

# United States Patent

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13.8, 16.5

[56] **References Cited**  
**FOREIGN PATENTS**  
707,084 9/1961, Canada ..... 34/9.5

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[54] **WOOD DRYING AND PRESERVING PROCESS**  
8 Claims, No Drawings

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F26b 5/04

**ABSTRACT:** Wood is dried by contact with an optionally preservative-containing hydrocarbon fraction, having a boiling range of not greater than 70° F. at a temperature of from about 125° F. to about 275° F. followed by exposure to subatmospheric pressure.

## WOOD DRYING AND PRESERVING PROCESS

## BACKGROUND OF THE INVENTION

All wood of any commercial importance is subject to deterioration after cutting and the degree and kind of deterioration depends on the type of use to which the wood is put. There are, of course, a number of natural agencies of wood deterioration, among which are wood-destroying (decay producing) fungi, molds, wood-boring insects such as termites and powderpost beetles, marine borers such as ship worms, martesia and limnoran, and the different kinds of deterioration which are normally referred to as weathering.

To combat this deterioration, before use green wood either as lumber or timber is dried and then treated with preservative chemical solutions. Conventionally, the drying and preservative treating are carried out in two distinct steps.

The wood drying step is suitably effected, on a commercial scale, either by tunnel air drying processes or by kiln drying processes, all of which are usually very time consuming, typically talking as long as 150 hours to produce woods having an acceptably low water content. Air drying by prolonged yard seasoning (generally from 3 months to 3 years) is also used.

Other more rapid drying processes have been developed but have received but very limited industry acceptance. U.S. Pat. No. 3,199,211, issued Aug. 10, 1965 to Bescher, describes a process whereby green wood is dried by contact with heated low-boiling aliphatic hydrocarbons such as isobutane at a pressure high enough to maintain the hydrocarbon as a liquid, followed by pressure release to vaporize the hydrocarbon and water. Many safety precautions must be taken to prevent explosion when using processes of this type. Another quick drying process is described in U.S. Pat. No. 2,892,261 issued Jun. 30, 1959 to Hutchinson, wherein green lumber is dried by steaming followed by contact with a nonaqueous solvent, preferably a wide-boiling oil, under conditions so as to not absorb oil into the lumber. As pointed out in U.S. Pat. No. 3,205,589 issued Sept. 14, 1965 to Fies et al. this type of process has a major disadvantage in that residual oil is deposited in the lumber which is very difficult to remove without having to resort to conditions so harsh as to be impractical or as to overly dehydrate the resulting wood product. Failure to remove residual drying oil results in a wood product which is not receptive to subsequent preservative treatment, which generally has a surface not suitable for painting, and which tends to have a relatively dark color. As indicated by a lack of commercial application, these product disadvantages generally more than offset any processing advantages of prior oil-drying processes.

For a more detailed consideration of various prior techniques for oil drying of wood, and the attendant difficulties involved, reference should be made to Reports No. 1665 (Revised) and R1665, respectively, entitled "Special Methods of Seasoning Wood; Boiling in Oily Liquids" and "Special Methods of Seasoning Wood; Boiling in Oil" published in Apr. 1956 and Feb. 1947 by the Forest Products Laboratory, an agency of the U.S. Dept. of Agriculture Forest Service.

It has been common practice to treat the wood with preservative as a second distinct process step following drying. A wide variety of organic preservative materials have been employed, for example, creosote-coal tar mixtures, betanaphthol, chlorinated tar acids, chlorophenols, and their derivatives and the like and inorganic materials such as copper naphthenate. Conventionally, an aqueous or an inexpensive wide-boiling hydrocarbon fraction solution of preservative chemical is used so as to place the preservative in a form that will penetrate the cells of the woods.

In this second treating step these preservative solutions are generally forced into the wood under pressure. In a widely accepted procedure, this treating step involves subjecting the dried wood to a predetermined air pressure (superatmospheric or subatmospheric, depending on whether empty cell or full cell retention is desired) and without releasing this pressure, introducing a bath of preservative onto the wood, then in-

creasing the pressure and optionally increasing the temperature and maintaining this elevated pressure for an interval of time. Thereafter the bath of preservative is removed from the wood and the wood is subjected to subatmospheric pressure whereby excess preservative and some residual preservative solvent is removed from the wood.

When high boiling organic-solvented preservative solutions are used, sludging problems often arise such as, for example, darkening of the resulting wood and production of an unpaintable product. Residuums of preservative solutions having wide-boiling high boiling range solvents often "bleed" from the treated wood.

## STATEMENT OF THE INVENTION

It has now been found that green and partially unseasoned woods can be rapidly dried by subjecting the wood to contact with a liquid narrow-boiling hydrocarbon fraction having an initial boiling point higher than the boiling point of water at elevated temperatures and subatmospheric pressure and then subjecting the wood to subatmospheric pressure in the absence of narrow-boiling liquid hydrocarbon to remove residual water and liquid hydrocarbon. In a preferred embodiment of the invention, preservative chemicals are incorporated into the liquid narrow-boiling hydrocarbon fraction and superatmospheric pressure is optionally applied while the wood is being treated with hydrocarbon so as to promote penetration of the preservative solution and thus effect drying and preservative treating simultaneously in a single step process. Wood dried, and preferably dried and preserved, using the process of the invention is exceptionally free of discoloration and is very suitable for painting.

## DETAILED DESCRIPTION OF THE INVENTION

## Narrow-Boiling Hydrocarbon Fraction

It is essential to the process of the invention to contact the wood with a heated liquid hydrocarbon fraction having a narrow boiling range which is above the boiling point of water. Generally suitable are individual aliphatic and aromatic hydrocarbons having atmospheric pressure boiling points of from about 250° F. and about 400° F. for example, the linear and branched nonanes and nonylenes, decanes and decylenes, undecanes and undecylenes, dodecanes and dodecylenes, toluene, the xylenes, diethyl benzene and the propyl and butyl benzenes and the like and also aliphatic and aromatic hydrocarbon fractions having initial atmospheric pressure boiling points of from about 250° F. to about 350° F. and which have atmospheric pressure boiling ranges from initial boiling point to end point of not greater than about 70° F.

Preferred among these are aliphatic and aromatic hydrocarbon fractions having Tag Closed Cup flash points of at least about 90° F. and having boiling ranges of not greater than about 60° F. Especially preferred among narrow-boiling aliphatic and aromatic hydrocarbon fractions are those having Tag Closed Cup flash points of at least about 100° F., having initial boiling points of from about 275° F. to about 325° F., having boiling ranges of not greater than about 50° F. and having 90 percent overhead distillation temperatures not greater than 30° F. above initial boiling points. For comparison, conventional mineral spirit or kerosene fractions have boiling ranges of about 100° F. (i.e. from 300—400° F. and 350—500° F. respectively) and generally have a 90 percent overhead temperature substantially greater than 30° F. above initial boiling temperature.

Because of greater availability, those narrow-boiling fractions having a predominant proportion of aliphatics are generally preferred. When preservative chemicals are to be added to these narrow-boiling fractions it is often desirable to use fractions containing at least about 10 percent by volume aromatics and preferably from about 20 to about 40 percent by volume aromatics to enhance preservative solubility.

## Preservative Chemicals

Preservative chemicals which may suitably be used in the process of the invention include the conventional organic and inorganic preservatives such as the chloro phenols, beta-naphthol, chlorinated tar acids, copper naphthenate, and the like. Preferred among these are the chlorphenols with pentachlorophenol being especially preferred.

Other materials, such as waterproofing agents, "antibloom" agents, fire proofing agents and the like may also be added to the treating solutions.

#### Operating Conditions

The process of the invention may be suitably used for drying and preferably simultaneously drying and preservative treating all types of green or partially unseasoned wood. Depending on the type of wood being treated and the extent of drying and treating desired it may be beneficial to vary these operating conditions to some degree.

The wood is contacted with the narrow-boiling hydrocarbon at elevated temperatures. Generally temperatures of from about 125° F. to about 275° F. may be used with temperatures of from about 135° F. to about 250° F. being very suitable and temperatures of from about 140° F. to about 220° F. being preferred. These temperatures are generally lower than conventional drying temperatures. As a result, there is far less potential damage to the wood fibers and a lower heating expense than with conventional processes.

The invention is not limited by the manner in which the wood is contacted with the hydrocarbon. Generally a batch process wherein the wood is immersed in the hydrocarbon is preferred. The wood may be stacked in a retort prior to filling the retort with hydrocarbon. The hydrocarbon may either be brought to operating temperature prior to contacting with the wood or may be heated up during contact. In any case, it is desirable to contact the wood with the hydrocarbon at full operating temperature for at least about 0.25 hour and preferably for from about 0.5 hour to about 12 hours. If drying alone is desired, contact times of from about 0.5 hour to about 6 hours are usually most suitable. If a preservative is added to the hydrocarbon and thorough penetration of the wood is desired, contact times of from about 2 hours to about 8 hours are usually most suitable.

When drying alone is desired, it is suitable to carry out the hydrocarbon contacting at atmospheric pressure. Alternatively, a subatmospheric pressure, which is higher than the vapor pressure of the hydrocarbon at the contacting temperature, may be employed for at least a part of the contacting period. When especially dense, hard to penetrate woods such as mountain spruce are dried it may be desirable to increase contacting time.

When, in addition to drying, preserving is desired, it is generally advisable to apply superatmospheric pressure during at least a part of the hydrocarbon contacting. The amount of pressure is not critical, with conventional preserving pressures, such as from about 10 to about 250 p.s.i.g., being very suitable.

Following contact with the hydrocarbon the wood is removed therefrom by any suitable means, for example, by lifting the wood from the hydrocarbon or by pumping the hydrocarbon from the treating vessel. With the wood still approximately at the treating temperature, subatmospheric pressure (vacuum) is applied to the wood and the wood is then permitted to gradually cool. The subatmospheric pressure employed is suitably selected lower than the vapor pressure of the hydrocarbon fraction used at the treating temperature. Subatmospheric pressures of from about 0.2 inches of mercury to about 20 inches of mercury absolute may be employed with subatmospheric pressures intermediate about 0.5 inches of mercury and about 10 inches of mercury absolute being preferred. More than one subatmospheric pressure may be applied, for example, a higher pressure being used initially followed by a lower pressure.

Subatmospheric pressure is initially applied at about the treating temperature, which temperature may be maintained if desired. While the wood is later cooled, the subatmospheric

pressure is preferably continued. Generally, the subatmospheric pressure is suitably applied for a total of from about 0.5 hours to about 24 hours depending on the degree of drying and hydrocarbon removal desired. Very good wood products, having low water contents and no evidence of solvent bleeding are produced from most woods when subatmospheric pressure is applied for from about 1 hour to about 12 hours.

The process of the invention will be further described by the following examples.

#### EXAMPLE I

Fourteen untreated Douglas fir poles, averaging 12 inches in diameter, having moisture contents varying from stump-green 79 percent by weight to 25 percent were placed in a commercial scale retort. Approximately 25,000 gallons of treating solution were then added at ambient pressure and temperature so as to totally submerge the poles. The treating solution was composed of 5 percent by weight of pentachlorophenol, 6.25 percent by weight of a water repellent additive concentrate marketed by Chapman Chemical Co. and 88.75 percent by weight of a narrow-boiling hydrocarbon fraction having a boiling range of from 308 to 350° F. and a Tag Closed Cup flash point of about 104° F. containing about 30 percent by volume aromatics and the remainder aliphatics. The temperature of the retort was then gradually raised to 170° F. over a period of 1 hour. After attaining this temperature at ambient pressure, the retort absolute pressure was reduced to 7 inches of mercury. After 6 hours at these conditions, the treating solution was pumped out of the retort, and the pressure further lowered to 3 inches of mercury absolute, where it was maintained for an additional 4 hours, still at 170° F. Vacuum was then gradually broken while the retort was cooled. Total heating time was 11 hours. The poles were removed and inspected immediately following cooling. The wood surface presented a superior appearance, being of light color, and giving the appearance of being freshly kiln-dried. Two different commercial paints were applied to sample poles immediately following cooling. The paints dried normally, adhered well and even after several months showed no lack of adhesion or discoloration, indicative of preservative bleeding.

Core samples were taken from the poles before and after single-step treatment. The moisture contents of these samples were measured, representative results are given in Table I.

TABLE I.—MOISTURE CONTENTS OF FOUR REPRESENTATIVE POLES

Sample:	Initial moisture, percent	After treatment moisture, percent
A.....	79.79	35.52
B.....	63.76	36.81
C.....	25.40	23.26
D.....	69.54	33.62

Especially green poles, for example Sample A, in Table I, showed the most pronounced drying. Poles containing from 20 percent to 30 percent initial moisture showed little moisture change by the treatment. Although no efforts were taken to promote preservative penetration, such as by application of pressure during treatment, substantial penetration was noted, in some cases complete sapwood penetration was observed.

#### EXAMPLES II & III

These Examples illustrate the use of pressure with preservative solutions containing narrow-boiling range solvents according to the invention, and illustrate the criticality of narrow-boiling solvents.

A practical size retort was loaded with kiln dried lumber (coastal fir and Ponderosa pine), including 2x4s, 133 5s and 4x4s. Sufficient treating solution to submerge the lumber was then added at ambient temperature and pressure. A treating solution identical to that used in Example I was used. At atmospheric pressure the temperature was slowly raised to

about 200° F. and there maintained for 3 hours, 110 p.s.i.g. pressure was then applied. The treating solution was then pumped out of the retort and the pressure was lowered to atmospheric. Then simultaneously the retort heat was shut off, the wood being allowed to slowly cool, and a vacuum was slowly pulled on the system eventually reaching an absolute pressure of somewhat less than about 0.5 inches of mercury. Following 1 hour, the pressure was slowly increased to atmospheric and the lumber was removed.

The surface of the lumber was light-colored, with a complete absence of sludge, and very suitable for painting. Samples of lumber were stained and then top coated with clear gloss enamel. The enamel dried normally and exhibited no softening or discoloration after 3 weeks room temperature storage. Other paints were also suitably applied.

The preservative penetration was very acceptable. 0.3 pounds of pentachlorophenol per cubic foot of wood was deposited in both coastal fit heartwood and Ponderosa pine sapwood. There was over three-eighth inch penetration of the fir heartwood and over 85 percent penetration of the Ponderosa pine sapwood.

The retort was loaded with a second charge of similar lumber. A treating solution composed of 5 percent pentachlorophenol, about 6 percent of Chapman Chemical Co. additive concentrate and the remainder (89 percent) conventional mineral spirits having a normal 100° F. boiling range (about 305—400° F.) was added and the pressure-treating procedure described above was carried out.

Following treatment, the lumber was removed, examined, and found to be markedly less desirable than that produced in the first run. It exhibited some pentachlorophenol blooming and tended to be somewhat oily and resist paint. Paint when applied discolored in places, indicating some solvent bleeding through to paint film.

The above treating experiments using the two different solvents were repeated several times. The amount of solvent recovered during the evacuation period was measured. When the wide boiling solvents were used, at most 35 percent (and generally about 30 percent) of the solvent which penetrated the lumber was recovered. When treating solutions containing the narrow-boiling solvents were used, as much as 60 percent (and generally at least 45 percent) of the solvent which penetrated the lumber was recovered. This more complete solvent recovery on a practical scale lowers processing costs and reduces the possibility of bleeding of the treated lumber.

I claim:

1. The process of drying wood comprising contacting the wood with a liquid narrow-boiling hydrocarbon fraction having an initial boiling point higher than the boiling point of water, at an elevated temperature in the range of from about 140° F. to 220° F., and then separating the wood from the narrow-boiling hydrocarbon and subjecting the wood to subatmospheric pressure in the range of from about 0.2 inches of mercury to 10 inches of mercury to remove water and residual hydrocarbon.

2. The process according to claim 1 wherein said hydrocarbon fraction has an initial atmospheric pressure boiling point of from about 250° F. to about 350° F., an atmospheric pressure boiling range from initial boiling point to end point of not greater than about 70° F. and a Tag Closed Cup flash point of at least about 90° F.

3. The process according to claim 2 wherein said hydrocarbon fraction contains a major proportion of aliphatic hydrocarbons and has a boiling range of not greater than about 60° F. and said subatmospheric pressure is less than the vapor pressure of the hydrocarbon fraction at said elevated temperature.

4. The process according to claim 3 wherein a subatmospheric pressure not lower than the vapor pressure of the hydrocarbon fraction at said elevated temperature is applied during a part of the contacting period.

5. The process of simultaneously drying and preservative treating green and partially unseasoned wood comprising contacting the wood with a preservative-containing hydrocarbon fraction having an initial atmospheric pressure boiling point of from about 250° F. to about 350° F. and a boiling range of not greater than about 60° F. at a temperature of from about 135° F. to about 250° F. from about 0.5 hours to about 12 hours and then separating the wood from said preservative-containing hydrocarbon fraction and then subjecting the wood to a pressure lower than the vapor pressure of the hydrocarbon fraction at said temperature.

6. The process according to claim 5 wherein a superatmospheric pressure is applied during the contacting of the wood with said preservative-containing hydrocarbon fraction.

7. The process according to claim 5 wherein said preservative is selected from the group consisting of chlorinated phenols, betanaphtol and copper naphthenate.

8. The process according to claim 7 wherein said preservative is pentachlorophenol.

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UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,571,943 Dated March 23, 1971

Inventor(s) Hulbert E. Sipple

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Front page, left column, after "90808" insert  
the lines  
-- [73] Assignee: Shell Oil Company, New York, New  
York, a Delaware Corporation --.

Signed and sealed this 7th day of September 1971.

(SEAL)  
Attest:

EDWARD M. FLETCHER, JR.  
Attesting Officer

ROBERT GOTTSCHALK  
Acting Commissioner of Patents