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Fence posts - production and treating costs

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FENCE POSTS: PRODUCTION AND TREATING COSTS

Good fencing is necessary on modern farms. The one above was constructed with fence posts treated in the fence post preservative treatment research program at State College.

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Fence post supplies in Mississippi are entirely inadequate to meet a demand, estimated to be 6,000,000 posts per year for the next two decades. If we are to avoid excessively high costs of post replacement resulting from the use of non-durable posts, some preservative treatment is a necessity.

Any such treatment must be simple but effective. In any case it must be inexpensive. Results of the work at Mississippi State College in 1946 indicate that there are two methods and two preservatives which meet these specifications.

Zinc Chloride, applied by the steeping method will give a post at a cost of 2 6/10 cents per year.

Pentachlorophenol, applied by a cold soaking method will give a post costing not over 2 2/10 cents per year.

Farmers may economically use either of these methods which require no special equipment.

There seems to be some possibility of the development of small community treating plants to serve areas as large as a county. More investigations on this phase of post treatment are necessary.

Caution. All preservatives are more or less poisonous. Cattle should be excluded from the vicinity of the farm treating plant and reasonable care must be exercised by persons using wood preservatives.

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FENCE POSTS: PRODUCTION AND TREATING COSTS

By W. C. HOPKINS

Farmers and other users of fence posts, located in regions or states devoid of naturally durable tree species, have always been without a simple, but satisfactory method of treating these fence posts. This has come about, not because of lack of research work on the problems, but simply because the known, effective preservatives have not been of a nature which lends itself to simple treating methods. Within the past ten years new preservatives and new processes have been developed, some of which seem to give promise of simple, economical use by farmers.

In order to be suitable for farmer application a preservative must be relatively easy to use, must require no elaborate or expensive equipment, and must not involve any work which has to be done at the farmer's busy season. These are rigid specifications which heretofore have ruled out almost every preservative and every method of treating.

The famous hot and cold bath method so widely discussed and the chief basis for U.S.D.A. Farmers' Bulletin No. 744,[9] is virtually eliminated from any consideration by these specifications. Other much talked about treatments such as the tire tube method,[13] are not satisfactory if any number of fence posts are to be treated. The application of the preservative although seemingly simple, is time consuming.

Two factors made a study of the various treating methods of great importance to the farmers of Mississippi. First, there is only a very small area of the state which has tree species naturally durable enough to make satisfactory fence posts. Second, it is now apparent that a more diversified type of agriculture, requiring a much greater amount of fencing, will soon be prevalent in the state. This interacts with the scarcity of suitable fence post species to create a necessity for a simple, economical treatment.

Wood is subject to attack by two agencies which cause deterioration. Fungi actually grow on the wood fibers, breaking them down by chemical action and utilizing them for food. Insects too, use wood for food, but the action of destruction is mechanical. Both agencies thrive best in a moist atmosphere, but both also require air, food, and certain temperatures. In the moist warm climate of Mississippi, conditions are favorable to these destructive organisms.

Since we cannot control the conditions of temperature or air, any attempts at preservative treatment must be concerned with poisoning the food supply and reducing the moisture content of the wood. Oil preservatives usually aim at both of these objectives, whereas the water soluble preservatives deal primarily with poisoning.

The species of wood which are by nature resistant to the attacks of insects and fungi possess this characteristic because they contain large amounts of heartwood which has in it natural oils that not only resist penetration by water, but which are also toxic.

FENCE POST REQUIREMENTS AND SUPPLY IN MISSISSIPPI

Normal annual consumption of fence posts in Mississippi is between 3.5 and 4 million posts. The accumulated, war-postponed fencing of the past five years will easily boost requirements for the next three years to 6 million per year. When the factor of diversification of farm enterprise is taken into account, it appears that this requirement of 6 million posts per year will continue for some time, possibly as much as 20 years. A further demand on our supply is being made by out-of-state markets. At present posts of durable species are being shipped in carload quantities to middle-western states which have no fence post supply. Presumably, this demand will continue and possibly will increase as wire and staples become available and war-deferred fencing programs get under way.

Mississippi's resource of natural fence posts is very limited. Five species: Bois D'Arc, black locust, red cedar, red mulberry, and old growth cypress are the only durable woods remaining in any quantity and they are found in numbers only locally.

Bois D'Arc was formerly found widely scattered over the delta and black belt sections as hedge fences, but most of these have been grubbed out until it is now confined almost entirely to the black belt section of the state. Black locust is native to Mississippi only on the Pontotoc Ridge. Although it has been very widely planted over the state, it has been almost a complete failure on the pine soils, consequently only a small supply is available. Red cedar, while scattered throughout the state, is present in quantity only on the lime soils of northeast Mississippi. Red mulberry occurs throughout the state on rich soils but is abundant in no locality. The supply of this species is so small as to be of minor importance in meeting the requirements. Cypress is found in relatively small quantities only in the delta section and in river bottoms.

The region of greatest concentration of these satisfactory fence post species is the very area which should see the greatest diversification of farming. As a result. many of the posts produced within the region will be used right there. There will be very few for export to other sections of the state.

The need, over much of Mississippi, for a simple, efficient means of prolonging the life of a fence post is obvious. The native durable woods give service from 15 to 30 years, but few others will last six years. Many posts being placed in service have a life expectancy of not more than two or three years. Fence post replacement involves far more than the cost of the post. The costs of setting and nailing on the fence, in the case of the cheap non-durable posts so widely used, equals or exceeds the cost of the post. Every time a farmer sets a pine post and puts a fence on it, he spends about 20 cents.

These posts will last no more than three years. In fifteen years, therefore. he spends one dollar. A pine post given a good treatment with one of the more recently developed preservatives, pentachlorophenol, should last 20 years at a cost of forty-three cents. This cost includes ten cents for placement and fastening the wire. The untreated post, then, costs 6-2/3 cents a year, whereas the treated post costs only 2-1/6 cents a year. Four and one-half cents per post per year amounts to considerable saving, even on a small farm.

Great opportunities for utilization of many of the inferior hardwood species exist in the field of fence post treatment. Experiments at Mississippi State College during 1946 have definitely proven that species such as elm, red gum, water oak, blackjack oak, and post oak, can be treated efficiently. Service records on these posts are not yet available, nor will they be for a long period of time. Ten year service records on pine posts treated with the same preservatives are available, however, and these posts are standing up remarkably well.

It now appears possible to treat almost anything in the woods and make a good post of it. This is a very important consideration because it helps to relieve the demand on the few durable woods we have, conserves pine posts which are more valuable if left to grow to larger size, and helps us develop a system of cutting in our woodlands which will be an aid in controlling the encroachment of hardwoods.

PREPARATION OF POSTS FOR TREATMENT

In all but one of the treatment methods to be discussed in detail in the next section, some pre-treatment preparation of the posts is necessary. The two steps

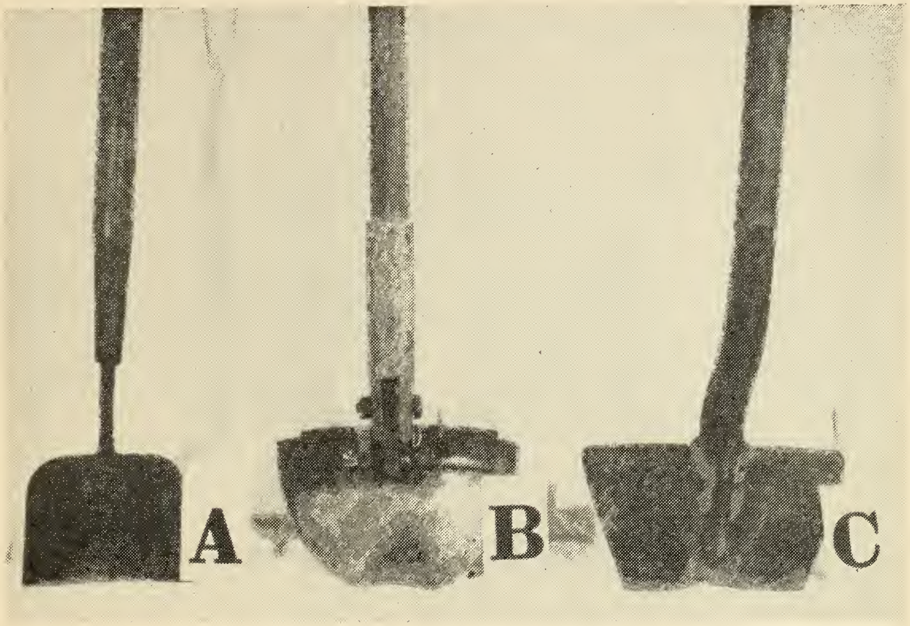

Figure 1. Post peeling tools. a. Hoe, b. Bottom half of shovel, c. Top half of shovel.

of this preparation are peeling and seasoning.

Peeling

Peeling, or removal of all bark from the post, is one of the most expensive operations in connection with fence post treatment. Unfortunately, it is also a very necessary operation. Preservatives, ordinarily, will not penetrate even the thin inner bark of trees, so that all bark, both outer and inner, must be removed from each post to be treated. Many tools have been used to do this job and each has its proponents. Most used in Mississippi, probably, is an old hoe, straightened out and ground down on the cutting edge so that a concave edge is obtained. In use, this tool is pushed along the log or post, removing a narrow strip of bark in the process.

A tool recently developed at the Mississippi Agricultural Experiment Station seems to be somewhat better.[4] This tool was made from the tip of the blade of an old round pointed shovel, ground concave on the cutting edge and fitted with a handle. It too, is used as a push tool, but has an advantage over the hoe in greater weight and more rigid construction. Another tool was constructed from the top half of the shovel blade and it also appears to be more satisfactory than the hoe. These three tools are shown in figure 1.

Peeling is most easily done in the spring and early summer when the sap is flowing more freely in the trees. The bark is loose at this time and is easily removable from most species of trees. However, this is the farmer's busy season and it is not expected that many will be able to fit this phase of post preparation into an already crowded time budget. Delayed peeling seems to have some possibilities. This method involves stacking the posts with the bark on for some time before attempting to remove the bark. Drying coupled with the activities

Figure 2. Good piling practice.

of some bark insects loosens the bark so that it comes off with comparatively little effort. Use of this method enables the farmer to cut his posts late in the summer or early in the fall and then remove the bark from seasoned posts a short time prior to treating. Post preparation and treating may then become winter activities which will not seriously hamper other work.

Seasoning

Several of the treating methods to be discussed, including the one which seems most promising, require that the posts be well seasoned or dried prior to application of the treatment. Good seasoning requires that the posts be piled and allowed to dry for 60 to 120 days, depending upon the time of year. Posts seasoned during the summer will dry more rapidly than those seasoned during the winter.

Proper piling is necessary if posts are to be seasoned without incurring attack by decay causing organisms. An open pile, so constructed that air will circulate freely around each post is best. The bottom of the pile should be raised at least a foot from the ground. Such a pile is illustrated in figure 2. Another method of piling, not so desirable, is shown in figure 3.

Posts should never be closely piled, or piled on the ground for seasoning. The large amounts of moisture present in the ground and in the posts create optimum conditions for the incidence of decay organisms. An illustration of very poor seasoning practice is shown in figure 4.

As posts season, cracks and checks develop on the surface. It is important that all checking take place prior to treatment because checks which develop after treatment may expose untreated wood and form an entrance for decay. Checking could be so severe as to detract from the nail-holding characteristics of the post.

If seasoning is to be done during the hot summer months and it is suspected that checking may be severe, the posts may be piled for seasoning in the shade where they will dry less rapidly.

Although there are no data to prove its value, it is recommended, without exception, that the tops of all posts be sharpened to a sharp edge with an axe. This gives the post a sloping roof which sheds water and prevents decay from the top. The smoothest saw cut is not satisfactory because it leaves a fuzzy surface which will retain some water. An axe cut, on the other hand, gives a very smooth surface. The operation should be performed after seasoning in order that no end checks will develop and prior to treating so that the superficial top treatment to be recommended will coat the cut surface.

Posts may be cut at any season of the year if properly cared for. As a rule, on the farm, they will be cut during the fall and winter. In any case, they should be piled to season immediately following cutting.

METHODS OF PRESERVATIVE TREATMENT

Wood preservatives fall into two general categories: (1), the oil or oil soluble preservatives and (2) the water soluble preservatives. Each has its uses and for some purposes the water soluble preservatives are quite satisfactory. It is felt that the oily chemicals will prove far superior for fence post treating in a climatic region which has as high annual rainfall as does Mississippi. It may well be that the service records will prove that we can obtain satisfactory treatments with some of the water soluble salts.

The Mississippi Agricultural Experiment Station began an experiment on preservatives and methods of application early in 1946. At that time it was de cided to use two of the oil preservatives,

Figure 3. Another method of piling. Not so desirable.

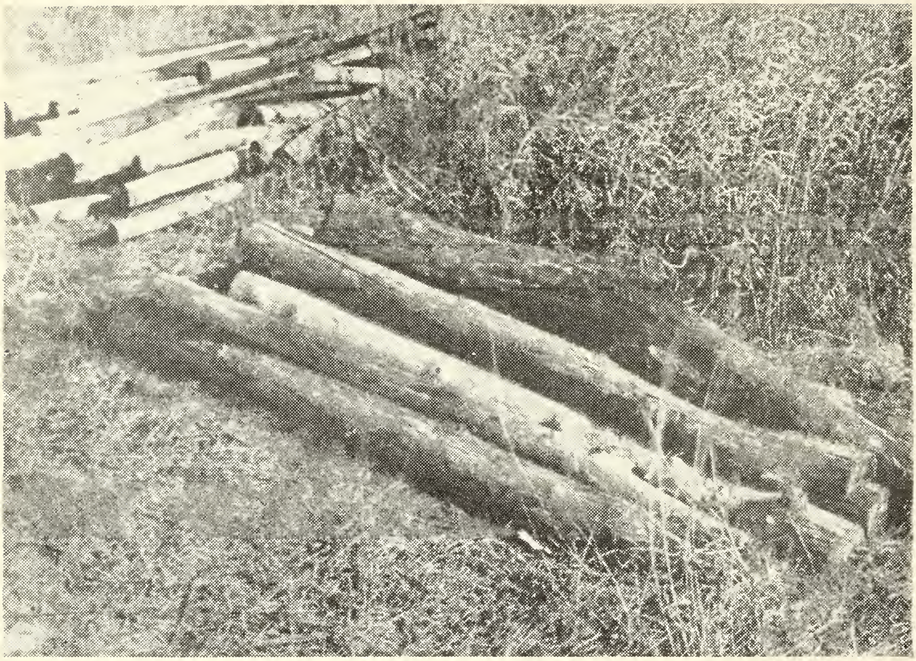

Figure 4. Very poor piling practice.

two of the soluble salts, and one which is a combination of the two. These preservatives were to be applied by different methods to five different species of posts —pine, red gum, red oak, post oak, and elm. Thirty posts of each species were to be treated by each method and each post was to be numbered and placed in service in the Dairy Department fences.

The first phase of the study, that involving the collection of data on costs of cutting, preparing, and treating, is now complete. Certain inferences as to expected service from posts in each treatment may be drawn from service records at other places.

It is felt that a publication embodying complete descriptions of each method of treatment and comparing costs of treatments may be of value at this time. At least one of the methods of treatment to be discussed below has much to recommend it to the farmer who has to treat fence posts.

Oil Preservatives

Hot and Cold Bath, Creosote

For a good many years the standard method of applying oil preservatives on a small scale has been by using a hot and cold bath plant. This involves immersion of the posts in a bath of hot preservative for several hours, removal from the hot bath, and immediate transfer to the cold preservative bath for a period of an hour or so. The principle underlying this method of treatment is the fact that a partial vacuum is created within the hot post when it is plunged into the cold preservative and ordinary atmospheric pressure forces the preservative into the wood.

Creosote, both pure and in mixture with other oils such as used crankcase oil, has been the standard preservative for use with this method. This preservative, in small lots, is expensive and it is not very pleasant to handle or work around, especially when hot.

A considerable investment in a treating plant is necessary, too. The experimental treating plant at State College was built at a cost of $200.00, and it is close to the minimum operable size. A picture of this plant is shown in figure 5.

The plant requires two tanks at least four feet deep. This automatically rules out the 55 gallon oil drums which are most readily available. 100 gallon oil drums would serve, but cannot be found. The tanks in the plant pictured were secured by buying a 500-gallon oil tank and cutting it in half. This gave 2 tanks of 250 gallon capacity. Beneath one tank a furnace must be constructed for the purpose of heating the creosote. The furnace need not be elaborate, but should be almost as large as the diameter of the tank and works best if rough grates are constructed. The flue will be safer if led away from the tank underground for several feet before being turned up. This, too, gives adequate room to work about the tank. The tanks must either be set up on a bank or a ramp must be built up alongside them to facilitate handling the posts.

In figure 5 it will be noted that the two tanks are set down in the ground, the hot tank on the left of the picture being slightly higher than the cold tank on the right. A pole rack leads up to the hot tank, extends between the two tanks, and then leads away from the cold tank. This facilitates handling of the posts between the tanks. If a roof is to be con-

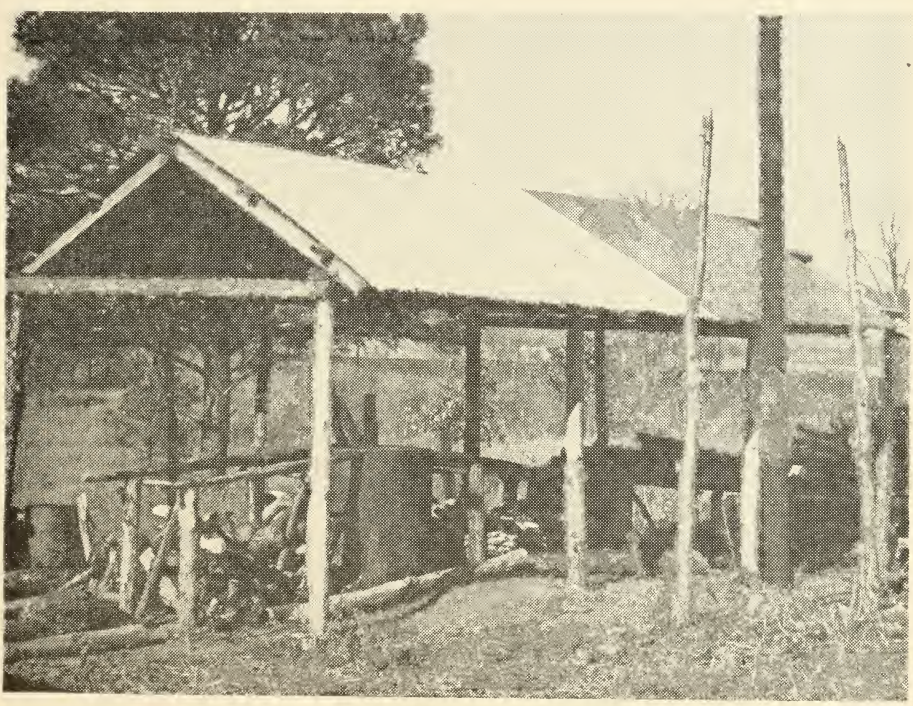

Figure 5. Experimental Post Treating Plant at State College, Miss.

structed over the tanks, it should be, at the lowest point, six feet above the top of the tank.

Older bulletins have advised that a rack with projecting screws or nails should be placed in the bottom of the tanks. Posts, impaled on these nails or screws, would then remain immersed. The work here has proven that posts can be held immersed to half of their length without such a device. Most of them are heavy enough to stay down and the few which persist in rising a few inches can either be wedged between other posts or held down with a brick or small rock laid on top of them.

In operation the plant is simple. A good fire is built beneath the hot tank which has been filled to a depth of two feet with pure creosote or creosote and used crankcase oil in the proportion of 1 to 1. The oil in this tank is heated to a temperature of 220° to 240° Fahrenheit. Meantime, 30 or 40 posts have been placed on the rack leading to the hot tank and the cold tank has been filled with pure creosote to a depth of two feet.

When the temperature reaches 220° Fahrenheit, posts are placed in the tank, butt end down, one at a time until no more can be gotten in or until the level of the oil in the tank rises to within six inches of the top. Care must be taken not to splash the oil over onto the fire. The time is noted so that after two hours have elapsed, the posts may be removed. An ordinary candy thermometer may be used to determine the temperature of the oil. The oil in the cold tank should have a temperature of about 100° Fahrenheit and if treating is being done during the winter, it may be necessary to add some hot oil from the hot tank.

After two hours have elapsed, the posts are removed from the hot tank and transferred at once to the cold tank, where they should remain for a period of time which may vary from 15 minutes to 1 hour. Treating schedules (length of time required in each tank) indicated by the experiments at State College are shown in table 1.

Table 1. Schedules of treating indicated for various species by experiments at Mississippi State College.

Kind of post	Time in hot bath	Time in cold bath
Pine	2 hours	20 minutes
Red Gum	2 hours	30 minutes
Red Oak	2 hours	1 hour
Post Oak	2 hours	1 hour and 15 minutes
Elm	2 hours	2 hours

Actually, all posts were treated on a schedule of 2 hours hot bath and one hour cold bath. The desired objective was an absorption of 6 pounds of creosote per cubic foot of wood, which translated to terms of posts mean an absorption of 3 pounds per post since each post was treated only half length and since each post averaged about one cubic foot in volume. The average absorptions obtained are shown in table 2. Table 1 has been constructed by applying the author's best judgment to the absorptions actually obtained on the 2-1 schedule.

Absorptions were obtained by measuring the depth in inches of the creosote in the cold tank immediately after placing the posts in it and just prior to removing the posts from it. The latter, subtracted from the former gives the number of inches change in depth, and this multiplied by the number of gallons represented by one inch of depth of tank, gives the gallons absorbed. This is easily translated to pounds by weighing one gallon of the preservative. The average absorption was then obtained by dividing the number of pounds absorbed by the number of posts in the charge.

If species of posts other than those listed are to be treated by this method, a few trial batches should be run at different schedules to determine which is best. Ordinarily, six pounds of creosote per cubic foot of wood will give a very satisfactory fence post.

Table 2. Actual average absorptions, in pounds per post, obtained on species used in tests at Mississippi State College.. Hot and cold bath creosote.

Kind of Post	Schedule	Average absorption	Remarks
Pine	2-1	8.70	Too high—reduce time cold bath
Red Gum	2-1	6.30	Too high—reduce time cold bath
Red Oak	2-1	2.80	Good
Post Oak	2-1	2.00	Too low—lengthen time cold bath
Elm	2-1	1.67	Too low—double time cold bath

In this, as in all tests at the college, half of the posts were also given a superficial, top treatment which consisted simply of dipping the top half of the post in the cold creosote a sufficiently long time to insure coating it with the preservative. Although data to substantiate the concept of top failure are lacking, it is recommended that such a top treatment be given in all instances. Because the top of the post is not subjected to long periods of dampness as is the bottom, the more effective hot and cold bath treatment does not seem necessary.

DIP METHOD—CREOSOTE

Creosote has been used and is still being used in a simple dipping or brushing process. This may afford sufficient protection for wood not in contact with the ground or not subjected to a great amount of moisture for considerable periods of time. For fence posts, however, it represents a waste of time and money simply because there is no absorption of the oil and the thin outer coat is ineffective in preventing absorption of water and entrance of decay causing organisms.

The method consists of simply dipping the post for an hour or so in warm creosote, or in painting warm creosote on the surface of the post with a brush. Posts held for two hours in a very hot bath of creosote absorbed no appreciable amounts of the preservative.

A comparison of the penetration obtained by the hot and cold bath method as against the dipping method is shown in figure 6.

PENTACHLOROPHENOL

Within the past ten years a new chemical, pentachlorophenol, has come into the wood preservative field. Now coming onto the market in fair quantities, under various trade names, and put out by several chemical companies,[1] it holds great promise of becoming one of the most easily applied and most satisfactory wood preservatives. Although tests thus far are not comprehensive enough and service records are not long enough to prove conclusively the value of this preservative, it is 10 to 100 times as toxic as creosote and much easier to use.

Pentachlorophenol is available in either a dry flake or concentrated solution form. In most cases the concentrated solution will be somewhat easier to use. Soluble in very thin petroleum oils, it has much the same property as water in that it will penetrate wood very rapidly and easily. While it may also be applied by the hot and cold bath method, there are much simpler methods which will give an effective fence post treatment. In the experiments which form the basis of this report it was applied by both the hot and cold bath and the cold soaking methods. The preservatives used in these experiments were contributed by A. D. Chapman and Co., and Wood Treating Chemicals Co.

Hot and Cold Bath

The same plant was used with this preservative but a different technique was

[1] A. D. Chapman & Co., 333 N. Mich. Ave., Chicago 1, Illinois; The Dow Chemical Co., Dowicide Division, Midland, Michigan; I. F. Lanchs, Inc., 911 Western Ave., Seattle 4, Washington; Monsanto Chemical Co., 1700 S. 2nd St., St. Louis 4, Missouri.; Wood Treating Chemicals Co., 5137 Southwest Ave., St. Louis 10, Missouri; Protection Products Mfg. Co., Box 747, Kalamazoo 99, Michigan.

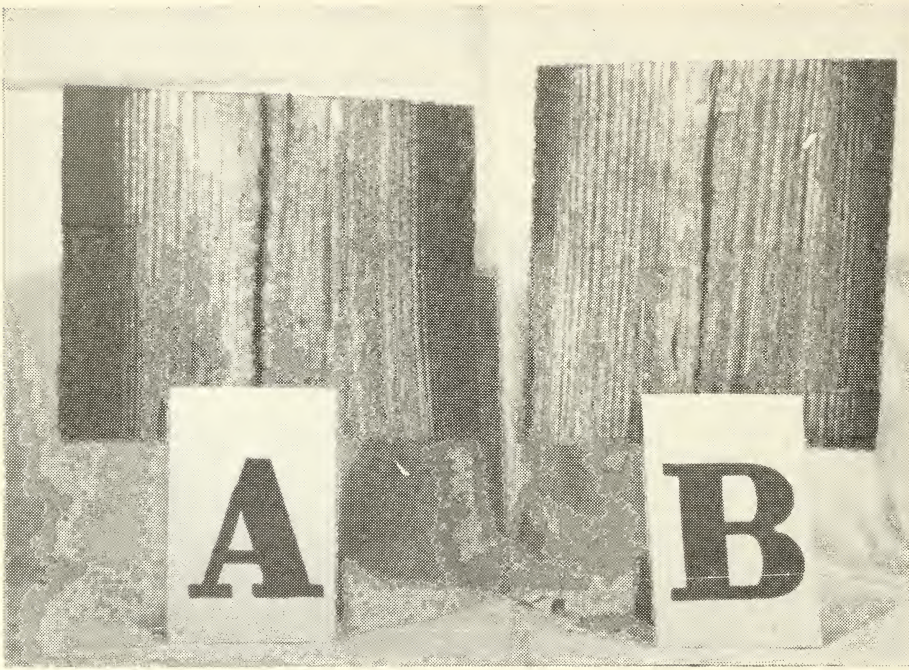

Figure 6. Penetration obtained on pine posts by two methods of treating with creosote. a. Hot and cold bath treatment. b. Dip treatment.

employed. Due to the very dangerous inflammability of the solution of pentachlorophenol in ordinary kerosene, hot water was substituted in the hot tank. A five percent solution of pentachlorophenol was placed in the cold tank. The water was much more difficult to heat to the desired temperature and hold there, so it was decided to hold the posts in the hot tank between three and four hours. At the end of this time the posts were immediately transferred to the cold tank where they remained for one hour. The average absorptions obtained by this treatment are shown in table 3.

The Forest Products Laboratory[12] says that at least one-half gallon of preservative per post must be retained to give a good treatment. This, however, applies to posts treated full length. The posts in this experiment were treated only half length so that retention between 0.250 and 0.333 gallons per post is considered satisfactory. As with the creosote, half of the posts were subjected to a one hour dip treatment of the top end, the others not being treated.

Table 3. Average absorption of pentachlorophenol in hot and cold bath treatment.

Kind of post	Schedule	Average absorption, gallons per post	Remarks
Pine	3-1	0.333	Satisfactory
Red Gum	3-1	0.235	Satisfactory
Red Oak	3-1	0.196	Slightly low
Post Oak	4-1	0.320	Satisfactory
Elm	3-1	0.304	Satisfactory

The use of hot water in the hot bath seems to have no deleterious effect on the absorption of preservative. This is probably due to the fact that most of the water taken up by the posts in the hot bath is in the form of steam when the posts are removed from the hot bath. Plunging the posts at once into the cold

Table 4. Absorptions of pentachlorophenol obtained by cold soaking method.

Kind of post	Soaking time	Average absorption gallons per post	Remarks
Pine	5 hours	0.773	Too much. Reduce time
Red Gum	6 hours	0.583	Too much. Reduce time
Red Oak	6 hours	0.333	Satisfactory
Post Oak	168 hours	0.500	Too much. 96 hours better
Elm	24 hours	0.400	Slightly high.

preservative condenses this steam and creates the partial vacuum which pulls the preservative into the wood.

Cold Soaking Method

Water and thin oil solutions are very readily soaked up by dry wood. This fact makes possible the use of a simple method of treating fence posts with pentachlorophenol solutions. The only equipment necessary is a tank or drum which will permit submerging the post to a point 8 or 12 inches above the ground line. Dry posts left in this solution for 5 to 24 hours will absorb amounts of preservative equal to that absorbed in the hot and cold bath process.

Absorptions obtained by this method at State College are given in table 4.

In the pentachlorophenol tests a 5 percent solution was used. This was obtained by mixing the concentrated solution of pentachlorophenol with ordinary kerosene in the proportions advised by the manufacturers. Other light petroleum oils such as diesel fuel oil are less expensive and should be used when available.

This cold soaking treatment has much to recommend it. It involves very little expenditure of labor in the actual treating process since it is quite possible for a farmer to place a batch of posts in the preservative in the morning, go away and work all day at something else, and remove the posts that night. If he were treating by the hot and cold bath method, he would have to stay close by to maintain the fire.

The experiments at the college have shown that it is possible to obtain absorptions with this method fully equal to those obtained by use of the hot and cold bath. As a matter of fact, absorptions equal to those generally obtained in pressure treating fence posts are possible. The pentachlorophenol solutions used at the college were about six cents cheaper per gallon than the creosote. If some solvent other than kerosene were used, a saving of ten cents a gallon might be effected. Due to the fact that absorption is much faster with some species than others, as shown by Table 4, each specie should be treated separately. This is true of all treating methods. Penetrations obtained in the cold soaking treatment are shown in figure 7.

Water Soluble Preservatives

Research in the field of wood preservation has been done on water soluble chemicals for many years. Some of the most promising of these chemicals have been in use as wood preservatives in arid regions for long periods of time. In such regions they have given good results, simply because the treated wood was not subjected to water in sufficient amounts to wash the chemicals out. Even in very moist climates, the record on at least one such chemical is sufficiently good to warrant its use, especially since the process is so simple and the chemical so inexpensive that a very low cost post results. Certainly this one treatment is better than none.

The water soluble chemicals and methods of application to be discussed here are those which have been used in the experiments at the college. Again, we have no service records here to indicate the expected life of these posts. We are, however, able to compare the costs of the various chemicals and draw certain inferences from service tests elsewhere.

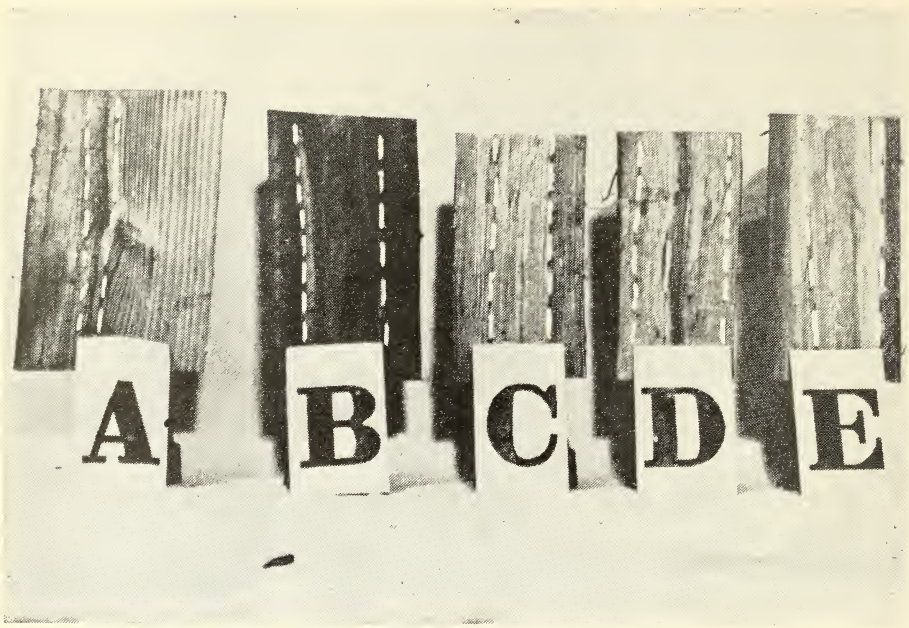

Figure 7. Penetrations obtained in Pentachlorophenol Cold Soaking Treatment. a. Pine, b. Red gum, c. Red oak, d. Post oak, e. Elm.

CHROMATED ZINC CHLORIDE

Chromated zinc chloride is an outgrowth of one of the most used water soluble preservatives, zinc chloride. This chemical has been used long enough to prove that there are excellent possibilities for treating with it in arid regions. Experiments at Clemson, S. C.[8] indicate that it may be used satisfactorily in more moist localities.

The method of application used here has been used in other localities with success. A tank or trough twelve or fifteen inches deep with a rack built up around it to hold the posts upright, is the only equipment necessary. The trough might be placed next to a wall or fence and the posts leaned against this for support. It is important that the treating be done under a shed. Rainwater, falling into the trough, will dilute the solution and ruin the treatment.

A solution made by mixing two pounds of chromated zinc chloride, with one gallon of water, is placed in this tank. One-half gallon of solution should be allowed for each post. Posts should be cut and placed in the solution within twenty four hours after cutting, large end down. The bark must not be removed from the posts. If only the amount of solution for the number of posts to be put in the tank is poured in, the posts should be left until all of the solution is absorbed. If more than enough solution is placed in the tank, the number of gallons absorbed may be measured and the posts removed when the average absorption reaches one-half gallon per post.

This absorption may require only a few hours, or it may extend over a period of a week depending upon the porosity of the wood and the rate of drying of the top of the post. The solution is pulled up into the post by capillary action. As the post dries at the top, the native liquids are pulled up in the post and the preservative solution in turn moves up through the pores of the wood.

Upon completion of absorption and removal from the trough, the posts are stood up, top end down, for two to four weeks to permit any excess solution in the butts to flow down into the top. The posts are now ready for placement.

Chromated zinc chloride and zinc chloride may be obtained from any chemical house.[2] Zinc chloride is slightly less expensive and on the basis of service tests at the Harrison Experimental Forest, somewhat better. This treatment, while it will not give as durable posts as oil treatments, is very simple, consumes little time, and is inexpensive. It will effect considerable saving over the practice of no treatment at all.

THE OSMOSE PROCESS

The Osmose Wood Preserving Company, of Buffalo, New York, has developed a process, and patented two preservatives for use with it, which makes use of the principle of osmosis. Osmosis is a natural process occurring in plants and animals whereby two solutions of different strength separated by a thin membrane such as a cell wall, tend to equalize. That is, the chemicals in the stronger solution move through the membrane into the weaker solution until there is an equal concentration of chemical substance on either side of the membrane.

The application of this process in wood preservation consists simply of coating the outside of a green post or piece of wood with a strong chemical solution and then placing the wood under a waterproof, more or less airtight cover. Osmosis sets in and over a period of 30 to 90 days the chemicals placed on the outside of the wood gradually become incorporated.

Two patented chemical mixtures are used for treating posts by this method.[3] One is a dry salt which is used to make a water solution applied to the post by brushing or dipping. The other is a tar solution, containing the same chemicals, which is applied only to the groundline area of the post with a brush.

Osmosalts

This is the mixture of chemicals which is used to make a water solution to be applied by brushing or dipping. The mixture used in the experiments at State College was 4 parts of water to 3 parts of dry chemical. This was applied to the posts with a cheap 4-inch paint brush, the posts being closely piled as the preservative was applied. After all posts were piled and treated, the stack was covered with waterproof tar paper and earth was banked up around the bottom to exclude air. The posts remained in this stack for 75 days before the cover was removed. Good penetration was obtained on all species. The method of piling and preservative application is shown in figure 8. Extent of penetration is shown in figure 9.

Posts which are being treated by this method must be cut and peeled not over twenty-four hours before treatment. This is a decided drawback from the farmers' standpoint because he cannot always afford the time during the proper peeling season.

Osmoplastic

This preservative is applied only to a small section of the post about twelve inches below groundline and three inches above groundline. The posts, which must be treated within 24 hours after cutting. are brought in with the bark on. The bark is then peeled only from the section to be treated and the tarlike solution of Osmoplastic painted on heavily with a paint brush. A small piece of waterproof paper is then wrapped tight-

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[2]E. I. Du Pont de Nemours and Co., Inc. Wilmington, Delaware, donated the chemicals used in the State College experiments.

[3]Sufficient of both of these preservatives to carry out the tests was contributed by the Osmose Wood Preserving Co.

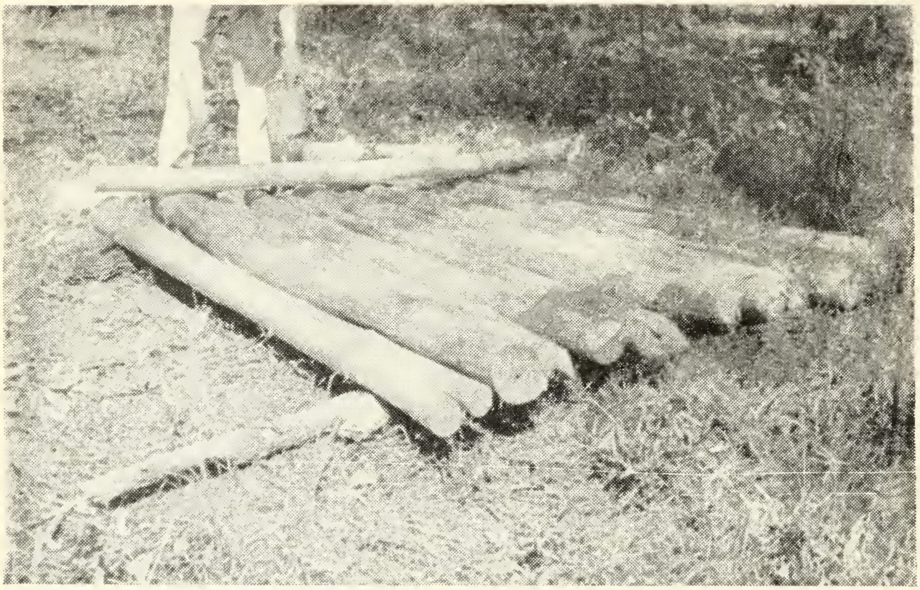


Figure 8. Osmosis Method with Osmosalts. Method of piling and application.

ly about the treated section of the post and tacked in place. The post, ready for treatment and after treatment is completed, is shown in figure 10. After treatment the posts should be stood up and allowed to dry for 30 days before placement.

Service records on posts treated in this manner are not sufficiently long to indicate whether or not it will prove economical.

COSTS OF FENCE POSTS

In the past much has been written concerning preservative treatment of fence posts without mentioning the various items of cost which go into treated and untreated fence posts. One of the main objectives of the work at State College has been to collect data on the man-hour requirements of each of the jobs involved in harvesting and treating fence posts. Since some preservative treatments require posts which have been peeled, stacked and seasoned, others require posts peeled but still green, and still others require posts green with the bark on, data on the separate job of felling and bucking, peeling, hauling and stacking, is desirable.

Each treatment, too, differs from every other in the amount of labor required in the process. Some preservatives cost more than others and a good post may require more of one preservative than another. All of these factors become items of cost, and cost to the farmer is a very important consideration.

Labor requirements in this study have been recorded in terms of man hours so that any prevailing wage rate could be applied. The work was actually done by day labor paid at the rate of forty cents per hour. Labor costs in the following tables then are obtained by multiplying the total man hours expended by the hourly rate of forty cents. These costs may be adjusted to prevailing wage rates in any similar area simply by substituting the prevailing hourly rate for the hourly rate of forty cents used in these tables.

No attempt has been made to separate the costs by species worked with. Admittedly, it is less expensive to make posts from pine than from any of the other species used but it is hoped that hereafter a good many fence posts will be harvested from the gum, red oak, post oak, elm, and other low grade hardwoods. The cost figures set forth herein will be applicable to these species.

There is no doubt that all of these costs are higher than they would be with experienced woods labor. The labor used on the project consisted of Negro farm hands, most of whom had never done any woods work. Peeling was for all of them a new task, consequently it was accomplished with the expenditure of much more time than would be required with labor accustomed to peeling. However, it was considered desirable, in this study, to make use of part time farm labor. The study was designed to furnish information for the farmer and the use of trained woods labor would have led to a fallacy in the costs which would have been misleading. Any farmer with his ordinary farm labor can secure his posts at a cost not to exceed those set up herein. Many men, who have hands more accustomed to woods work, will obtain their posts at a cost considerably less than this.

Hot and Cold Bath Treatment

The factors contributing to the costs of this method of treating are cost of plant, labor cost (including cutting, peeling, hauling, seasoning and treating), cost of preservative, and cost of fuelwood.

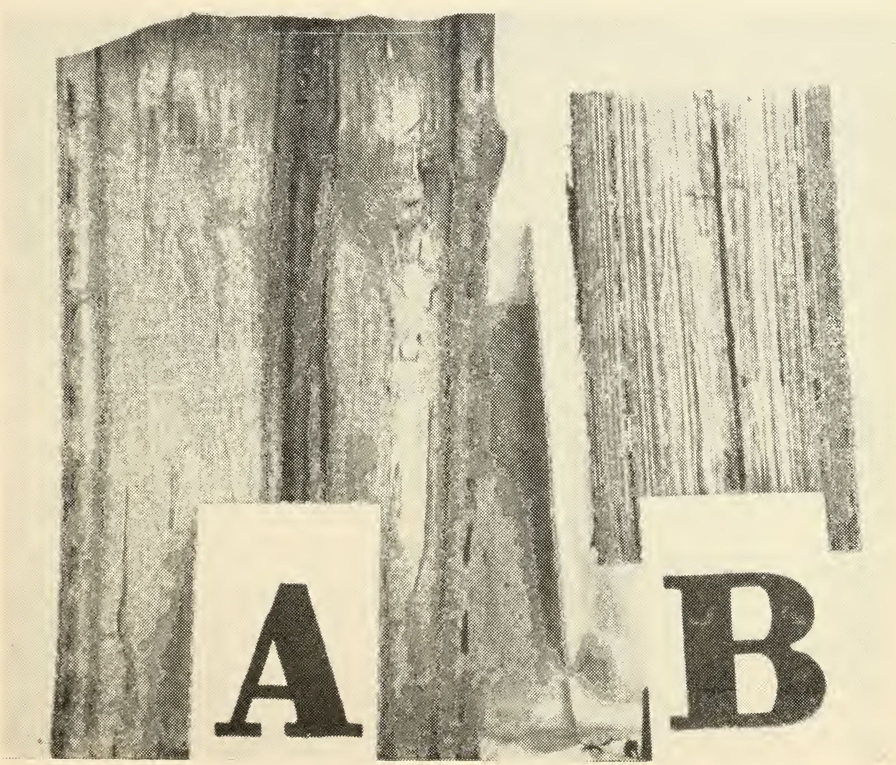


Figure 9. Penetration obtained in Osmosalts treatment. a. Red gum. b. Pine.

Table 5. Labor costs of fence post production and treatment by various methods.

Operation	No. of posts	Man hrs. expended	Man hrs. per post	Hourly rate	Labor cost per post
Cutting	1830	310	0.1694	0.40	$0.068
Peeling	1480	575	0.3885	0.40	0.155
*Hauling and stacking	1830	100	0.0546	0.40	0.022
Creosote—hot and cold bath	150	20	0.1333	0.40	0.053
Creosote—dip	150	10	0.0666	0.40	0.027
Osmosalts—brush	150	90	0.6000	0.40	0.240
Osmoplastic—brush	150	42	0.2800	0.40	0.112
Zinc Chloride—steeping	150	5½	0.0366	0.40	0.015
Pentachlorophenol—hot and cold bath	150	26	0.1733	0.40	0.069
Pentachlorophenol—cold soak	150	6½	0.0433	0.40	0.017

*Hauling costs will vary with length of haul and equipment used. In this study the distance averaged about one mile. About ¼ of the posts were hauled on a pickup truck, 2/3 of them on a 1½ ton truck and the balance with a team and wagon.

As mentioned previously, the experimental plant at Mississippi State College cost approximately $200.00. Actual cost was $191.50 which is broken down as follows: tanks, $28.50 (an old 500 gallon gasoline tank cut in half crosswise to make two 250-gallon tanks about 4½ feet deep); other materials (roofing, etc.) $73.00; labor $50.00; and supervision, $40.00.

The farmer building his own plant might not include any cost for supervision. If he put no roof over the tank he would reduce the labor cost by 50 percent. He might then, build a workable plant, without any shed, for a figure close to $75.00. Such a plant is not to be recommended since the treating will presumably be done in the fall and winter when rain is probable. Work can go right on if there is a shed over the tanks.

If we assume a depreciation charge of one cent per post and a cost of $200.00 for the plant, we have to treat 20,000 posts to pay for the plant. This charge for depreciation would probably run closer to 3 or 4 cents per post.

The labor cost on posts treated by this method is high because of the necessity of peeling and of maintaining a fire under the hot tank all of the time while treating. From table 5 the cost per post for labor would run between 29 and 31 cents.

Preservative cost varies with the preservative used. Grade I coal tar creosote costs 33-1/3 cents per gallon in 50-gallon lots. If the desirable absorption of ¼ gallon per post (butt treatment only) is obtained, the cost per post would be slightly over 8 cents per post. When the top is then given a dip treatment, the preservative cost would approach 9 cents per post.

Pentachlorophenol (1 to 10 concentrate) costs $2.00 per gallon. Mixed with 10 gallons of kerosene at 10 cents per gallon, the cost of 11 gallons of preservative solution becomes $3, or 27.2 cents per gallon. This cost may be reduced to 23.6 cents per gallon by use of diesel fuel at 6 cents per gallon, as a solvent. If the desired absorption of ¼ of a gallon per post is obtained, the cost of preservative would be about six cents. Here again, the top treatment would run the cost per post up to about seven cents.

Considerable fuelwood is consumed in heating the hot tank and maintaining it at the proper temperature. Some difference would occur, dependent upon the kind of wood used for fuel and whether creosote or water was used in the hot tank. About one-half cord of wood per hundred posts was used in the experiments at State College and the cost of this wood at the plant was figured at $5 per cord. Cost of fuel per post then, was 2½ cents. Three cents is thought to be a better figure for the pentachlorophenol treatment because of the longer time required to heat the water and the necessity of a hotter fire to maintain it at the required temperature.

Some charge for depreciation of equipment other than the treating plant should be made. One cent per post should cover all expenses other than those discussed before. This charge will apply to all treatments.

Table 6 gives a comparison of the cost of the hot and cold bath method with creosote and with pentachlorophenol.

It should be emphasized that the cost of preservative included in the above table is the cost only of the preservative

Table 6. Comparison of the cost of creosote and pentachlorophenol treatments applied by the hot and cold bath method.

	Creosote	Penta-chlorophenol
Plant depreciation	$0.03	$0.03
Labor	0.29	0.31
Preservative	0.09	0.07
Fuelwood	0.025	0.03
Equipment depreciation	0.01	0.01
Total	$0.445	$0.45

actually absorbed. This method of treatment (with tanks the size of those at State College) requires an additional seventy gallons of preservative in the cold tank. In the case of creosote, where the oil is used in the hot tank, another additional 100 gallons of preservative is needed. The initial costs then should be in creased as follows:

Creosote treatment:
170 gallons creosote at $0.333 = $56.61

Pentachlorophenol treatment:
70 gallons pentachlorophenol 5% solution at $0.236 = $16.52.

There is no way of distributing these figures as a cost per post because the leftover oils may be saved and used again. The factor of initial cost, however, is heavily in favor of pentachlorophenol.

Posts treated with creosote by the Hot and Cold Bath Method are good for 20 years. It appears likely that pentachlorophenol treated posts will be just as good. The cost per post per year will be in both cases oniy slightly over two cents.

Creosote Dip Treatment

This treating method involves labor costs of cutting, peeling, hauling, seasoning and treating a small cost for preservative, and the cost of equipment depreciation. No cost of plant is involved because any old drum or barrel may be used provided it does not leak and will permit submersion to half the length

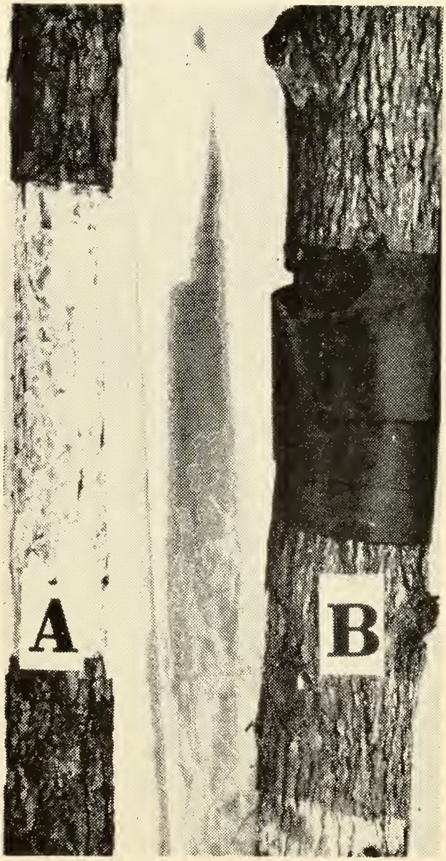


Figure 10. Osmoplastic Method of Treatment
a. Post peeled and ready for treatment.
b. Treatment complete.

of the post. Little preservative cost is incurred because there is negligible absorpton and penetration. One gallon of preservative will easily treat ten posts. Table 7 shows a breakdown of the costs of treating by dipping in the experiments at State College.

Posts so treated might be expected to last five years. The cost per post per year, therefore, is slightly over 5 cents or 3 cents more than for posts treated by the hot and cold bath. The dip treatment is little better than no treatment and it involves the same costs of preparation as are incurred with the hot and cold bath.

Table 7. Cost per post of dip method of treatment with creosote.

Labor	$0.27
Preservative	0.03
Equipment depreciation	0.01
Total	$0.31

Osmose Treatment

The osmose treatment with Osmosalts is more expensive than the hot and cold bath or dip methods. The same costs of preparation are incurred. No plant is necessary, but this saving is more than taken up in the labor of treating. The preservative is more expensive too, and it is doubtful if posts so treated will give as long service as creosoted or pentachlorophenol treated posts. A dipping process, instead of a brushing process, would undoubtedly give much lower costs.

Table 8 breaks down the cost of the brush treatment with osmosalts. For comparative purposes it is assumed that the labor involved in dipping would cost the same as for dip creosoting and a figure which may be valid for dip treatment is also given. Some saving of preservative would be affected by use of a dip method but no attempt to estimate this is made.

The saving in preservative on the dip method might run to 5 cents per post. Even this much would still mean a cost of at least 41 cents per post. For the brush method the cost per post per year would run from 4½ to seven cents if we assume a 10 to 15 year service life for these posts. Ten-year service records are available which indicate that these posts may last longer.

Table 8. Cost per post of Osmose treatment by brush and dip methods.

	Brush	Dip
Labor	$0.49	$0.27
Preservative (50 lbs. at 52 cents)	.16	.16
Paper (covering)	.02	.02
Equipment depreciation	.01	.01
Total	$0.68	$0.46

The Osmoplastic ground-line treatment is somewhat less expensive since this method does not involve so much labor of peeling. The cost break-down on this method is as follows in table 9. The preservative costs $5.25 per gallon and two and one-half gallons were required to treat 150 posts.

Service tests in south Mississippi show that some of the posts treated by this method have decayed within four years. It is believed that a five-year average life of such posts will be good under the climatic and soil conditions in Mississippi. This would make the cost six cents per post per year.

Table 9. Costs of Osmoplastic ground-line treatment.

Labor	$0.20
Preservative	0.09
Equipment depreciative	0.01
Total	$0.30

Chromated Zinc Chloride Steeping Treatment

This method of treatment is one of the least expensive of any tested at Mississippi State College during 1946. No cost of peeling enters into the total cost and the chemical used is inexpensive. No elaborate plant is required either, any trough or barrel which will hold 10 or 15 inches of water being satisfactory. Chromated Zinc Chloride in 50-pound lots costs 15 cents per pound and Zinc Chloride 14¼ cents per pound. Costs of the posts treated by the steeping method at State College are shown in table 10.

It will be noted that an average absorption of 1.36 pounds of salts per post was obtained. If the recommended absorption of 1 pound per post had been adhered to, preservative cost and total would have been reduced five cents. The total would then be 26 cents per post. Service tests elsewhere indicate that a ten-year average life of post may be expected. This would give a cost per post per year of 2.6 cents.

Table 10. Costs of chromated zinc chloride steeping treatment.

Labor	$0.10
Preservative (1.36 lbs. per post)	0.20
Equipment depreciation	0.01
Total	0.31

Pentachlorophenol Cold Soaking Treatment

All of the costs of preparation incident to the hot and cold bath treatment are incurred with this method, but the cost of actual treating is somewhat less. Preservative costs are about the same, depending of course upon how long the posts remain in the solution and how much preservative they absorb. Table 11 shows the cost of this treatment when absorption is held to the desired ¼ gallon per post.

Posts treated in this way may be expected to last fully as long as posts treated by the hot and cold bath method since just as good absorptions are obtained. While service records are only ten years old, there is every indication of a 20-year average life. If posts treated in this manner will last so long, the cost per post per year is only one and six-tenths cents.

Table 11. Costs of pentachlorophenol cold soak treatment.

Labor	$0.26
Preservative	0.06
Equipment depreciation	0.01
Total	$0.33

Table 12 constitutes a summary and comparison of the costs of treating by the various methods.

Community Treating Plants

Thus far all discussion in this treatise has centered about methods of treatment and plants which may be used by an individual farmer. There is, however, considerable interest about the state in small commercial or cooperative treating enterprises designed to fit the needs of communities. Without a separate study on the needs for such plants, costs of operation, etc., it is hard to make any definite recommendations. Some information, however, has been collected in connection with the other work on treating and may be of value to persons interested in these small scale treating plants.

Most Mississippi counties will probably support a profitable small plant. A good county has 10 or 12 townships each of which would require about 100,000 posts to divide it into 160 acre lots. If we accept the anticipated demand of 6,000,000 posts a year for the state and divide by the number of counties, we arrive at an annual county demand for nearly 75,000 posts. A good efficient plant of the hot and cold bath type can probably handle about 600 posts per day. If nothing but posts were treated in this plant, a demand of 180,000 per year would be necessary to insure continuous operation. There is no reason, however, why all kinds of construction material, bridge timbers, etc., should not be handled at the same plant.

Types of Plants Adapted to Community Use

There are almost as many ideas about the most suitable type of small scale treating plant as there are persons interested in such plants. No one, however, (except the manufacturers) recommends small pressure plants. They undoubtedly give superior treatment, but the cost of such a plant is excessive and highly trained per-

Table 12. Summary of all costs of treating fence posts by various methods used at Mississippi State College in 1946, on a cost per post basis.

Method	Plant depreciation	Labor	Preservative	Fuel	Equipment depreciation	Total	Expected av. life years	Cost per post per year
Creosote hot and cold bath	$0.03	$0.29	$0.09	$0.025	$0.01	$0.445	20	$0.022
Pentachlorophenol hot and cold bath	0.03	0.31	0.07	0.03	0.01	0.45	15 to 20	0.022 to 0.030
Creosote dip	—	0.27	0.03	—	0.01	0.31	5	0.062
Osmosalts, brush	—	0.49	0.18	—	0.01	0.68	10 to 15	0.068 to 0.045
*Osmosalts, dip	—	0.27	0.18	—	0.01	0.46	10 to 15	0.046
Osmoplastic, brush	—	0.20	0.09	—	0.01	0.30	5 to 8	0.060 to 0.040
Chromated zinc chloride, steeping	—	0.10	0.15	—	0.01	0.26	10	0.026
Pentachlorophenol, cold soak	—	0.26	0.06	—	0.01	0.33	15 to 20	0.016 to 0.022

*Theoretical. See text.

sonnel is required to operate it. Estimates obtained on such plants during the course of this investigation ranged from $20,000 to $75,000. No one would be justified in investing so much in a plant to serve only a community.

The only other alternative is some large scale adaptation of the hot and cold bath plant. The cold soaking process with pentachlorophenol would not be satisfactory because it consumes too much time for use in a commercial operation. Continuous production is an important factor in the economical operation of these small plants.

Georgia's vocational agriculture teachers have set up and are operating a number of community creosoting plants which are based on the hot and cold bath process. Most of these plants consist of a single tank made of reinforced concrete or steel plate and heated through coils in the bottom which carry steam from a gin or community cannery. In operation the posts are heated in the creosote, the steam turned off and the posts and creosote allowed to cool together. There are some disadvantages to this method, chief of which are the facts that absorption is harder to control and only one charge per day can be run through the plant. Their tanks are usually 4 feet deep x 4.5 feet wide and range in length from 15 to 30 feet. Posts are handled by an overhead travelling hoist.

The Delta Branch Experiment Station, Stoneville, Mississippi, has an experimental installation which works on the true hot and cold bath principle of two tanks. These tanks are semi-circular in cross section, 5 feet wide at the top x 2.5 feet deep and about 20 feet long. The tanks are placed end to end with about four feet between them. A brick, dutch-oven furnace was constructed under one. A travelling, overhead hoist is used to pick up bundles of posts, place them in the tanks and transfer them from one tank to the other. With some modification, this design appears to be satisfactory for small scale community plants.

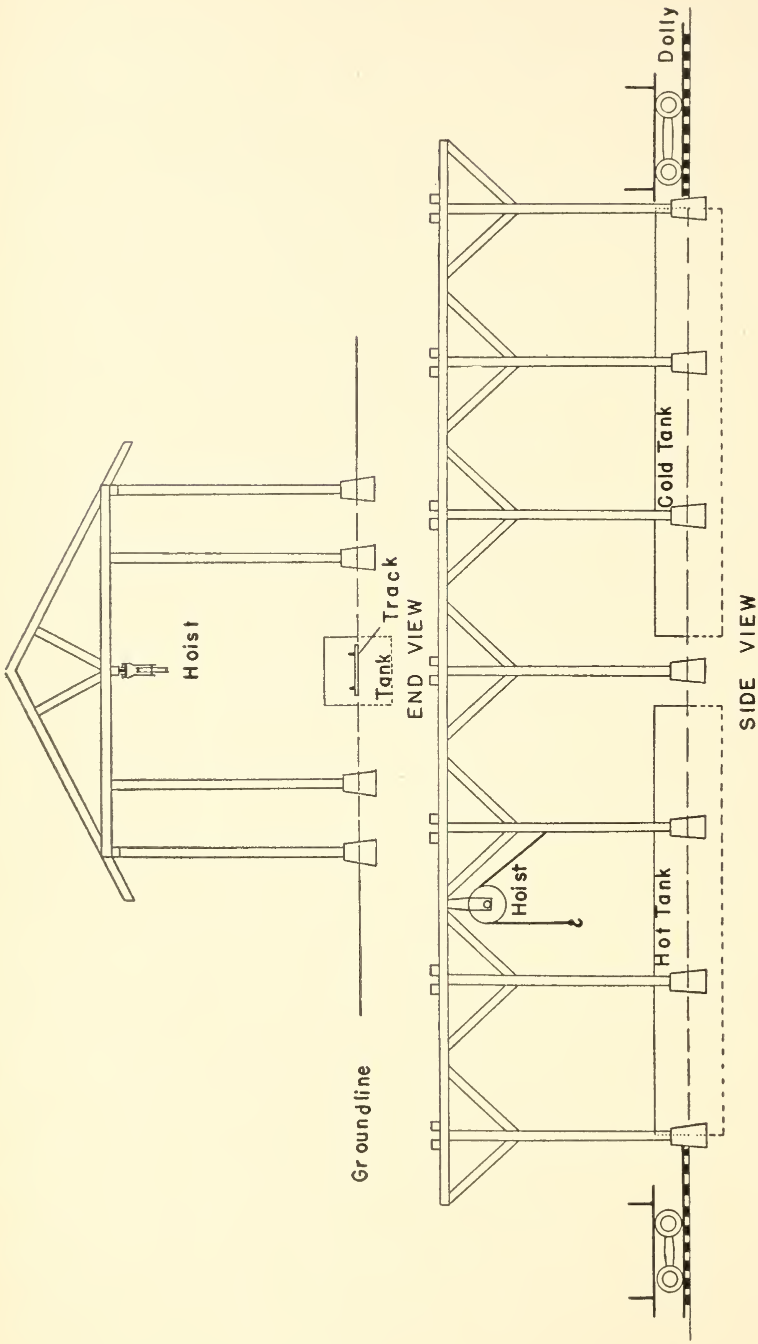
A satisfactory plant might consist of two rectangular steel tanks 4 feet deep by 4 feet wide by 25 feet long, set two feet in the ground and heated with steam coils. Steam might be supplied by a gin or sawmill boiler if available. The cold tank should be supplied with coils too, so that exhaust steam from the hot tank or cold water may be used to raise or lower the temperature of the oil in the cold bath. Average absorptions will be easy to check if a gauge, reading in gallons, is installed on the cold tank. A thermometer should be placed on the hot tank. An overhead, traveling hoist should be provided for moving charges, and several dollies would be a distinct advantage in moving charges to the tanks and away from them. Charging the tanks would be facilitated if oil storage tanks of carload capacity were provided. A shed should cover the entire plant. Posts may be treated half-length only by providing a removable skeletal partition to divide each tank into compartments 4 x 5 feet. Some method of exerting pressure to submerge charges to be treated full length is necessary. A hinged rack could be devised which would be operated by means of cables and pulleys, the power to be furnished by the overhead hoist.

Figure 10 and 11 show the diagrammatic layout of such a plant.

An advantageous adjunct to any small treating plant would be a small, mechanical, peeling machine. Several have been developed, but the field is still wide open. A machine somewhat similar to the pole sizing machine in use at large treating plants, but on a smaller scale, might be satisfactory.

Costs of Operation

A very complete plant sufficient to serve the needs of a county could be built for a cost of $10,000. Such a plant would have a life of at least 10 years. It would have a capacity of at least 600 posts per



DIAGRAMMATIC VIEW OF SMALL PLANT

Scale 1" = 5'

FIGURE II.

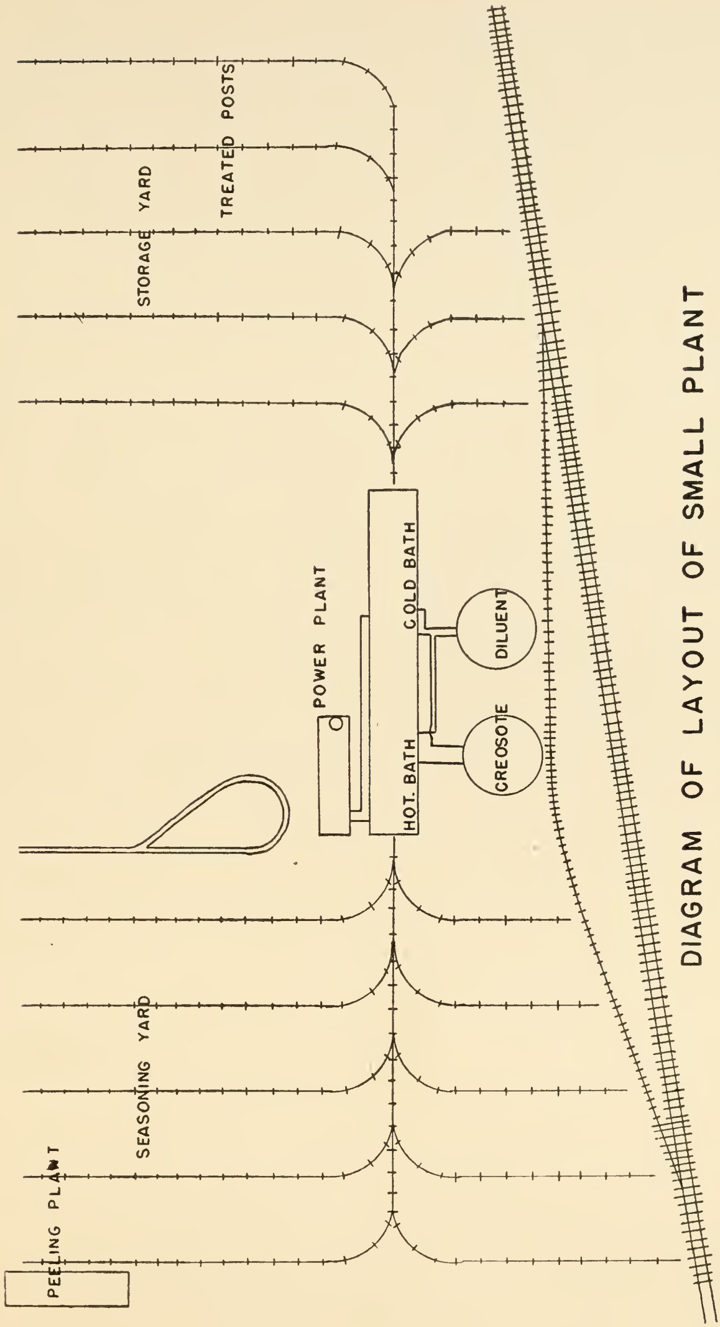


DIAGRAM OF LAYOUT OF SMALL PLANT

FIGURE 12.

day. In a year's time, operating 300 days out of the year it would treat the equivalent of 180,000 posts. The plant could be operated by three men. Labor costs might be 85 cents an hour for the trained operator and 65 cents an hour for the other two men. A supply of posts, necessary to start operations might cost 10 cents each. An estimate of the daily and per post cost of operation is given in table 13.

Profit of 3 cents on the post (or post equivalent) would return over 50 percent of the investment to the operator in a year's time. A system whereby the farmer could bring in green, unpeeled posts and trade them, paying the difference in cash, for treated posts, would be very advantageous.

The best preservative for use in these plants will probably be creosote as it is somewhat cheaper in carload lots than is pentachlorophenol. The cost of preservative may be reduced by diluting the oil in the hot bath with fuel oil, crank case oil, etc., in the proportion of 1 to 1.

All of the figures and ideas presented in this section are theoretical and are based on the author's best judgment rather than on any actual operations. This must be borne in mind when attempting to use them in any contemplated plant construction or operation. The local conditions with respect to demand for treated posts, labor, equipment cost, and operating costs should be carefully investigated. We have merely attempted here to outline some of the possibilities.

Table 13. Estimated daily and per post cost of operation of small commercial hot and cold bath plant.

	Daily	Per post (600 posts per day)
Depreciation	$ 3.33	$0.005
Operating costs, fuel, etc.	12.00	0.020
Labor	17.20	0.030
Preservative	25.50	0.042
Creosote at 17 cents gal. in carload lots		
Post cost	60.00	0.100
Total	$118.03	$0.197
Allowance for taxes, etc.		.013
Total		.220
Profit		.03
Cost of post to consumer		$ .25

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