Problems in the SEASONING of SOUTHERN HARDWOODS

FIGURE 1-

Showing red gum logs heavily sap stained during storage in the mill yard- A considerable amount of sap rot has already developed and many of the boards cut from the logs will contain infection.

WITH the rapid decrease in our forest resources comes the economic necessity of converting the tree volume into the maximum amount of salable lumber of the highest possible grades- If by careful and efficient methods a given annual output can be maintained with a smaller drain on the stumpage ho'ding of a mill company, much will be gained.

Lumbermen today are coming to a keen appreciation of the public and private benefits which may be brought about by improving log storage and seasoning practice. The problems of the Southern lumberman are of especial interest and importance in this connection, because with the depletion of the Northern hardwood forests the center of production is swinging farther south year by year. Moreover, the exploitation of Southern hardwood is made peculiarly difficult by the inherent tendency of the wood to check and warp and by the pestilent activities of wood-destroying insects and fungi, The Forest Products Laboratory, during the last few years, has devoted a great deal of attention to seasoning problems of this character, and while many questions are yet to be answered, helpful progress has been made. The, outstanding losses in logging and seasoning practice will be briefly reviewed here and an account given of what has been done to reduce them.

LOSSES IN HANDLING AND STORAGE—METHODS OF PRESERVATION

A great part of the loss due to fungi, insects. and checking occurs in the more valuable hardWood species selected for particular utilization (Figs. 1 and 2). Owing to seasonal logging and other conditions prevailing in the various industries, much of the raw material is accumulated and stored in quantities in order to insure an adequate supply (Fig. 2). The piles may be erected in the woods, at shipping points, at the mill, or at the manufacturing plant. Very often the storage of logs in the woods, at shipping points, or along railroad spurs or main lines is carried on in a haphazard fashion and the logs are bulked without skids on swampy or undrained ground- Here they may be left for a consderable time before they are finally loaded and shipped to destination. During this period stain and decay organisms enter the logs, heart rots continue to develop (Figs- 3 and 4), end checks make their appearance, and insects begin and continue their destructive activities. The data thus far accumulated indicate that the loss due to decay in stored logs represents from three to as high as 50 per cent of the merchantable volume. Even if we assume that the lowest figure, or three per cent, is lost through decay in storage, this would inflict an annual loss of 310 million cubic feet on the basis of the total 1922 production of those forest, industries which usually store logs for considerable periods. The equivalent loss of lumber is more than one million hoard feet. with an approximate money value of $42 250 000. This is the nation's minimum annual bill for waste in log storage and handling due to decay alone. The addition of losses due to sap stain, end checks- and insect depredations would perhaps double the estimate. A dequate preventive measures would mean not only better stock for the purchaser and bigger profits for the operator: but ultimately a direct saving of stumpage. It is quite possible that a concern planning on a ten-year supply of logs from its timber lands would be able to extend this to a twelve or a fourteen year cut by insuring proper log storage.

FIGURES 3 AND 4.

Hardwood logs in storage showing the fruiting bodies of wood-rotting fungi developing from the decaying heartwood. These signs indicate that the rot is probably extending itself and gradually reducing the volume of sound wood.

To complete the story, however. we must add to the log storage losses the subsequent losses due to the deterioration of lumber cut from insect or fungus-infected logs. This accounts for much of the heavy bluing and rotting of air-seasoned sap gum and for the well known "interior dote" of elm and other hardwoods (Fig. 5). Furthermore, small checks starting in the log during storage may enlarge during the seasoning of the lumber. It often happens also that boards cut from infested logs contain insects or insect larvae which may seriously damage the stock unless they are killed by heat or chemical treatment.

Of the various methods employed in preventing losses during log storage the following are to be recommended for trial: Coating the ends of logs with various mixtures: spraying the entire log with chemicals: storing logs under water; decking and rapid seasoning; barking followed by rapid seasoning. All these methods. however, plainly imply delayed handling and log storage- The best method, if possible, is to avoid slow handling or storage altogether- Mills throughout the country unable to avoid storage or slow handling have tried all of the above methods and more—without, however, obtaining anything like uniformly satisfactory results.

As long ago as 1907 Dr. Hermann von Schrenk (see his "Sap Rot and Other Diseases of the Red Gum," U- S- Dept- Agric- B. P. I- Bul- 114) coated the ends of red gum logs with a thin layer of coal tar creosote and found the treatment fairly successful. Although it did not inhibit the action of fungi coming in through the broken bark along the

FIGURE 2.

The yard of a large hardwood plant, showing long piles of stored hardwood logs, track facilities, and steam loader- Many of these logs when sawed showed from one to three feet at the ends badly decayed

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sides, it did effectively prevent the stain and rot organisms from entering the ends of the logs. The cost of this end coating was eight cents per thousand board feet. An aim of the Forest Products Laboratory at the present time is to develop an ideal end coating that shall be (1) cheap and without discoloring effect upon the log interior; (2) easy to handle and apply; (3) not easily removed by water; (4) not, harmful to the saw; and (5) really effective in preventing stain, rot, end checks, and insect damage. With this end in view the formulae shown below are suggested for trial. Although no final prediction can be made as to the success of these particular mixtures, it is hoped that the trials by individual mills under practical conditions may point the way to the most effective combinations.

COATINGS AGAINST FUNGI AND INSECTS

Two mixtures suitable for tests in preventing fungous and insect attack but not intended for the prevention of end checks are the following:

Kerosene and Coal Tar Creosote

Kerosene ..... 3 parts
Coal tar creosote, grade 1, liquid oil ..,1 part

Strain, then use as spray over ends and sides of logs. May be used for either spray or brush treatment of entire peeled logs where slight discoloration caused by the chemical is not objectionable.

Kerosene-Cresol

Kerosene ..... 10 parts
Cresol ..... 1 part

Can be used as a spray or a brush treatment over ends and barked areas with slight if any discoloration-

ALL-PURPOSE COATINGS

Formulae for end coatings aimed at preventing end checks as well as stain, decay, and insect attack are as follows:

Creosote-Pitch

Coal tar creosote, grade 1, liquid oil ..... 1 part
Coal tar pitch ..... 1 part

Can be used as a coarse spray or a brush treatment to log ends and barked areas where slight discoloration of wood is not objectionable-

Pine Oil-Pitch

Pine pitch ..... 7 parts
Pine oil, crude ..... 3 parts

Can be applied either as a spray or brush treatment to log ends and barked areas without discoloration of the wood.

Gloss Oil and Cresol

Hardened gloss oil (see U. S. Forest Products Laboratory Tech- Note No 186 for proper specification) ..... 10 parts
Cresol ..... 1 part

Can be applied as a brush treatment-

Betanaphthol, orthodichlorobenzine, sodium flouride, or other chemicals may be used in place of cresol-

Effect on color of wood not determined

Kaolin-Cresol

Kaolin ..... 50 parts
Water (or enough to make a stiff paste) ..... 40 parts
Cresol ..... 5 parts
Linseed oil ..... 5 parts

Apply as a paste to ends of logs and barked areas. This treatment should not discolor the wood.

Brushing the exposed surfaces of logs with an antiseptic solution and then spraying with melted paraffin is to be recommended. The one drawback is the necessity for keeping the paraffin not for spraying.

SPECIAL SPRAYS FOR INSECTS

The spraying of logs with various chemical solutions has found favor, more particularly in the control of insects which infest logs. The Bureau of Entomology of the U. S. Department of Agriculture recommends spraying with a solution of orthodichlorobenzine or of coal tar creosote as an insecticide-

CONSIDERATIONS RELATING TO STORAGE

It is a well known fact that the storage of logs under water is an effective means of preventing losses due to fungi and insects and of avoiding checks. The logs should be completely covered with water, however, because partial submersion or an alternate wetting and drying will favor the entrance of fungi and insects, and will no doubt produce checks.

Stain and decay will not develop in well seasoned and well cared-for logs, since the moisture content is insufficient. Checks may appear as the result of rapid drying, however, and certain insects may find the conditions favorable able. To accelerate drying with a view to preventing stain and decay, the practice of decking logs on high skids may prove beneficial, although checks and a certain amount of insect damage may follow. Where practicable in extreme cases, barking and decking the logs at the proper time may prove effective in preventing all damage but that due to checks. Incidentally, all the methods presented except storage under water may be used at the same time-

It is well to repeat that the ideal plan is to avoid slow handling or storage. If the log is

FIGURE 8-

Flat-piled gum. Note the overlap arrangement of stickers at the end of the pile, the central "chimney," and the height of the foundation- The loose stickers and rubbish around the piles detract from an ideal example.

FIGURE 6-

End-racking of sap gum- The job shown here is far from perfect- The ideal method of end-racking is to place the boards at right angles to each other, with crossing at the extreme ends.

kept moving from the time it is cut from the tree until it is sawed at the mill, there will be a minimum of sap stain and decay, and the damage due either to insects or to end checks will be greatly reduced.

AIR-SEASONING OF HARDWOOD LUMBER

Air-seasoning of native hardwoods to a so-called shipping weight is and probably will continue to be a common practice at the Southern mills, despite the fact that at best the method is wasteful of the nation's forest capital and is a cause of financial loss to the sawmill man and in some cases to the manufacturer of the fabricated article. But before kiln-drying hardwoods green from the saw becomes common, the principles underlying the art of kiln-drying will have to be more generally understood and shown to be practical. For the Southern species some further study of drying characteristics will be necessary. In the meantime, however,' enough work has been accomplished along the line of improved air-drying to point the way toward annual savingsl of millions of feet of valuable hardwood lumber.

At one of the representative and progressive Southern hardwood mills it was found that blue stain and sap rot last year caused a loss of about $40,000. At another mill a loss of 35 per cent in oak was reported as being due to honey-combing alone. Checking and warping are common to ad species and cause enormous losses which can, nevertheless, be greatly reduced. The losses are producd by defects which vary in kind and degree with the item of lumber affected-

SAP GUM

To reduce the degrades due to rot, stain, and certain insects, the surface of sap gum lumber should be dried to 30 per cent as rapidly as possible. This will inhibit the development of wood destroying fungi and stains- The sap stains do not cause decay, but spoil the appearance of the lumber for a number of uses. It must always be borne in mind that conditions favoring the development of sap stains also favor the decay-producing fungi. The degrade from checks and warp can be controlled if rapid drying can ha stopped at about 30 per cent and the stock then properly flat piled. Flat piling of the freshly sawed sap gum should be avoided, especially during the season favorable to the growth of fungi Decay infections occurring in the green boards may continue to develop while lumber slowly seasons, in which case the decay may extend into the sound portions of the board and the area first infected becomes soft And doty.

End-racking Sap Gum

The chief benefit of end-racking is rapid initial surface drying. End-racking of plain-sawed sap gum in thicknesses up to 6-4 inch and quarter-sawed sa-p gum of all thicknesses for a period ranging from 8 to 15 days allows drying of the surface o the boards to a point where mold and rot do not thrive (Figs- 6 and 7). Afterward the stock may be flat piled so as to prevent the warping and checking which are sure to result from end-racking alone-

From the results of end-racking at various sawmills, the following conclusions relative to the most efficient methods have been reached:

1. The racks should be built about 16 feet long and perpendicular to the alley- This plan faci Rates handling, economizes the yard space already laid out for flat piling, and in some cases promotes a more efficient movement of air through the lumber-

2. The lumber should cross at the extreme ends to form an inverted V (Fig. 6) rather than an X (Fig- 7)- It thus becomes necessary to vary the heights of the racks to accommodate the different lengths. This procedure will reduce end checking to a great extent and prevent an unsightly strip of moldy wood in the center of the board.

3. There is a tendency for the bottom ends of boards which are already infected to continue rotting and for- adjacent sound boards to develop decay- As a precaution the footings should be placed at least a foot above the ground; they should preferably be treated with a good wood preservative, and the ground kept free of debris and weeds-

When sap gum is air-dried by the combination of end-racking and flat piling in the best known manner, the degrade is much less than occurs when flat piling alone is used. End-racking is a forward step and may be as far as some sawmill men feel that they can afford to go toward improved seasoning practice-

As a matter of fact, air-drying sap gum by any known method is far from satisfactory- To cut down 'degrade by end-racking involves an increase of yard space, tramways, etc., in addition to the extra handling costs. The fact that the method offers minimum protection against warping and checks makes it necessary to rehandle the stock into a stickered flat pile just as soon as the surface of the wood is dry enough to resist stain and rot- When the varying temperatures, humidities, and rates of air movement are considered, it becomes evident that difficulty will be encountered in adjusting yard routine so as to get the sap gum out of the racks before it has had time to warp and check.

A preliminary steaming treatment is a great improvement over air-drying alone. It will be discussed in detail further along-

AIR-DRYING OF OAK AND PLAIN RED GUM

Oak and plain red gum are not heavily degraded by stain and rot the principal causes of degrade being checks, honeycomb, and warp- These defects can be controlled in some measure by flat piling the stock according to certain rules- The air-seasoning studies of the Forest Products Laboratory have thus far been limited largely to softwoods, but the fundamental principles of air-seasoning, are applicable to hardwoods as well.

The following practices (see Forest Products Laboratory Note A-1) are recommended for hardwoods.

1. The pile bottoms should not be less than 18 to 24 inches above the ground at the rear end of the pile, and the ground kept clear of vegetation, stickers, old boards, or anything which might hinder the air movement under the loads. The stringers should be free from fungous life. Some of these points are illustrated in Fig. 8.

2. The piles should not exceed 6 feet in width.

3. The piles need not be more than 6 feet apart- Reducing this distance between piles, or otherwise retarding the air movement through the lumber, will slow up the drying rate and decrease surface checking but, on the other hand, will tend to encourage fungous growth- To prevent surface checking and collapse the rate of circulation should be reduced; to prevent fungous development the piles should be opened up, thereby permitting faster air movement- The method of piling will therefore be determined to a certain extent by the predominant seasoning defects of the species to be dried-

4. The lengths of stock should be kept separate; stickers should be placed in correct vertical alignment in rows about 20 inches apart; the end stickers should project beyond the end face of the pile about one-half inch in order to prevent end checking-

5. The stickers should be about one inch thick and in general need not be more than an inch wide, though it will be found convenient

FIGURE 5-

Upper photograph shows the clear surface of an elm plank which, when sawed, disclosed the central areas filled with "interior dote," as shown in the lower photograph- Proper steaming treatment previous to piling in the yard for air seasoning will eliminate most of this costly defect-

to have stickers about 1½ inches wide for the ends, thus providing for overhang-

6. The stickers for gum and oak, as well as for Southern hardwoods *in* general, should be cut from seasoned heartwood of red gum and should be frequently sterilized by steaming to 200 degrees F- If a steam box, retort, or kiln is available, the procedure will be simple-

7. The piles should be equipped with good covering boards- Ordinarily, worthless old warped stock is used for this purpose. Such boards may throw a fairly good shade, but as roofing they are open to criticism. Recent tests have shown that much of the degrade in red gum and oak is due to checks resulting from rapid drying after exposure to rain. A roof is usually expected to shed water-

In general, then, there are two types of air-drying practices—each designed to reduce the degrade peculiar to certain classes of defects- End-racking followed by flat piling is best suited for lumber which is largely degraded by rot and stain. Flat piling, with a view to controlling the drying rate, will reduce checking and honeycombing somewhat- A number of the mills could reduce seasoning losses by giving their yards more careful attention- But air-seasoning of Southern hardwood green from the saw to shipping dry weight at the very best is wasteful of our forest resources and reduces the profits of the sawmilling industry-

KILN-DRYING

Kiln-drying of the Southern hardwoods from a green condition to a relatively low moisture content is- growing in popularity as a seasoning method- Kiln manufacturers are making great strides toward the development of a perfect kiln. Some lumbermen, after planning to kiln-dry a fractional part of their stock green from the saw, after careful investigation are installing the best kilns they can buy.

The success of this movement depends primarily upon whether or not the dry kilns installed are susceptible of close temperature and humidity control, and whether or not the circulation is rapid enough to insure the desired drying conditions in all parts-

The big financial savings to be gained by kiln-drying have been so readily shown by even cursory investigations that there is little wonder that good business men are venturing into the process- Kiln-drying makes it possible to book orders for lumber which has not yet been sawed because the seasoning period is so short that delivery can be guaranteed in a reasonable time- For instance, in a recent experiment 4-4 quartered red gum green from the saw was dried to seven per cent in 11 days—without any degrade- As this article is written a schedule is being followed which gives promise of drying 10-4 and 12-4 plain sap gum satisfactorily in about two weeks. These items are not air-seasoned in summer. because of the resultant excessive degrade-

The present status of hardwood studies indicated that kiln-drying will enable the lumberman to cut from orders rather than in anticipation of the market, thereby reducing the tie-up of capital involved in large air-seasoned yard stocks-

A case in point: A mill man found a demand for 12-4 first and second cypress 14 inches and wider- The cost of cutting and handling was very high, and before the stock was dry enough to ship there was no longer a market for the material- It had to be re-manufactured into more salable sizes, and the manufacturer, instead of getting a premium on the high-grade timber, took a loss because the goods and the market were not ready at the same time. This is, of course, an isolated case, but the fact remains that the practice of cutting on orders, made possible only by the use of dry kilns, is the cure for all such losses and will put the sawmill business on a more stable basis. Increased turnover and reduction in freight charges are also points in favor of kiln-drying green from the saw-

Kiln-drying ordinarily kills fungi and wood-destroying insects- (See U- S- Department of Agriculture Bulletin 1262-) No further damage can be done by fungi to *a* kiln-dried board unless the board becomes reinfected when its surface is wet- Furthermore, unless it remains wet for some time the fungus can do no real damage, for its progress depends on an adequate moisture supply.

NEED OF RESEARCH

A number of kiln-drying problems still call for careful study- Perhaps the most difficult of all, though some progress has been made toward a solution, is the matter of drying thick quarter-sawed oak and gum rapidly without "collapse," or excessive shrinkage in thickness. Flat-sawed swamp oak is notable for its checking propensities, but this difficulty can be overcome by using high humidities and low temperatures at the beginning of a kiln run- A recent experiment in the field showed that when the dry-bulb temperature did not not exceed 116 degrees F- for the first eight days and the relative humidity was held at 85 per cent, no checking occurred- During the same period, however, the stock dried slower in the kiln than matched stock put out in the yard to air-dry in the usual manner- Nevertheless with respect to freedom from checking the advantage was all with the kiln-dried stock.

SURFACE CHECKS IN OAK LUMBER

Small surface checks in profusion will occur on lowland Southern oak during either air-seasoning or kiln-drying if the temperatures and humidities are not properly controlled. Such checks usually close up tight by the time the lumber is ready for shipment and therefore pass the lumber inspector unnoticed- Here the importance of proper kiln-drying may be lost sight of, because air-dried oak in which the checks have closed sells for as much money as kiln-dried stock of the same grade which never was checked- But the air-dried lumber containing closed checks is not and—regardless of any corrective treatment—never will be as good as stock free of this defect. To make it suitable for high-grade cabinet work, the manufacturers have to season it further and in the end condition or steam it to relieve case-hardening- The little innocent-looking checks which formed in the yard open up again and swallow manufacturing profits, and the most valuable lumber must be put to an inferior use. In a certain coffin factory the losses due to this one cause are known to run into thousands of dollars annually.

Until it is generally recognized that the formation of checks at any stage of drying is a detriment to the efficient utilization of the board, the kiln-drying of lowland oak green from the saw for furniture and cabinet use will not be economical. The more easily dried Northern and Southern highland oak can be bought for cabinet work and the more refractory Southern swamp oak converted into products which can stand some checks without degrade- Sooner or later, though, the swamp oak will have to take a more important place in the cabinet industry and stock kiln-dried without checks will then be at a premium.

LOSSES IN KILN-DRYING

A composite value of the loss sustained by the Southern lumberman on account of kiln-drying is not available; individual losses are not expressed in the same terms. But from the figures obtained in a recent survey "of the Southern hardwood mills, there is no question that the aggregate loss is huge- It is equally certain that by improving kiln equipment and kiln operation the losses could be greatly reduced with large net financial gains.

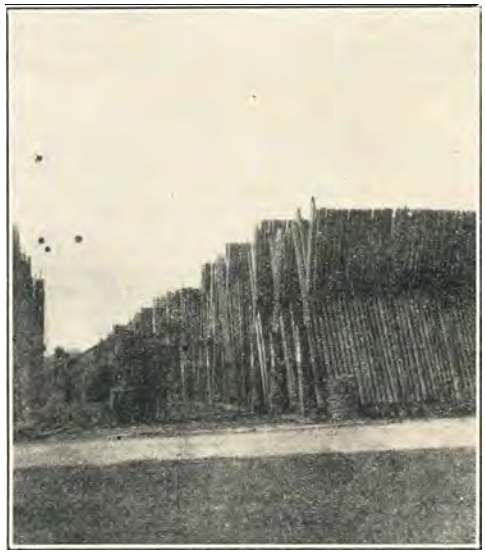


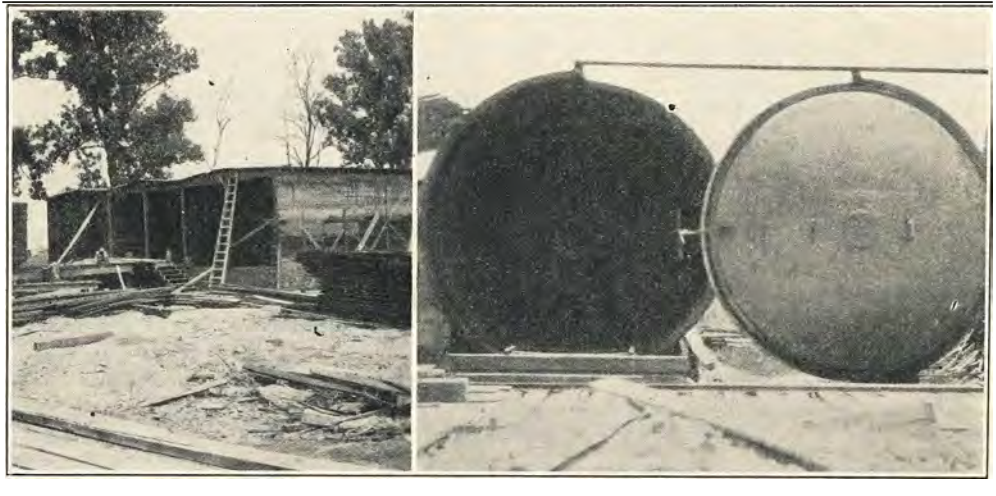
FIGURE 7-

A yard of end-racked gum. Creosote was painted on the lumber where the boards cross to eliminate stain, but the treatment was unsatisfactory- X piling allows the stock to end check, whereas with end-crossing this defect is considerably reduced.

Kiln-drying is not a mysterious ceremonial rite, the success of which depends on some occult characteristic of a certain make of kiln. Dry-kiln construction is simply an engineering problem to construct a room in which temperatures, humidities, and circulation can be controlled to suit the requirements of the class of stock being dried. Kiln-drying will be a success whenever the three essential factors have been properly worked out and the kiln has been put in the charge of a competent operator.

KILN-DRYING PRELIMINARY TO AIR-DRYING

Recent experiments were conducted at a Southern hardwood mill to determine whether or not it was feasible to give hardwoods a partial drying in the kiln as a preliminary to air-drying. Obviously, if the process proved a success, an economic saving in kiln equipment could be effected. The Forest Products Laboratory has long advocated kiln-drying of hardwoods green from the saw, but the time required to reduce the weight of a charge of



FIGURES 9 AND 10-

Left—Experimental "steam. boxes" in process of construction at a Southern hardwood mill- Each room will hold about 40,000 board feet of open-piled lumber- One of the rooms is equipped as an internal fan kiln- Right—Type of steam cylinder used in the pressure steaming of certain hardwoods, such as sap gum. The cylinder holds one truck-load of open-piled lumber, appproximately 3,000 board feet.

lumber has tied a kiln up longer than most lumbermen thought practical- For this reason probably more than for any other, kiln-drying has not received the popular support of the hardwood mill man-

The results of the experiments were most gratifying, although the problem was entirely too complex to afford a definite answer in all phases in the few weeks available for the study. The data indicate that a kiln treatment followed by air-drying is actually more practicable in reducing lumber to a shipping dry weight than either kiln-drying or air-drying alone- The scheme was found particularly suited to plain-sawed red gum and even the refractory Southern oaks. It developed that 4-4 plain red gum lost about 1 1-2 pounds of water per board foot when dried in an internal fan kiln for 50 hours at a temperature of 160 degrees and 75 per cent relative humidity, with a degrade of less than one per cent- Fig 9 shows the experimental kilns under construction-

After 16 days of air-drying the average weight of 400 feet was 3-2 pounds per foot, at which weight some of the material was shipped. One truck was a little heavy, but the rest was as dry as the usual three months' old stock- Although it might be a little rash to plan a 4-4 plain red gum turnover every 16 days, the data nevertheless show unmistakably that a short cut has been discovered- The early stages of drying, when the stock is wet, are favorable for the development of fungi and checks- The preliminary kiln treatment disposes of the fungi, and by proper humidity control in the kiln the checks can be prevented- The net result of the treatment is that the lumber comes to shipping dry weight in a bright, flat condition and practically free from seasoning defects- As previously pointed out, the stock must be protected from both sun and rain after removal from the kiln-

The behavior of plain-sawed swamp red oak under the combined kiln and air-drying process gives promise of revolutionizing seasoning methods for this refractory material- When steamed to a temperature of 160 degrees F-, and *cooled* in saturation to 120 degrees, then dried at a temperature of about 115 degree. and high relative humidities, the test stock showed no surface checking either in the kiln or when put in the yard- That such results are, to say the least, unusual will be realized by all who have been burdened with the problem of seasoning the species in question-

STEAMING PRELIMINARY TO AIR-DRYING

Steam preliminary to air-drying, whether the chamber used is a steam cylinder at high pressures or a steam box or dry kiln at atmospheric pressure, is indeed a boon to the manufacturer of woods which are primarily degraded by the attack of sap stains, rot, and worms- Preliminary steaming, like kiln-drying, is less effective than it should be, for the reason that operation at some plants is carried on blindly without regard to what the treatment is expected to accomplish-

Steaming at high temperature is beneficial for two reasons: first, it sterilizes the wood by killing the rot and stain fungi and insects; second, it furnishes heat for rapid surface drying when the stock is pulled out- But the technique of preliminary steaming must be right; the losses usually charged to the process itself should really be charged to faulty operation.

STEAMING SAP GUM

In the case of sap gum, for instance, if the material is allowed to cool in the preparator or steam box in a saturated atmosphere, the remaining heat is insufficient to dry the surface rapidly upon exposure to the outside air. In reality the surface may be wetter than before steaming and is in fact an ideal condi tion for the germination and rapid development' of fungus spores alighting out of every breeze-

Fungi will develop on green sap gum even after steaming If It is bulk piled for even a short time, from which it would seem that unless the surface is dried by evaporation as fast as the moisture transfuses through the wood from the inside, the surface is soon put in a condition favorable for fungous infestation, In order, then, for a steaming treatment to be beneficial to the seasoning of sap gum, it is necessary to pull the stock out of the steaming chamber hot, avoid bulking, and thereafter keep it drying as fast as weather conditions will permit, taking care to stack it properly and to shelter it with an adequate roof-

STEAMING AS A CURE FOR DOTE IN ELM

Elm, particularly in the heavier dimensions, deg. ades badly from interior dote- It is estimated that 1,250,000 board feet of Southern elm are rejected annually in Detroit yards on this account- The prevalence of dote lowers the standard and debars Southern elm from the place it would otherwise occupy in the manufacturing world- Steaming for two or three hours at 180 degrees F. is a cure for the difficulty, and when once the treatment becomes a general practice the market for elm be larger- As a matter of fact, all Southern hardwoods can be steamed beneficially-

THEORY OF STEAMING

Steaming seems to boil and wash away certain elements of the sap liquid- It is possible that the elements washed away from the lumber are more or less necessary to fungous life. It is upon this theory that at some plants the sap gum is steamed for 14 hours- and longer in a steam box at atmospheric pressure- Experiments made by the Forest Products Laboratory indicate that, however necessary the sap liquid may be to the development of fungi, a steaming treatment of four or five hours is as beneficial from the practical standpoint as the longer periods.

Since saturated steam can give up its heat by condensing, a pound of water results from every pound of steam required to warm up a load of lumber in a preparator, kiln, or steam box- If the water settles on and soaks into the lumber, the gain in heat content must expend itself in evaporating the moisture deposited on it by the steam, and the lumber is no drier after cooling than it was before steaming. A real gain of heat in a steaming treatment, then, can be effected only by stacking the stock so that the water will run off before it is absorbed- Theoretically, edge piling would be the ideal arrangement- The proper duration of the treatment from the standpoint of drying results would be the time required to heat the wood and its contained water to the temperature of the surroundomg medium. Roughly, the time can be estimated at one hour for each inch in thickness- Some additional time may be allowed to insure sterilization. Most fungi are kilted in 4-4 stock when ex= posed for 40 or 50 minutes to a 'temperature of 200 degrees F- For 8-4 stock at the same temperature an exposure of 1% hours was found effective- In the case of insects present in the green lumber, personal observations indicated that the steaming treatment-4 to 5 hours at 200 degrees F-—was fatal to them- (See article by Snyder in Journal of American Forestry, December, 1923-)

PRESSURE STEAMING

In certain regions of the South, lumber green from the saw is given a preparatory steaming treatment under pressure previous to seasoning in the yard- The equipment used consists of heavy plate-metal cylinders equipped with track, trucks, and a close-fitting door (Fig- 10).

The schedules for steaming in these cylinders vary considerably. For 4-4 sap gum the time of steaming allowed ranges from 15 to 40 minutes and the gauge pressure from 20 to 30 pounds- For 6-4 stock, periods of 20 to 30 minutes at approximately 30 pounds pressure are found in use, while for 8-4 material 45 minutes at 30 pounds pressure is a frequent allowance- Both red gum and red oak are treated by this process at one mill, under the following schedules: 6-4-inch red gum, 40 minutes at 15 pounds pressure; 8-4-inch red gum, 50 minutes at 10 pounds pressure; 6-4-inch red oak, 30 minutes at 25 pounds pressure-

The mills using such apparatus claim that it appreciably shortens the air seasoning period, prevents stain, mold and decay, and eliminates certain mechanical defects common to air-dried stock- Care must be taken. however, to avoid severe surface checking. Bulk piling after leaving the retort encourages fungous growth; therefore rapid handling from the cylinder to the pile is essential in preventing sap stain-

In addition to the advantages mentioned, it is of interest to note that the high temperatures used, if maintained for sufficient periods of time, are positively effective in killing the fungi and insects present in the green boards- It has been reported that piling the lumber to allow sufficient slope for draining the condensed moisture is beneficial in removing the surface sap and making the board a less favorable medium for fungous growth.

THE STEAM BOX

Within the last year the Forest Products Laboratory has made a special study of steaming Southern hardwoods in a two-tracked end-piled room 60 feet long. The advantages of the treatment became apparent from the start- It was found that 4-4 plain sap gum when steamed 5 hours at about 200 degrees F., was dry enough to ship within 7 to 10 days- The stock was practically free of checks- It was straight, and flat, and exceptionally clear and bright.- The end rot so common in sap gum had been arrested before it had had time to develop into a source of degrade-

SCHEDULES

The data show conclusively that 4-4 plain sap gum, ash, and black gum can be suc- treated in a steam box. The best results were obtained by opening both doors at the conclusion of the steam treatment- After about `'2 hours the box could then be unloaded comfortably- If the requisite kiln cars and tracking facilities are available at a mill, the lumber should be left on the cars for 10 days or two weeks, after which (with summer drying conditions) it is then usually ready to ship-

Different in behavior were plain red gum and oak (4-4 stock), which surface-checked severely when given a similar treatment, that is, 200 degrees for 5 hours and pulled hot. This difficulty was overcome by keeping the doors closed after the steaming treatment until the stock had cooled to about 140 degrees- Pulling the charge at this temperature almost eliminated the surface checking- The treatment was so effective in killing the fungi and worms, and the subsequent drying rate on the yard so satisfactory, that no experiments were made with shorter steaming periods-

For quarter-sawed gum and oak, the steaming was not shown by the study to be good practice. Aside from the destruction of fungi and worms, no special advantage was noted. The quarter-sawed stock (4-4, 8-4, and 10-4) after being steamed seemed to shrink and collapse. worse than, unsteamed material. The data, however, are not conclusive on this point- More work will have to be done with quarter-sawed items before definite _conclusions can be reached about them.

ADVANTAGE OF THE STEAM BOX TREATMENT

Large quantites of lumber can probably be steamed cheaply in a steam box- The treatment sterilizes the stock and the subsequent drying rate on the yard is faster than stock which is air-dried alone. If properly handled there is little danger of stock ever becoming dozy, and stain is reduced to a minimum- The appearance of the lumber is very pleasing- It is bright and straight, and checks are rare-

The steaming treatment has been found to be an efficient method of straightening badly warped air-dried sap gum. What this means to the gum industry can hardly be appeciated until one has taken a census of the large amount of warped sap lying around almost every hardwood sawmill-

SUMMARY

1. Southern sawmill operators can greatly improve their hardwood product by taking advantage of improved methods of log storage and seasoning-

2. Men who have spent years in pine mills are now engaged in the manufacture of hardwood lumber- Much must be learned and unlearned before the Southern hardwoods can be exploited with the minimum waste and maximum profits-

3. The Southern mills are now being hurt because some of their products are not up to the standard- The popularity of oak flooring is on the wane- Southern elm is being avoided on account of interior dote- The soft, dozy sap gum won't hold screws and nails well enough for the automobile and upholstering industries, and other woods are being substituted-

4. Experimental research is about the only economical' corrective for these handicaps- The Forest Products Laboratory is eager to render any assistance possible, either by dissemination of information already available or by co-operating in studies of new problems-