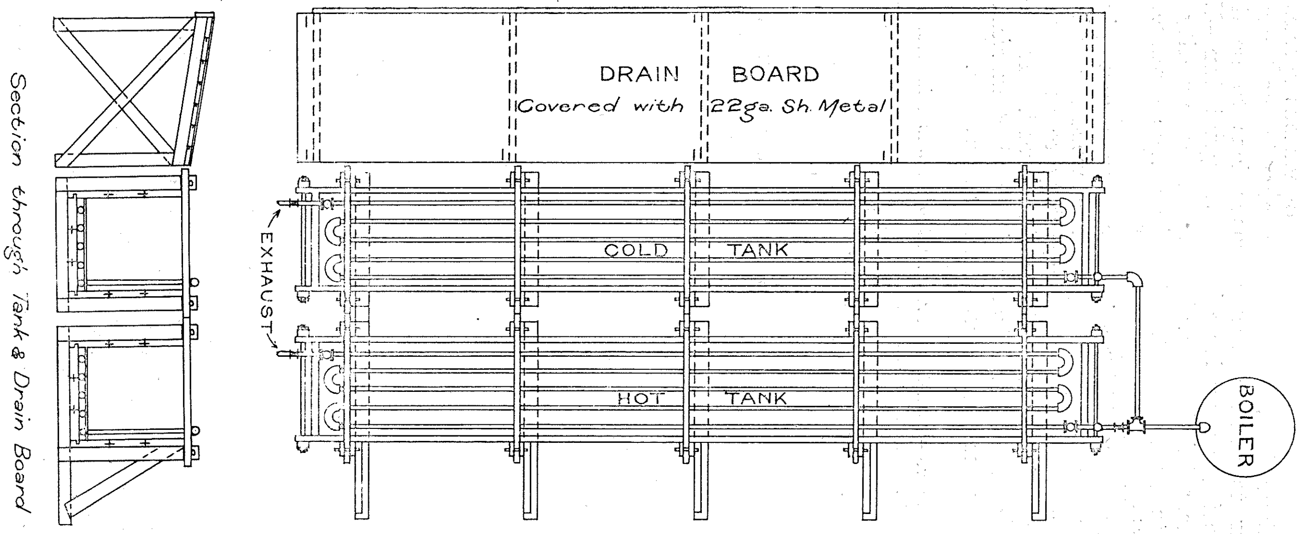

FIG. 4. SECTION OF LONG WOODEN TANK.

OPERATION OF PLANT.

The Forest Service has investigated the non-pressure treatment of fencing-posts cut from the thinnings of various species growing in the Rotorua plantations, but the tests have in most cases been too few in number to allow any final conclusions to be drawn. The work was done in co-operation with a Wanganui firm—New Zealand Coal-tar Products (Limited) which donated a quantity of creosote corresponding to Grade 2 of the American Wood-preservers' Association's specification.

For general guidance Table 2 has been drawn up to give an indication of the treatment required by various woods, but frequent tests of penetration and absorption are necessary to adapt the treatment to the varying physical characteristics of the wood. In the case of the more porous woods, such as *Pinus radiata* and *P. muricata*, the times of treatment may possibly be considerably shortened.

Table 2.—Open-tank Treatment of Exotic Timbers.

Species.	Butt.		Top.	
	Hot Bath.	Cold Bath.	Hot Bath.	Cold Bath.
	Hours.	Hours.	Hours.	Hours.
Pinus Murrayana	1	1	..	1
P. muricata	1	2	..	2
P. pinaster	1½	3	..	3
P. radiata	1½	3	1½	1
P. Laricio	1½	3	..	1
P. Austriaca	2	4	2	4
Larch (on two successive days)	8	16	8	16
Eucalypts	2½	3	2½	3

P. Austriaca was the most difficult of the pines to treat. Larch was difficult to impregnate, and the results indicate that the English practice of two series of hot and cold baths of eight and sixteen hours respectively are required for effective treatment. All the eucalypts examined, including *E. ovata*, *E. risdoni*, *E. coriacea*, and *E. amygdalina*, required approximately the same treatment. Stephens (6) finds that other eucalypts respond to this treatment.

Absorptions are best measured by weighing sample posts before and after treatment, and penetrations by drilling auger-holes several days after treatment, as the creosote has a tendency to spread even after extraction from the cold bath. The auger-holes require to be stopped with creosoted plugs. The treatment must be varied until the desired absorptions and penetrations are obtained. If the penetration is not sufficient, either the hot or the cold bath should be lengthened; whereas with a satisfactory penetration accompanied by too heavy an absorption the cold bath should be shortened. To secure the best results the temperature of the hot bath should increase slowly up to the maximum. Fluctuations of temperature should be avoided.

For those timbers requiring the same treatment for both butt and top the posts are completely immersed in both the hot and cold baths. Where the top requires a cold bath alone, only the butt is given a hot bath, the whole post being later immersed in the cold bath. Sometimes, as in *Pinus radiata,* the top requires a shorter cold bath than the butt. This is conveniently secured if the depth of the long tank is sufficient to allow the post to be stood upright at the end of the period required for the treatment of the top. Any of these treatments can be secured by the use of the round or long flat tanks such as are shown in Figs. 2 and 3.

Particular care is necessary to prevent creosote spilling over on to open fires, with consequent loss of posts and equipment.

CARE OF TIMBER AFTER TREATMENT.

Treated timber requires careful handling so that the treated envelope of wood remains unbroken. Exposure of any untreated wood, either by cutting or by accident, should be remedied by applying several coats of hot preservative. If posts are not used immediately after treatment they should be piled well off the ground—in close piles if completely treated, but in open piles if only the butt has been preserved.

In setting the posts the heavily treated butt portion should extend at least 6 in., and if possible 12 in., above the ground.

EXTRA LIFE DUE TO TREATMENT.

Unfortunately, there are few authoritative records available regarding the relative durability of treated and untreated fence-posts in New Zealand. The New Zealand Railways creosoted a large number of rimu and white-pine sleepers over twenty years ago, and many of them lasted for as long as fourteen years, the chief cause of removal being mechanical failure rather than decay. Bradley (5) has also treated *Pinus radiata* with good results. Weiss (7), one of the recognized American authorities on the subject of wood-preservation, has estimated the life of treated and untreated posts as follows: Untreated, five years; brush-treated creosote, nine years; dipped creosote, eleven years; impregnated with creosote, twenty-one years. The records of the German Post and Telegraph Department over a period of fifty years show that creosoted pine poles (pressure treated) have an average life of 20·6 years.

COST AND VALUE OF TREATMENT.

The chief item of cost in the treatment of fencing-posts is the preservative. The average range of prices in the main New Zealand centres for the principal preservatives purchased in bulk is as follows, the lower values referring to locally made products, the upper to imported materials: Creosote, 1s. 6d. to 3s. per gallon; carbolineum, 2s. 6d. to 5s. 6d. per gallon; vertical-retort creosote, 1s. 6d. to 7s. 6d. per gallon. Freight charges to the farm make the cost somewhat higher.

The cost of applying the preservative is difficult to estimate, as opportunities of using labour already employed, cost of fuel, &c., all require consideration. Operating under the most exacting conditions as regards the allocation of costs, it is not likely that they will amount to more than 3d. per post.

The amount of creosote absorbed varies with the species and the treatment. Table 3 has been prepared to show the volume of preservative absorbed by various-sized posts, adopting a minimum penetration of 1 in., and a minimum absorption for pines, larch, &c., of 20 lb. per cubic foot of treated wood for the butt portion and of 10 lb. per cubic foot for the top portion, and for eucalypts of 10 lb. per cubic foot for the whole post. All posts are 6 ft. in length.

Table 3.—Volume of Treatable Wood and Amount of Creosote absorbed per Post.

—	Minimum Penetration.	Average Absorption in Pounds per Cubic Foot.	Diameter of Post. 4 in.	5 in.	6 in.	7 in.
	Inches.					
Volume of treatable wood ..	1	..	..	..	..	..
Cubic feet	..	..	0·4	0·5	0·65	0·8
Absorption by pines ..	1	15	..	..	..	..
Gallons	..	..	0·6	0·8	1·0	1·2
Absorption by eucalypts ..	1	10	..	..	..	..
Gallons	..	..	0·4	0·5	0·65	0·8

Example 1: Given that *Eucalyptus ovata* posts can be cut and delivered from the farm plantation for 6d. per 5 in. post, and that creosote is delivered for 1s. 8d. per gallon, estimate the total cost of a treated post using the above-quoted minimum penetrations and absorptions—

	s. d.	s. d.
Cost of post delivered at plant		0 6
Cost of treating—		
Labour	0 3	
Creosote (volume equals ½ gallon, costing 10d.) ..	0 10	
		1 1
Total		1 7

RELATIVE COSTS AND SERVICE CHARGES.

The fundamental problem of farm economics is that of investment, and in choosing between treated and untreated posts an analysis of the relative investment costs based on compound-interest calculations is necessary if sound judgment is to prevail. Comparisons are best made on the basis of annual service charges, which are determined by the sinking-fund method. These annual service charges represent the equal annual payments which at annual compound interest will provide for renewal at the end of the life of the post without any scrap value for the post. They are determined by the formula :—

$$\frac{CR(1 + R)^n}{(1 + R)^n - 1}$$ where C = final cost of post in place, R = rate of interest (5 per cent. = 0·05), n = life of post in years.

Table 4 has been compiled from this formula to show the annual service charges on a post costing 1s. set in place, with interest at 5 per cent. The table may be applied to give annual service charges on posts of other values by simple multiplication.

Example 2: What is the annual service charge for a post costing 1s. 7d. treated, *plus* 1s. to set (see previous example), and having an estimated life of fifteen years? Table 4 shows that the annual service charge for a post with a life of fifteen years and costing 1s. set in place is 0·097s.

Table 4.—Annual Service Charges on Posts costing 1s. in Place. Interest at 5 per Cent.

Computed from the formula :—

$\frac{CR (1 + R)^n}{(1 + R)^n - 1}$ where C = final cost of pole in place, R = rate of interest (5 per cent. = 0·05), n = life of post in years.

Life in Years.	Annual Cost.	Life in Years.	Annual Cost.	Life in Years.	Annual Cost.
	s.		s.		s.
1	1·050	11	0·121	21	0·078
2	0·504	12	0·113	22	0·076
3	0·367	13	0·107	23	0·074
4	0·282	14	0·101	24	0·073
5	0·231	15	0·097	25	0·071
6	0·197	16	1·092	26	0·070
7	0·173	17	0·089	27	0·069
8	0·155	18	0·086	28	0·067
9	0·141	19	0·083	29	0·066
10	0·130	20	0·080	30	0·065

The annual service charge for a post costing 2s. 7d. in place is 0·097 × 2·6, equals 0·252s., or approximately 3d.

By estimating the initial costs and lives of the treated and untreated posts and determining their annual service charges a fair approximation of the economics of the problem may be obtained.

Example 3: Ascertain if the treated *Eucalyptus ovata* post of the two previous examples is cheaper to use than a totara post costing 3s. with an estimated life of thirty years.

	Totara.	*E. ovata.*
	s. d.	s. d.
Cost of post	3 0	0 6
Cost of treatment	..	1 1
Cost of setting	1 0	1 0
Total cost	4 0	2 7
Life (years)	30	15
	0·065 × 4	0·097 × 2·6
Annual service charge	0·26s.	0·25s.

The *Eucalyptus ovata* is thus slightly cheaper to use.

CONCLUSIONS.

Preservative treatment makes available for fencing purposes many timbers hitherto regarded as unsuitable for such work. Other farm timbers may also be treated with advantage, a variety of preservatives other than creosotes being available for this class of treatment. Owing to the lower costs of these preservatives the economy to be effected in the treatment of such timbers is generally greater than can be attained with fencing-material. A further article will be contributed dealing with these methods of treatment.

APPENDICES.

(1.) BRITISH STANDARD SPECIFICATION FOR CREOSOTE FOR THE PRESERVATION OF TIMBER.

This specification covers the requirements of creosote suitable for the treatment of railway-sleepers and telegraph, telephone, and hangar poles.

Type A.

(1.) The material shall consist essentially of a distillate of coal-tar, and shall be free from any admixture of petroleum or similar oils.

(2.) The specific gravity shall be not less than 1·015 and not more than 1·07 at 38° C. (100° F.) when compared with water at the same temperature.

(3.) The material shall become completely liquid on being slowly warmed to 38° C. (100° F.) with stirring, and on cooling down shall remain completely liquid after standing for two hours at 32° C. (90° F.).

(4.) The amount of water in the creosote shall not exceed 3 per cent.

(5.) When 100 c.c. measured at 38° C. (100° F.) of the dry creosote are distilled from a 250 c.c. distillation-flask at such a rate that the distillation is complete in about twenty minutes, there shall distil at 760 mm. pressure—Up to 205° C. (401° F.), not more than 7 c.c. ; up to 230° C. (446° F.), not more than 40 c.c. ; up to 315° C. (599° F.), not more than 78 c.c. : the volume of all fractions being measured at 38° C. (100° F.). The residue above 315° C. (599° F.) shall be soft and not sticky, and its weight shall be not less than 22 grms.

(6.) The amount of tar acids shall be not less than 5 per cent. and not more than 16 per cent. by volume.

(7.) The amount of matter insoluble in benzol (benzene) shall not exceed 0·4 per cent. by weight.

Type B. Alternative for Scotch Creosote.

(1.) Scotch creosote shall conform to the above specification with the following exceptions :—

(2.) The specific gravity shall be not less than 1 at 38° C. (100° F.). In the case of the blast-furnace oil the specific gravity may be lower, but shall not be less than 0·940 at 38° C. (100° F.).

(3.) The distillate at 315° C. (599° F.) shall be not more than 85 c.c., and the residue not less than 15 grms.

(4.) There shall be no upper limit to the amount of tar acids.

(2.) AMERICAN WOOD-PRESERVERS' ASSOCIATION STANDARD SPECIFICATION FOR CREOSOTE OIL FOR TIES AND STRUCTURAL TIMBER FOR OPEN-TANK TREATMENT.

(1.) The oil shall be distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements :—

(2.) It shall not contain more than 3 per cent. of water.

(3.) It shall not contain more than 0·5 per cent. of matter insoluble in benzol.

(4.) The specific gravity of the oil at 38° C. compared with water at 15·5° C. shall be not less than 1·03.

(5.) The distillate, based on water-free oil, shall be within the following limits :—

	Grade 1.	Grade 2.	Grade 3.
Up to 210° C., not more than ..	5%	8%	10%
Up to 235° C., not more than ..	25%	35%	40%

(6.) The residue above 355° C., if it exceeds 5 per cent., shall have a float test of not more than 50 seconds at 70° C.

(7.) The oil shall yield not more than 2 per cent. coke residue.

(8.) The foregoing tests shall be made in accordance with the standard methods of the A.W.P.A.

(3.) AMERICAN WOOD-PRESERVERS' ASSOCIATION STANDARD SPECIFICATION FOR HIGH-BOILING OR ANTHRACENE OIL FOR BRUSH OR SPRAY TREATMENT.

(1.) The oil shall be a pure distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements :—

(2.) It shall be fluid at 15° C. and crystal-free at 38° C.

(3.) It shall not contain more than 1 per cent. of water.

(4.) It shall not contain more than 0·5 per cent. of matter insoluble in benzol.

(5.) The specific gravity of the oil at 38° C. compared with water at 15·5° C. shall not be less than 1·09 nor more than 1·13.

(6.) The distillate, based on water-free oil, shall be within the following limits: Up to 235° C., not more than 2½ per cent.; between 235° C. and 300° C., not more than 20 per cent.; up to 355° C., not less than 50 per cent.

(7.) The residue above 355° C., if it exceeds 35 per cent., shall have a float test of not more than 50 seconds at 70° C.

(8.) The oil shall yield not more than 2 per cent. coke residue.

(9.) The foregoing tests shall be made in accordance with the standard tests of the A.W.P.A.

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