SENIOR THESIS

"IMPROVEMENTS IN ARTIFICIAL SEASONING"

Submitted

by

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PREFACE

This paper deals with the process of artificial seasoning. Since the lumber industry at the present time is in a position where it must raise the quality of its product, artificial seasoning is rapidly gaining in significance and is one of the means employed to raise the quality and increase the adaptability of lumber.

In this paper I have tried to show the relative importance of artificial seasoning, the general conditions and methods of kiln drying and the improvements which have been made. Material on this subject is rather limited but from the information which I have gathered and compiled from various sources I hope I have succeeded, at least to a limited extent to show the status of artificial seasoning and the vast field of study which it embodies if improvements are to be made.

Everald Nelson

TABLE OF CONTENTS

TABLE OF CONTENTS

"IMPROVEMENTS IN ARTIFICIAL SEASONING"

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Progress in artificial seasoning has been stimulated and continues to be stimulated by the realization that if the lumber industry is to survive, it is necessary to turn out a product of such quality that it can compete with the many wood substitutes and will be satisfactory to the wood working trades. The lumber industry is finding an extensive market for its product in these trades since the amount used in wood using industries is now within 10% of that used for constructional purposes. The demands of these trades are for good lumber carefully refined, graded, and properly seasoned.

A few years ago only the highest grades of lumber were dried artificially since the process was regarded as too expensive. Only the larger mills had dry kiln facilities and such equipment was considered more an auxiliary than a necessity. Today dry kilns are regarded as a necessary part of every sawmill equipment, and a large percentage of the lumber is dried in this manner.

Dry kilns also make possible a saving in transportation costs. The lumber industry at the present time is paying in the neighborhood of $300,000,000 per year for transportation of its product. This can be substantially reduced by lowering the moisture content, thus reducing the weight in some cases as much as one third or one half

the original weight. At the present time specifications for standard moisture contents have been adopted by the Southern Pine Association and this is the trend in the West Coast Lumbermen's Association since the specifications for moisture contents are listed in the grading rules but adherence to them is optional. In making standardized and certified grades of lumber, standard moisture contents of lumber properly seasoned will be the big item in making possible a product of exact quality which can meet the needs and specifications of the most exacting consumers.

In the minds of many who are not familiar with the improved methods of kiln drying, this process at its best is but an inferior substitute for the natural process of drying brought about by the ordinary atmospheric conditions. However, regardless of this attitude, the kiln drying of lumber has made rapid strides in past years and the present trend is toward improvements and experiments which will give a better end product.

Arthur Koehler and Rolf Thelen in their book "Kiln Drying of Lumber", make the statement that of the 20,000,000,000 feet of lumber that are kiln dried annually, most of it consists of the upper grades. This is a significant fact since this amount comprises more than half of the total amount of lumber used in the United States each year.

The drying of lumber by artificial means has progressed with the rapidity it has due to numerous reasons, the two primary ones being, (1) to reduce its moisture content more rapidly than can be done in air drying, and (2) to reduce the moisture content below that attainable in air drying. Where air drying would require several months or an entire season, kiln drying can be done in a few days or in two or three weeks. In this locality a moisture content of from 12 to 20% is the lowest attainable in air drying while with the use of dry kilns a bone dry condition can be reached if desired. Where wood is to be used in heated buildings or even in out-of-doors where tight joints are necessary, it is necessary to dry the material to a comparatively low moisture content, approximately 4 to 8%. It would be impossible under the ordinary atmospheric conditions to reach this per cent.

Rapid drying means a quick turnover of capital, a more flexible operation, less capital tied up in yards and lower insurance costs and taxes.

Several other reasons for using kilns may be given, (1) If lumber is properly kiln dried, there is less deterioration due to stain, decay, insect attack, checking, warping, casehardening, and honeycombing while drying than usually occurs in air seasoning. (2) The high temperature of a kiln causes much of the pitch in resinous woods to come to the surface, later to be dressed off,

while that remaining in the interior is hardened. This a disadvantage of air seasoning since this pitch is not hardened and after the wood is put into use the pitch may exude and cause a disagreeable condition. This may also take place where the material has been seasoned artificially if high enough temperatures have not been used which will harden the pitch. (3) Lumber dried at a high temperature loses some of its capacity to hold moisture and under certain conditions does not shrink and swell so much as that which is dried under low temperatures. (4) Properly kiln dried lumber causes less trouble in gluing and painting than air dried stock. (5) Less handling of lumber usually is required when it is kiln dried without preliminary air drying. This results in a saving of labor charges. (6) Wood destroying and sap stain fungi are killed by the temperatures usually maintained in kiln drying. (7) Insects are killed by the high temperatures used.

Those who were prejudiced to kiln drying claimed that the natural method must undoubtedly be better than any artificial method in which man interferes with the process of nature. A little thought will show the absurdity of such a belief. In attempting to dry lumber by artificial means man does not interfere with the laws of nature but makes efficient use of them. Of course the successful seasoning of lumber by artificial means depends upon a

number of considerations and consequently no arbitrary statement can be made in favor of either one of the processes which will hold for all conditions. Enough experimental work has been done however, to indicate that with proper care all kinds of lumber can be dried in a kiln with fully as good or better results as far as the quality of the lumber is concerned as can be obtained in air drying.

The early attempts to season lumber artificially consisted of crude equipment and methods to say the least. Very likely the first attempts consisted of stacking lumber in open piles in a warm room and allowing it to remain until dry or until needed. The lack of proper kiln drying methods however is evidenced by the open joints and checks in high grade furniture which has been preserved in museums.

Later a separate room or special building was used for this purpose and the dry kiln came into existence. The first kilns built in Europe consisted of a chamber with a perforated floor beneath which a fire was built. The smoke and hot air from the fire passed through the lumber piled openly on the floor above and out through a vent in the ceiling. It was considered advantageous to burn green branches of the same kind of wood that was being dried in order to get the best results. Some kilns were provided with a fire box or furnace over which a basin of water was

kept to humidify the air.

An even less elaborate kiln, known as the "smoke kiln" or "Arkansas kiln" is still in use at the present time in the southern states. This kiln consists of a platform set on posts boarded in on three sides. Lumber is piled on the platform and a fire built underneath it, the smoke and heated gases passing through the lumber pile. The lumber is of course blackened by the smoke, but the discoloration is dressed off later.

From these early forms the dry kiln has passed through a number of modifications until the present perfected types were reached. There are still many improvements yet to be made and several dry kiln companies are constantly working in an attempt to further improve the methods of artificial seasoning.

The low efficiency and poor results obtained from the early types of kilns cannot be attributed to any one cause but to many. In the first place it was a new field and little was known. Theories were advanced which rather than being a step forward proved to be in direct contrast to what actually should take place. For example it is sometimes claimed that wood dries from the inside out, that is, the interior becomes dry first. This is supposed to be accomplished by heating the lumber through to the interior; the high temperature is then supposed to drive the moisture out. A little reflection will show

that the interior of any substance cannot become dry before the exterior is at least equally dry. If high temperature in itself did "drive" moisture, it would first drive it toward the center of the lumber as it is being heated, and later, when the interior became as hot as the surface, the moisture would go neither in one direction nor in the other.

Moisture travels from the inside to the surface layers only because the surface layers are drier, the moisture having a natural tendency to pass from the wetter to the drier portion. Therefore while lumber is drying, the outer shell must always have a somewhat lower moisture content than the core.

The equipment was crude in the early years of artificial drying. No methods were used to force circulation or to supply humidity and the supply sources of heat were ineffective. At first it was believed that heat was all that was necessary to dry the stock. Today it is well known that heat, humidity, and circulation are not only necessary but must be properly controlled, if lumber is to be dried rapidly and without injury.

From these early types the dry kiln has evolved until kilns having reversible circulation and automatic control apparatus regulated by clockworks or electricity may be said to be the latest developments in the mechanical construction of kilns.

Numerous makes of kilns are on the market, each designed along special lines with one or more characteristic features, but they all fall into two classes, as far as the method of operation is concerned, namely the progressive and the compartment kiln. Both have been in use for many years and each has its own field of usefulness.

The progressive kiln finds its greatest field of usefulness at the sawmill, planing mill and factory where large quantities of easily dried stock are turned out continuously, while compartment kilns find favor at the mill or factory where different kinds of lumber each in comparatively small quantities or woods difficult to dry are handled or when ever refined drying is to be done. The tendency at the present time is toward a greater use of compartment kilns as the charge is under the control of the operator during the entire period and conditions can be changed from time to time thus giving a better final product.

Kilns may be further classified as to the method of getting rid of the excess moisture in the air into the ventilating and the condensing types or as to the method of bringing about movement of air into the natural draught and forced draught types.

In ventilating kilns the fresh air is taken in from outdoors and a certain amount of moist air is

expelled. This includes both natural and forced draught kilns. Inlet and outlet ducts and flues are provided in nearly all ventilated kilns, their location depending upon the type and the make of the kiln. In condensing kilns, the same air is used over and over again except what leaks out and some means is provided for removing some of the moisture from the air. Condensers and blowers are often used for this purpose.

The tendency in modern up to date mills is toward more efficient dry kilns, however very crude forms are still in use. The cost of installing improved kilns cause the mill management to get along with the old types if at all possible. The efficiency obtained from these kilns is extremely low. When one considers the fact that in some kilns the ends are open, he will have some idea of the loss when kilns at the best seldom run higher than 50 of 60 per cent efficient.

Sources of losses which lower the efficiency are many. Some can be prevented or at least overcome to a large extent while others will no doubt always be present, since the machine of 100% efficiency is yet to be made. Factors lowering the efficiency may be roughly divided into those due to the equipment and those due to the operator. Under the first group we have such things as type of kiln building, location and type of flues, type and arrangement of fans and air ducts, kind and placement

of heating coils, kind of heating system, and the type of control instruments.

Inefficiency due to the operator results from lack of knowledge concerning general principles, uneven piling of loads, loads improperly built, that is, placement of stickers, poor maintenance of equipment and not following the proper drying schedule.

Each of these factors will be taken up separately and some attempt made to show how improvements are being made by prominent dry kiln companies.

A poor kiln building will undo all the efficient drying otherwise possible. Material for a kiln should have a low thermal conductivity so that the walls and roof will have a low heat conductance. Hollow tile is the material most commonly used. However many kilns built by the Moore Dry Kiln company are of wood frame with ply roofing or building paper between the layers of lumber. This makes a satisfactory type of building but the fire insurance rate is high and the construction is not permanent.

Kilns of concrete construction are also built. The concrete, although not having the high insulating value, makes a permanent type of construction. In cold countries where such construction is used some form of insulation is employed to reduce heat losses, particularly through the roof.

Several kinds of insulation might be used. The thermal conductivities of various insulations and construction materials appear in the following table:

Material	Thermal Conductivity
Firtex	.31
Douglas Fir	1.00
Concrete	9.46
Sawdust	.41
Building Brick	3-6
Masonite	.33
Diatomaceous earth	.31
White Pine	.78

Dry kiln doors in all cases should be insulated, especially in cold climates. A common form is some form of insulation covered on both sides with some sheet metal.

In connection with the building may be considered the location of flues or vents, their purpose being for ventilation, that is the escape of moisture laden air. Flues may be so located that the air passes out through them rather than following the desired course of circulation. In the Northwest Blower kiln the flues were located in the center of the roof. An air duct was placed between these underneath the load. The idea was to have the air go up on each side of the load and down through the center. Rather than following this course much of it

took the path of least resistance and passed out through the flues. These flues were open at all times, no way of closing them being possible. The flues today are such that they can be opened or closed according to conditions. One of the late developments in this regard is the Cone Automatic vent control, which was invented by Mr. Cone of the Longbell Lumber Company. This was supposed to be a great improvement since it was so designed that the vents would be automatically opened and closed according to the humidity. The vents are operated by a humidity control instrument and whenever the humidity becomes too high the vents are automatically opened and likewise when the air becomes dry they are closed. Their main purpose was to reduce the high humidity due to evaporation of water from the lumber. Their use in many kilns is impractical however, since this excess humidity is kept down by the leakage of the kiln building.

I might mention at this point that the improvements which I will describe are those developed by the Moore Dry Kiln Company. This company has done as much or more than any other kiln company toward the improvement of artificial seasoning.

Since it is necessary that the moist air be carried away from the lumber and heat carried to it, circulation is probably one of the most important things in successful

dry kilning. It is a common belief that circulation hastens the drying, but it does this only by supplying heat and carrying away moisture. Circulation in itself does not evaporate moisture. It should also be remembered that drying should not be regulated by the circulation, which should always be active but by the temperature and humidity.

Circulation in a kiln may be induced by gravity or by mechanical means. Circulation by gravity is brought about by the rising of hot air because it is expanded and has become lighter whenever there is cooler air to take its place. It is believed by some that after the air has passed through the lumber it is heavier because of the moisture it has picked up and therefore seeks the lower levels. This is not the reason. It is heavier than when it entered the pile because it is cooler. Moist air is lighter than dry air of the same temperature because when water vapor is present in air it replaces the air, thus the combination is lighter. Gravity as a means of producing circulation is not depended on in modern kilns, its greatest objection being that it is too slow.

Two general methods are used for producing circulation mechanically, (1) jets or sprays of water or steam, and (2) power driven fans and blowers. Water sprays are used only in the water spray kiln of which they are the unique element. Steam sprays are used in practically every type

of kiln as they serve to increase the humidity as well as the circulation and are also used for preliminary steaming, intermittent steaming and high humidity treatments. They are not nearly so efficient as power driven fans or blowers which are without question the most efficient producers of circulation and are coming into increasing favor.

The latest development in circulation is by the Moore Dry kiln Company and is the variable speed circulation which is a new and exclusive feature of their Reversible Cross Circulation kilns. In addition to the greater ease of perfecting dry kiln schedules that this improvement brings, it saves power and steam without affecting the time, speed or quality of drying. With this improvement it is possible to vary the rate of circulation as the charge changes in moisture content. In green lumber the cell walls are saturated with water but in addition to this, free water is contained in the cell cavities. It is obvious that when lumber contains so much water, a very rapid drying rate can be maintained at the surface for as fast as the water is evaporated, more water is brought to the surface, the cell walls acting like the wicks in a kerosene lamp. Experience has proved that the best means of providing a very rapid rate of evaporation at the surface when the lumber contains free water is by

means of a rapid circulation of air which brings heat to the lumber more efficiently and brushes away the surface film of vapor from the wood, Therefore a high rate of air circulation in the kiln is demanded in this stage of the drying process.

Finally, however, a point is reached when the cell cavities of the wood become empty and the wick like action of the cell walls no longer draws moisture to the surface so rapidly. This point is known as the fiber saturation point. In other words, when further evaporation will result in an actual reduction in the moisture content of the cell walls themselves, the fiber saturation point has been reached. When the lumber contains approximately 25% moisture, that is when it reaches the fiber saturation point, a further reduction of the moisture content will produce shrinkage as water will then be removed from the cell walls. Now, when the fiber saturation point has been reached, too rapid surface drying will evaporate the moisture from the cell walls near the surface more rapidly than it can diffuse or spread through the lumber, or can be carried to the surface by the capillary action of the minute layers of wood in the cell wall. Therefore the surface drying rate may be decreased either by increasing the relative humidity in the kiln, reducing the temperature or by reducing the speed of circulation. The latter is

probably the easiest and the most satisfactory as well as affecting a saving. With the aid of variable circulation during this last period of drying, the amount of steam spray that would otherwise be used to maintain the desired relative humidity is substantially reduced. It is obvious that much of the power required to produce adequate circulation is saved. By this method the drying rate can be more easily kept under the full control of the kiln operator, yet the advantages of positive and uniform circulation are fully maintained to the very end of the drying period.

By reversible cross circulation is meant that the air currents pass through the lumber alternately from one side to the other depending on the direction the fans are run. This is an advantage since it insures uniform drying of both sides of the load.

Reversible cross circulation kilns also elliminates wasted wpace in the loads due to the leaving of chimneys or flues left to aid circulation. Loads can also be built with no spaces between the edges of the boards. This increases the holding capacity of the kiln 20 to 50 per cent. In "A" flue stacking thick stickers are necessary for satisfactory drying and the cost of piling is materially increased.

In the Moore Reversible Cross Circulation kiln

multiblade disc fans are distributed on eight foot centers throughout the kiln and produce a free flow of air at a high velocity uniformly across the coils, sprays, and lumber in one continuous circuit. Twelve bladed, thirty six inch reversible fans are used, delivering the same amount of air when turning in either direction. They are of sturdy construction and are of the most efficient design yet devised by this company. The air ducts are open at both ends of the kiln and have graduated openings to distribute incoming air. Being amply large they enable operators to reduce humidities when required. Ventilation is direct through the roof and large dampered openings are provided which may be opened or closed to suit operating conditions.

The second necessary element in successful drying is heat. All the types and makes of kilns are based on the principle that high temperatures are required to hasten the drying process. There are several reasons why heat is necessary in a kiln, some of the most important are: (1) Heat is necessary to evaporate moisture as it comes to the surface of the lumber. (2) High temperatures hasten the transfusion of moisture from the interior to the surface. (3) Heat is required to separate water from wood below the fiber saturation point, the amount of heat per pound of water evaporated increasing as the wood becomes drier. (4) Increasing the temperature increases

the capacity of the air for moisture. It almost doubles every 20 degrees F. (5) Heat produces circulation. (6) High temperatures such as are usually maintained in a kiln prevent decay, blue stain, and mold during the kiln drying. (7) Heat makes wood plastic, that is, it reduces its tendency to develop internal stresses.

There are three ways heat may be supplied to any object namely conduction, radiation and convection. Only one of these--convection--that is by heated currents of air or vapor, is practical in lumber seasoning. Of the methods of supplying heat for the kiln including direct furnace heat, gas, electricity, hot water, and steam, steam is the one which is almost universally used.

Kilns are usually supplied with steam radiators of one kind or another but those constructed of pipe coils are in most common use. The heat, imparted to the radiators by the condensation of the steam, is transferred to the lumber by the air and vapor which pass over the radiators and then through the lumber piles. Some of the advantages of pipe coils are, low first cost, ease of manufacture and installation, ready adaptibility to a tremendous range of shapes and sizes, ease of repair by the shop mechanic or millwright and a high heat transmitting efficiency. In order that a pipe coil be efficient it must have certain qualifications. First, it must be of such size and shape

and so located that it can heat the air in the proper manner, second, it must be mechanically strong and durable and provided with a means for permitting the expansion and contraction of the individual pipes in the coil, third, it must provide for the ready escape of air and water from the entire system, fourth, it is essential in many cases that the amount of heating surface be readily adjustable by changing the number of pipes in use.

The pipe coils used for dry kiln heating fall roughly into two general classes known as header and return bend. In the former a number of pipes spring from the same supply head or header and return to a similar drip pipe which is located at the other end of the kiln.

The return bend coil is usually made up of 180 degree return elbows. This type of coil is more efficient since the heating is practically uniform from one end of the kiln to the other. In the case of the header coil the ends of the pipe at the supply end become hot first thus causing one end of the kiln to be hotter than the other.

The location of the pipes in the kiln is important and is determined by the design of the kiln and air circulation. The essential requirement is that they shall be in direct path of the circulation and shall not interfere with it beyond the friction and baffling effect caused by the passage of the air over them.

To secure the best results it is desirable that the heating surface be broken up into a number of separate units, each independent of the others so that the proper amount of heating surface for the work in hand may be selected and the steam kept up according to the units in use.

The efficiency of many kilns is lowered due to insufficient radiation surface, that is, not enough steam pipes or insufficient steam pressure. Since the temperature increases with an increase in pressure it is necessary to have a boiler of sufficient horse-power so that the maximum desired temperatures may be obtained. The following table shows how the temperature increases as the pressure increases.

Pressure in pounds absolute	Temp. in degrees F.
1	102
5	162
10	193
15	220
20	228
30	250
40	267
50	281
70	303
110	335
160	364

Care should be taken when the kiln is installed to see that large enough boiler and sufficient pipes are put in. If any of the steam pipes are outside the kiln they should be wrapped or covered with some good insulating material in order that heat loss be prevented.

Another source of loss is due to the valves and steam traps. Steam valves serve the purpose of either regulating the steam flow or to simply turn it off and on. Reducing valves are used to reduce the pressure since the pressure maintained in the steam main is frequently higher than necessary to furnish the desired temperature in the kiln. By means of such a valve the pressure can be reduced to any desired point. If these various valves are not in proper adjustment and working order, the steam will not be properly regulated, thus causing, not only a waste of heat but also an inferior grade of drying.

Steam traps also have a bearing on the efficiency of a heating system. Since steam imparts its heat through condensation it is necessary to free the coils of this water. This function is performed by steam traps which are devices that allow the escape of water but trap the steam. Therefore the proper working of these traps is essential in order to secure the maximum heat.

The third necessary element in kiln drying is humidity which is necessary for a number of reasons.

Among the most important are, (1) To prevent or to reduce surface and end checking, (2) To prevent severe casehardening and to relieve it if it does occur, (3) To hasten the transfusion of moisture, (4) To even up the moisture content and (5) To regulate the dryness of the lumber.

In order that lumber be properly dried, it is necessary that the proper humidity be maintained. This has been facilitated by means of the automatic control instruments which regulate it throughout the run. Humidity is maintained or increased by means of jets or sprays of steam. Whenever the moisture in the air becomes too low these are automatically turned on and vice versa.

Automatic devices for controlling the conditions in a kiln have probably been as great an improvement and as important as any other item in increasing the efficiency. The charge is placed in the kiln and the control instruments are set for the desired conditions. From this point until the end of the run the operator need only occasionally check the equipment and change the instruments in accordance with the drying schedule. Such instruments are of two types, the indicating type and the recording type. In the first the conditions at any one time can be seen on the instrument while in the recording instrument a record is made of the conditions throughout the run. This is made possible by connecting

the thermometers and indicating mechanism with a clockworks. One of the most satisfactory of these kinds of instruments, the Foxboro Recorder Controller, gives positive and accurate control of temperature and humidity and records them on a 12 inch chart. It is a simple instrument that automatically opens and shuts the heating and spray valves of the kiln. The dry bulb controls the heating valve and keeps the temperature of the kiln exactily at the point desired. In the same way the wet bulb controls the spray valve holding the humidity at a constant point. The temperature and humidity may be set at any point and as often as desired, the setting being done with a clock-key. There is one electric control instrument, namely the Bristol Electric, which is giving satisfactory service but as yet has not come into wide usage.

An ingenious device, The Foxboro Kilnboy, is a control mechanism which controls drying by the moisture content of the lumber. It is a scale that weighs the sample as it dries in the kiln and records the weight in terms of moisture content outside the kiln and at the same time controlling the drying schedule of the sample. The entire drying is controlled by a sample chosen and prepared in the usual way, which is placed on one end of the scale beam as if it were to be weighed. After the scale

is adjusted the entire operation becomes automatic. The sample steps up the schedule just as fast as the condition of the lumber allows.

Another device recently perfected if for the purpose of measuring the moisture content directly. This instrument, the Tag-Heppenstall Moisture Meter, as it is called, was invented by Mr. Heppenstall, also of the Longbell Lumber Company. It operates by means of dry batteries and the size of the case is about 10 by 10 by 12 inches. Weighing only 20 pounds it is convenient to carry around. To measure the moisture content it is only necessary to drive two needle points which are located on a testing handle, into the board. The switch is then turned on and the moisture content is read direct on a dial. The instrument measures the electrical resistivity of the wood across the contact needles. Investigators agree that electrical resistivity is an accurate measure of moisture content.

A great deal cannot be said concerning kiln operators except that in order to secure efficient dry kiln work, it is necessary that they have a thorough knowledge of the entire process. They are often lacking in a knowledge of the process of artificial drying as well as the fundamentals concerning the characteristics of lumber. It is here that men trained along these lines will

greatly improve the quality of lumber at a comparitively lower cost to the mill.

A common source of loss due to the operator is the uneven piling of the loads. Random lengths are placed in the load and no effort is made to have the ends even. This results in a loss of space which would under proper piling accomodate several thousand feet of lumber per month. However the operator may not be responsible for this condition in all cases. Where the loads are built by stackers it is unpreventable but if the lumber were sorted as to length this would be illiminated. Along with sorting for length goes sorting for grade and moisture content. A great saving in both time and money can be enjoyed if heartwood lumber is separated from sapwood pieces and pieces containing both heartwood and sapwood further segregated. Since sapwood contains a great deal more moisture than heartwood, it would still be wet while the heartwood would be dry if mixed pieces were dried in the same load. By segregating these pieces into separate loads this disadvantage can be overcome and the efficiency considerably increased. In building the loads care should be taken in placing the stickers. If they are not placed directly over each other, kinky lumber will result.

The operator should be familiar with the drying schedule which will best season the lumber. The

temperatures and humidities to be used must be known and the increases or decreases in each throughout the run which will produce the best seasoned product must be determined. In order to do this a knowledge of the properties and characteristics of the various woods is not only desirable but imperative.

It has been said that a good operator and poor kiln make a better combination than a poor operator and good kiln.

In conclusion, owing to the fact that greater demands are being made for better quality lumber, artificial seasoning has made the progress it has. It is a new field, a great deal is being done at present but there is much yet to be accomplished. Stimulated by this necessity and demand of wood using trades, the dry kiln has been revolutionized from the early form and rapid progress is being made toward more efficient methods, equipment, and better qualified men for their operation.

I have attempted in my paper to show briefly how this progress has taken place and some of the improvements which have changed artificial seasoning from a crude process to one of almost scientific exactness. It is with the idea of showing the importance of artificial seasoning, the general conditions existing in dry kiln operation and the improvements being made in

this field by the development of better equipment, more scientific methods and better qualified operators, that I have prepared this paper.

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