United States Patent

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[54] **METHOD TO IMPROVE THE IMPREGNATION OF WOOD**
13 Claims, No Drawings

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[50] **Field of Search** 21/7, 64; 117/57, 147, 148, 136, 47; 34/13.8

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ABSTRACT: A method to impregnate wood with a preservative, fire-retarding, stabilizing or the like wood treating agent, comprising compressing the wood across its grain for a short period of time, allowing the wood to recover from the compression and impregnating the wood with the agent while varying the pressure conditions of the wood environment.

METHOD TO IMPROVE THE IMPREGNATION OF WOOD

The present application is a divisional application of U.S. Pat. application 731,626, filed May 23, 1968 and entitled: "-WOOD DRYING METHOD," by the same applicant, now U.S. Pat. No. 3,507,053 dated Apr. 21, 1970.

The present invention relates to a method for impregnating wood with a preservative, fire-retarding, stabilizing or the like wood treating agent in fluid condition and is characterized by the fact that the wood is subjected to a perpendicular-to-grain compression treatment in order to facilitate the passage of fluids through it.

The method will be described with reference to the impregnation of preservatives in Eastern spruce lumber, as this industrial operation is of prime commercial importance in North America. However, that the same compression treatment could also be applied successfully to similar industrial processes involving the passage of fluids through the wood of the same or of other species.

Important benefits would result for the forest products industry from an improvement of the penetrability of wood to fluids, including preservatives and stabilizing agents. The behavior of various wood species differs markedly with regard to impregnation. Actually the heartwood of very common softwoods, particularly the spruces and the true firs, are considered between "difficult" and "very difficult" to penetrate and are consequently discarded from many uses. The number of such uses is constantly increasing as the specifications for durability, fire endurance or dimensional stability become more stringent and require that the normal characteristics of wood be improved. The same holds true for many hardwood species. Under these conditions, a process that will allow to slightly increase the retention and/or penetration levels of fluid preservatives, fire-retardants or stabilizing agents by these so-called "refractory" woods, while preventing wood degradation, will find a full economical justification.

The perpendicular-to-grain compression treatment which is the essential step used in the method subject of the present invention and which shall now be described, has the characteristic of being quite simple and of requiring only a small capital investment while allowing to reach the sought effect, that is: facilitate the passage of fluids through wood and/or reduce the substantial losses due to wood degradation by a too severe impregnation schedule.

Essentially the method consists to subject wood to a sufficiently high transverse or perpendicular-to-grain pressure, that is to say approaching or exceeding the elastic limit of the wood in the particular conditions where the pressure is applied. The perpendicular-to-grain crushing strength of wood, hereby defined as the stress or strain level above which the final product would be permanently damaged, makes up the only limit to the pressure that can be used.

Any method for applying the required perpendicular-to-grain pressure can be used, its effect being virtually instantaneous. So, for example, the wood can be compressed quickly or slowly; cold or warm; before or during the period of impregnation; only once, at given steps, or by cycling; on all faces of the wood pieces, or on only two of their sides; on the full length of the boards like in a platen press, or only in limited zones at one time like between rollers. However, it is evident that it will be more often practical to have the boards passing quickly one after the other between two or four parallel pressure rollers, these being part of a conveying system.

The present invention will now be illustrated by means of the following example:

EXAMPLE: PRESERVATION OF EASTERN SPRUCE STUDS

Fifty-six green, grade select and No. 1 Eastern Spruce studs were used in this preservation experiment. Their moisture content varied between 33 percent and 50 percent, with an average value of 37 percent. Before the tests, the nominal 2 inch × 4 inch material was skip-planed on four sides to an actual 1¾inch × 3⅞inch cross section. The equipment used for the transverse prepressing treatment was designed to pass lumber at any chosen speed between 10 and 50 feet per minute between two 5-inch rollers placed parallel, one over the other. This equipment is capable of exerting sufficient perpendicular-to-grain pressure to produce a thickness reduction of 12.5 percent in an 8-inch wide board through a double acting 6-inch hydraulic cylinder acting on the top roller. The amount of compressive strain, and the change in board thickness and width immediately after compression, were measured with a strain gage transducer system. The equipment served to produce thickness deformation in the studs, at a speed of 50 lineal feet per minute approximately; seven groups were thus prepressed each at one out of seven different strain levels to produce a thickness reduction in the studs of between 5 percent and 20 percent, the eighth group remaining as untreated control (see table 1).

TABLE 1

RETENTION AND PENETRATION OF PRESERVATIVE SOLUTION IN

EASTERN SPRUCE STUDS

Prepressing Treatment Strain	Nonsteamed Retention	Nonsteamed penetrated Area	Steamed Retention	Steamed Penetrated Area
%	lbs/ft³	%	lbs/ft³	%
0 (control)	8.17	15.3	9.14	22.5
5	8.38	20.8	10.43	23.7
5	8.56	19.7	10.35	24.6
10	8.72	21.9	9.80	21.8
12.5	9.73	27.0	9.66	28.7
15	10.31	22.8	10.01	22.0
17.5	10.55	26.2	11.12	27.3
20	10.92	23.5	9.98	28.0

The same preservative treatment was applied to all the material immediately after prepressing. The impregnation cycle started with half an hour vacuum at 26-inch Hg; thereafter, the release of this vacuum and the simultaneous introduction of preservative were followed by application of a 100 p.s.i. pressure during 2 hours. The preservative fluid was a 2 percent aqueous solution of a commercial product called "-greensalt," whose main components are copper sulfate, potassium dichromate and arsenic pentoxide.

The weights of the boards immediately before and after impregnation gave the net retention of preservative solution in pounds per cubic foot of wood. However, these data were completed by accurate determination of the penetrated area on cross sections located at midlength of the studs; for this purpose, the presence of preservative at the sections has been made visible by a brush application of a sodium pentachlorophenate solution. The results of the measurements are shown on the left-hand side of table 1.

Furthermore, exactly the same experiment was repeated on a similar lot of green Eastern Spruce studs, with the only exception that the material had been steamed at 210°–212° F. (Wet Bulb) during 2 hours prior to the transverse prepressing treatment. The results of the experiment on steamed lumber are shown on the right-hand side of table 1.

Finally, static bending tests were performed on specimens representing all the treated samples. The gathered data concerning the modulus of rupture (MOR) in the water-saturated state, are given in table 2.

TABLE

STRENGTH OF THE TREATED MATERIAL

Prepressing Treatment Strain %	Modulus of rupture in static bending (average of seven samples) NonSteamed p.s.i.	Steamed p.s.i.
0	5710	4478
5	5566	4406
7.5	5897	4617
10	5786	4382
12.5	5933	4454
15	5463	4534
17.5	5195	3975
20	5259	4035

For unsteamed material, the left-hand side of table 1 definitely indicates an improvement in the retention of preservative with increase of the strain level imparted during the prepressing treatment. The same holds true, but with somewhat more variations, for the area of penetration of the preservative solution.

At least with regard to the penetrated area or distribution of preservative, similar effects are shown to exist in the steamed samples (right-hand side of table 1); however, they are much less pronounced. A comparison between the two sets of results leads to the conclusion that perpendicular-to-grain prepressing could not be added to, but could replace presteaming as a treatment to counteract the poor penetrability of "refractory" woods. As indicated in table application of 2, the new method, at moderate strain levels, and without steaming, avoids the degradation of wood and the consequent reduction of its mechanical properties due to steaming. The optimum pressure for the green Eastern Spruce Studs used in this experiment is located between 10 percent and 15 percent thickness deformation.

I claim:

1. A method to improve impregnation of wood with a preservative, fire-retarding, stabilizing or the like wood treating fluid, comprising the steps of positively and mechanically compressing the wood perpendicular to its grain by pressing against opposed faces of said wood for a short period of time, at a pressure approaching or exceeding the elastic limit of the wood, but below the pressure which would permanently damage the wood, to thereby increase the permeability of the wood, allowing the wood to recover from said compression so as to regain substantially its original specific gravity and subsequently impregnating the wood with said treating fluid.

2. A method as claimed in claim 1, wherein the impregnating step comprises first placing the wood in a treatment zone at a pressure below atmospheric pressure, then allowing the treatment zone pressure to increase to atmospheric pressure while introducing the treating fluid and then increasing the treatment zone pressure to above atmospheric pressure.

3. A method as claimed in claim 1, wherein the compression step is effected at a pressure in the zone of the elastic limit of the wood.

4. A method as claimed in claim 1, wherein the compressing step is effected at a pressure which is slightly less than the pressure which would permanently damage the wood.

5. A method as claimed in claim 1, wherein the wood is in the shape of lumber and the compressing step is effected by passing said lumber between at least 1 pair of pressure rollers effecting compression in a single direction.

6. A method as claimed in claim 5, wherein the lumber passed between said rollers at a speed of about 50 feet per minute.

7. A method as claimed in claim 5, wherein said pressure rollers effect a thickness reduction of on said lumber lying between 5 and 20 percent of its thickness.

8. A method as claimed in claim 7, further including steaming said lumber before subjecting it to said compression step.

9. A method as claimed in claim 1, wherein said wood is Eastern Spruce.

10. A method as claimed in claim 2, wherein said wood is Eastern Spruce.

11. A method as claimed in claim 3, wherein said wood is Eastern Spruce.

12. A method as claimed in claim 7, wherein said wood is Eastern Spruce.

13. A method as claimed in claim 8, wherein said wood is Eastern Spruce.

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