(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 699 120 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
21.01.1998 Bulletin 1998/04

(21) Application number: **94915175.7**

(22) Date of filing: **17.05.1994**

(51) Int. Cl.[6]: **B27M 1/02**

(86) International application number:
PCT/FI94/00199

(87) International publication number:
WO 94/26485 (24.11.1994 Gazette 1994/26)

(54) METHOD FOR COMPRESSIVE SHAPE-DRYING OF WOOD

VERFAHREN ZUM IN FORM PRESSEN UND TROCKNEN VON HOLZ

PROCEDE DE SECHAGE ET DE COMPRESSION POUR LA MISE EN FORME DU BOIS

(84) Designated Contracting States:
AT BE CH DE DK ES FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **18.05.1993 FI 932246**

(43) Date of publication of application:
06.03.1996 Bulletin 1996/10

(73) Proprietor:
VALTION TEKNILLINEN TUTKIMUSKESKUS
02151 Espoo (FI)

(72) Inventors:
- **VIITANIEMI, Pertti**
  FIN-00740 Helsinki (FI)
- **KONTINEN, Paavo**
  FIN-02100 Espoo (FI)

(74) Representative:
VOSSIUS & PARTNER
Siebertstrasse 4
81675 München (DE)

(56) References cited:
GB-A- 1 129 733
GB-A- 1 426 555
SE-A- 216 911

- **DERWENT'S ABSTRACT, No. 85-247595/40, week 8540; & SU,A,1144883 (VORON FORESTRY INST), 15 March 1985 (15.03.85).**

EP 0 699 120 B1

Description

The invention is related to a method according to claim 1 for compressive shape-drying of wood.

Methods are known in the art in which dry wood is compressed to improve the surface hardness of wood. In these methods the compression operation is preceded by a drying phase which is extremely energy-hungry and time-consuming.

Corresponding methods developed for green wood are applicable to deciduous wood only. Such prior-art methods have caused checks in the compression set wood that impair the quality of the end product.

It is an object of the present invention to achieve an entirely novel method and apparatus for compressive shape-drying of wood.

The invention is based on a process in which green wood is compressed in a first phase rapidly with a high pressure, and subsequent to said compression phase, the wood is allowed to recover toward its initial dimensions, and after these phases, the compression is continued with a low pressure toward a desired compressed end dimension. At the start of the compression phase the wood is kept at a temperature of approx. 150 °C, and at the end of the workphase the temperature is advantageously approx. 125 °C.

More specifically, the method according to the invention is characterized by what is stated in the characterizing part of claim 1.

The invention provides significant benefits.

The invention is particularly advantageous in the treatment of nordic grades of coniferous wood. The method is environmentally safe as wood color can be varied by a single process without the use of hazardous chemicals. The present drying process is rapid with reference to conventional drying methods. Furthermore, the variations of the method offer a controlled technique to modify the surface hardness, strength and stiffness as well as color change properties of the wood.

In the following the invention is examined in greater detail with reference to exemplifying embodiments illustrated in the annexed drawing in which:

Figure 1 is a side view of a compression apparatus suited for implementing the invention;

Figure 2 is a pressure-time graph of the process according to the invention; and

Figure 3 is a thickness-time graph of the process represented in Fig. 2.

With reference to Fig. 1, the compression apparatus comprises an upper compression platen 5, top support columns 8 of the upper compression platen, and a lower compression platen 6 with hydraulic actuator cylinders 7. The wood-facing surfaces of the platens are heatable. Both platen surfaces are coated with steam-permeable wires 3 and 4, whose material can be, e.g., perforated sheet metal or metal fabric. The planks 1 to be compressed are placed between the wire fabrics 3 and 4, and the compression stroke is limited by backing gages 2 placed at the edges of the compression platens 5 and 6.

With reference to Fig. 2, compression is commenced with a high initial pressure of 20 kp/cm^2, which is upheld according to the exemplifying embodiment for 10 min. Next, the compression pressure is lowered to 5 kp/cm^2. Compression at this lower pressure level is maintained for 2 h 50 min.

With reference to Fig. 3, the thickness of a plank having a cross section of 50 x 100 mm (height x width) is reduced in the first compression phase to the height of the gages 2 (33 mm), then partially recovering toward the initial plank thickness reaching 37 mm thickness when the compression pressure is reduced to 5 kp/cm^2. Subsequently, the low compression pressure gradually compresses the plank toward the final thickness determined by the height of the gages 2. As a rule, the compression pressure used in this phase is such that it permits the thickness recovery of the plank by approx. 10 % of the maximum thickness compression attained during the first phase; however, the applied low pressure must be at least so high as to achieve a compression equal to the natural thickness reduction caused by the drying of the wood, whereby the occurrence of internal honeycomb checks is avoided.

The temperature of the compression platens 5 and 6 is adjusted such that the steam pressure corresponding to the temperature measured inside the wood 1 remains smaller than the applied compression pressure, whereby the steam expansion is prevented from causing checks already during the compression phase. The goal of the elevated temperature is to achieve shorter compression time. The surface temperatures of platens are controlled in the range 150 - 125 °C.

The control of the compression pressure is implemented by allowing the compression platens to rest against the gages 2 for a while just before the press is decompressed.

The applied compression time and temperature are determined by the desired end moisture content of the wood. The goal is to attain an end moisture content not greater than 3 %.

The internal temperature of the wood is typically controlled to approx. 150 °C at the start of the compression phase, and the temperature is lowered to approx. 125 °C at the end of the compression phase, whereby any risk of steam expansion at the decompression of the press is avoided.

The method according to Figs. 2 and 3 was developed as a result of the following tests:

Test 1:

A green pine plank (50x100 mm^2) was compressed

at 150 °C. The height of the gages was 33 mm and the compression pressure was 20 kp/cm^2, whereby the compression platens continuously approached each other until stopped by the gages in approx. 10 min. Thereinafter, the compression platens were kept resting against the gages for the entire duration of the compression time. The duration of the compression phase was 4 h, and when the press was decompressed, bangs caused by steam expansion were heard and multiple checks were found on the plank surfaces.

Test 2:

This test was otherwise similar to Test 1 with the exception that the upper and lower surfaces of the planks were covered by wire fabrics in accordance with Fig. 1. When the press was decompressed after 4 h compression time, no steam expansion bangs occurred and the plank surfaces remained intact. After cross-cut sawing the planks at their mid-length, internal checks were found. Such inside splits were caused by contraction of the wood during the drying phase.

By conducting the process according to the time-pressure graphs of Figs. 2 and 3, both the steam expansion bangs and the internal checks could be obviated.

Relative thickness reduction by compression (in per cent from initial thickness) is advantageously in the range of 20 - 50 % depending on the wood grade. The maximum practicable thickness reduction for coniferous wood is 40 %, and for deciduous wood, 50 %.

The typical compression pressures applied during the first compression phase are in the range of 15 - 20 kp/cm^2.

Typical duration of the first, rapid compression phase is approx. 3 - 10 % of the total duration of the compression process. In the example illustrated in Figs. 2 and 3, the first compression phase takes up approx. 5 % of the total compression time.

Claims

1. A method for compressive shape-drying of wood (1), said method comprising compressing green wood (1) in a first phase rapidly to a desired shape against gas-permeable surfaces (3,4) down to a desired end dimension and simultaneously heating the wood, wherein

   - during a second phase of the compression process the compression pressure is lowered to a level causing a thickness reduction equal to or greater than the thickness reduction caused by the drying of the wood, and

   - the internal temperature of the wood is lowered with the progress of the compression process.

2. A method as defined in claim 1, **characterized** in that the wood (1) is compressed during the second phase using such a pressure that permits the wood thickness to recover by approx. 10 % of the maximum thickness reduction attained during the first phase.

3. A method as defined in claim 1 using a wood internal temperature of 150 °C at the start of the process, **characterized** in that the internal temperature of the wood (1) is lowered to 125 °C toward the end of the second phase.

4. A method for compressive shape-drying of pine wood as defined in claim 1, **characterized** in that the relative thickness reduction is in the range of 20 - 40 %.

5. A method for compressive shape-drying of pine wood as defined in claim 1, **characterized** in that the compression pressures during the first phase are approx. 15 - 20 kp/cm^2, and during the second phase, approx. 5 kp/cm^2.

6. A method for compressive shape-drying of wood as defined in any foregoing claim, **characterized** in that the duration of the first compression phase is 3 - 10 % of the total compression time, preferably approx. 5 %.

Patentansprüche

1. Verfahren zum Druck-Formtrocknen von Holz (1), wobei das Verfahren in einer ersten Phase die schnelle Pressung von frischem Holz (1) zu einer gewönschten Form gegen gasdurchlässige Oberflächen (3,4) herunter zu einer gewünschten Endabmessung und das gleichzeitige Erwärmen des Holzes aufweist, wobei

   - während einer zweiten Phase des Pressungsprozesses der Preßdruck auf einen Pegel herabgesetzt wird, der eine Dickenverminderung bewirkt, die gleich oder größer als die Dickenverminderung ist, die durch das Trocknen des Holzes bewirkt wird, und
   - die Innentemperatur des Holzes mit dem Fortgang des Pressungsprozesses herabgesetzt wird.

2. Verfahren nach Anspruch 1, dadurch gekennzeichnet, daß das Holz (1) während der zweiten Phase unter Verwendung eines solchen Drucks gepreßt wird, der es gestattet, daß sich die Holzdicke um annähernd 10% der in der ersten Phase erreichten maximalen Dickenverminderung erholt.

3. Verfahren nach Anspruch 1, die eine Holzinnentemperatur von 150°C zum Beginn des Prozesses

verwendet, dadurch gekennzeichnet, daß die Innentemperatur des Holzes (1) gegen Ende der zweiten Phase auf 125°C herabgesetzt wird.

4. Verfahren zum Druck-Formtrocknen von Kiefernholz nach Anspruch 1, dadurch gekennzeichnet, daß die relative Dickenverminderung im Bereich von 20 - 40% liegt.

5. Verfahren zum Druck-Formtrocknen von Kiefernholz nach Anspruch 1, dadurch gekennzeichnet, daß die Preßdrücke während der ersten Phase annähernd 15 - 20 kp/cm^2 und während der zweiten Phase annähernd 5 kp/cm^2 betragen.

6. Verfahren zum Druck-Formtrocknen von Holz nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Dauer der ersten Pressungsphase 3 - 10% der Gesamtpreßzeit, vorzugsweise annähernd 5 % beträgt.

Revendications

1. Procédé de séchage et de compression pour la mise en forme de bois (1), ce procédé comprenant une compression de bois vert (1), dans une première phase rapidement en une forme souhaitée, contre des surfaces perméables aux gaz (3, 4), jusqu'à une dimension finale souhaitée, et simultanément un chauffage du bois, procédé dans lequel

   - pendant une seconde phase du processus de compression, la pression de compression est diminuée à un niveau provoquant une réduction d'épaisseur égale à ou supérieure à la réduction d'épaisseur provoquée par le séchage du bois, et
   - la température interne du bois est abaissée avec la progression du processus de compression.

2. Procédé suivant la revendication 1, caractérisé en ce que le bois (1) est comprimé pendant la seconde phase en utilisant une pression telle quelle permet à l'épaisseur du bois de récupérer approximativement 10 % de la réduction d'épaisseur maximale atteinte pendant la première phase.

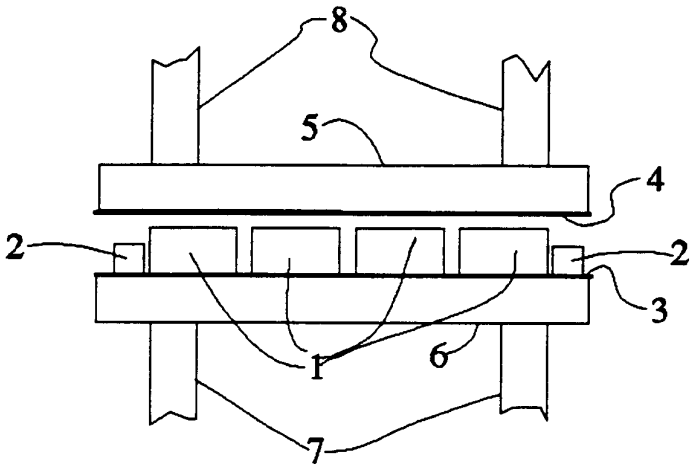
3. Procédé suivant la revendication 1, utilisant une température interne du bois de 150°C au démarrage du processus, caractérisé en ce que la température interne du bois (1) est abaissée à 125°C vers la fin de la seconde phase.

4. Procédé de séchage et de compression pour la mise en forme de bois suivant la revendication 1, caractérisé en ce que la réduction d'épaisseur relative est de l'ordre de 20-40 %.

5. Procédé de séchage et de compression pour la mise en forme de bois suivant la revendication 1, caractérisé en ce que les pressions de compression pendant la première phase sont d'environ 15-20 kp/cm^2 et pendant la seconde phase d'environ 5 kp/cm^2.

6. Procédé de séchage et de compression pour la mise en forme de bois suivant l'une quelconque des revendications précédentes, caractérisé en ce que la durée de la première phase de compression est de 3-10 % du temps de compression total, de préférence d'environ 5 %.

Fig. 1



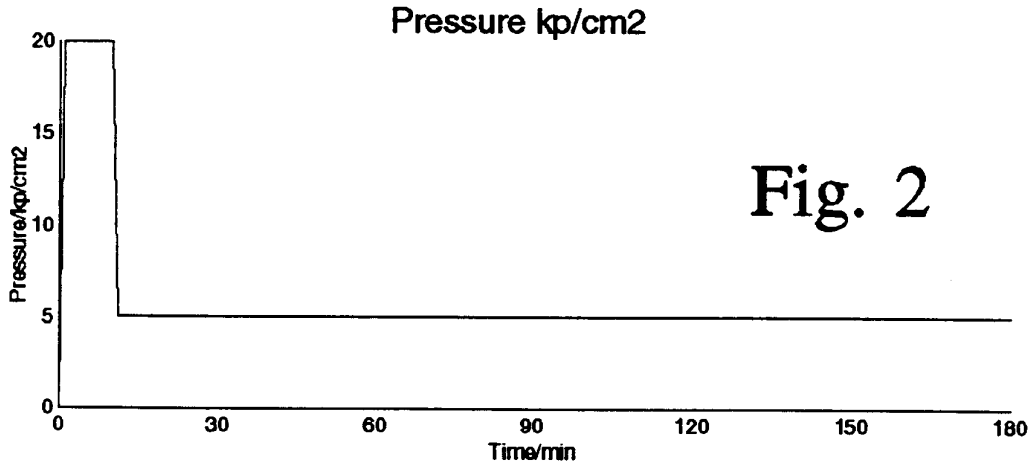


Fig. 2

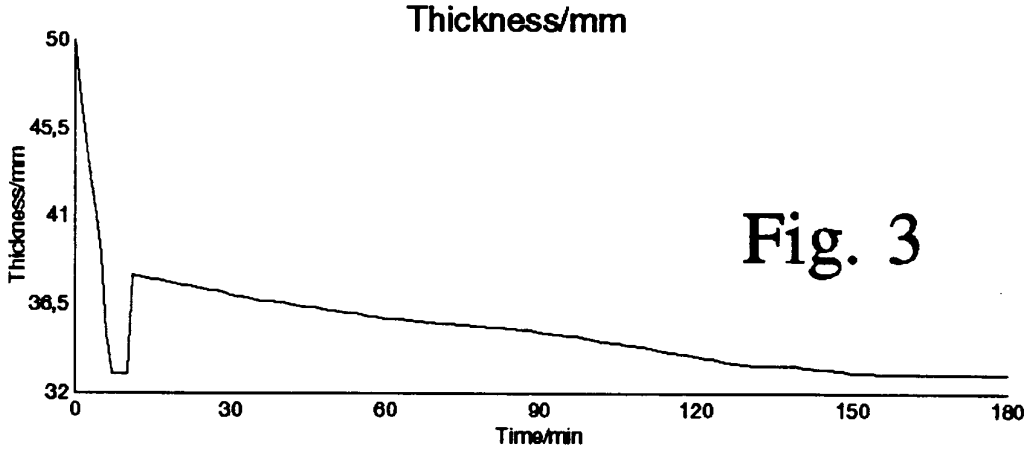


Fig. 3