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

(11) **EP 1 809 825 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
29.07.2009 Bulletin 2009/31

(21) Application number: **05856497.2**

(22) Date of filing: **08.10.2005**

(51) Int Cl.:
B27K 5/02 *(2006.01)* ***E04B 1/86*** *(2006.01)*
G10K 11/162 *(2006.01)*

(86) International application number:
PCT/KR2005/003350

(87) International publication number:
WO 2006/080731 (03.08.2006 Gazette 2006/31)

(54) **A METHOD FOR IMPROVING WOOD SOUND-ABSORBANCE AND A SOUND-ABSORBING WOOD THEREBY**

VERFAHREN ZUR VERBESSERUNG DER SCHALLDÄMMUNG VON HOLZ UND SCHALLDÄMMENDES HOLZ DADURCH

PROCEDE D'AMELIORATION DE L'ISOLATION PHONIQUE DU BOIS ET BOIS D'ISOLATION PHONIQUE

(84) Designated Contracting States:
DE FR GB

(30) Priority: **20.10.2004 KR 20040083840**

(43) Date of publication of application:
25.07.2007 Bulletin 2007/30

(73) Proprietors:
- **Kang, Chun-Won**
  Iksan-si, Jeollabuk-do 570-731 (KR)
- **Ecowell Co. Ltd.**
  Jeonju-Si, Jeollabuk-Do, 561-756 (KR)

(72) Inventors:
- **KANG, Chun-Won**
  Iksan-si, Jeollabuk-do 570-731 (KR)
- **KWAK, Chae Eul**
  Gunsan-Si
  Jeollabuk-Do 573-764 (KR)

(74) Representative: **Chaillot, Geneviève et al**
Cabinet Chaillot
16-20, Avenue de l'Agent Sarre
B.P. n 74
F-92703 Colombes Cedex (FR)

(56) References cited:
EP-A1- 0 846 812
DE-A1- 3 739 313
GB-A- 719 245
JP-A- 08 120 878
JP-A- 2004 278 160
KR-A- 2003 060 189
US-B1- 6 186 270
US-B1- 6 691 358

EP 1 809 825 B1

Printed by Jouve, 75001 PARIS (FR)

Description

[Technical Field]

[0001] The present invention relates to a method of improving the sound-absorbing performance of wood as a sound-absorbing material, and more particularly to a method of improving the ability of wood to absorb sound waves incident in the fiber direction of the wood in a given frequency range by delignifying it.

[0002] An object of the present invention is to provide a sound-absorbing board having sound-absorbing properties superior to that of unmodified wood by chemically treating wood.

[Background Art]

[0003] Currently, glass fiber, rock wool, gypsum board and the like, which are used as internal or external sound-absorbing materials, are frequently used as building materials, because they have excellent sound-absorbing capacity and insulation properties. However, when exposed in air during use, they will have a harmful effect on human health due to dust, etc., so that their use has gradually been restricted. Also, these materials have low intrinsic strength, and so require a supporting frame.

[0004] Wood, with the potential to replace non-eco-friendly materials, is a recyclable natural material and has a beautiful appearance and good processability, as well as excellent strength compared to other materials. However, wood resources in Korea mainly consist of small-diameter logs, curved logs and the like, and thus, there is a need to maximize the utility of the small-diameter logs or curved logs, having low added value.

[0005] The present inventor has delignified wood materials, using small-diameter logs or curved logs, by chemical treatment, and discovered that delignification resulted in substantial improvement in the sound-absorbing capacity of the wood materials thereby completing the present invention.

[0006] Wood is a sound reflective material having a sound absorption of about 5% in a frequency range that human beings mainly use during their life. Thus, there have been many creative inventions to improve the sound-absorbing performance of wood. Korean Patent Application No. 99-38842 (entitled "a sound-absorbing wood material and a preparation method thereof") filed by the applicant discloses a wood board having improved sound-absorbing performance and low density and, at the same time, requisite strength, which is prepared by a method comprising the steps of: adding a synthetic resin adhesive to wood particles in an amount of about 5-30% by weight and stirring the mixture; forming the stirred mixture into a mat; placing the mat into a mold having a plurality of discharge holes form in the circumferential surface thereof; interposing the mold between upper and lower cowls each having a plurality of core pins, which have different diameters and are arranged on the same axis; and pressing the upper and lower cowls, in which the pressing step is performed at a temperature of about 140-240 °C and a pressure of about 20-40 kg/cm 2 for at least 5 minutes. Also, Korean Patent Laid-Open Publication No. 2003-30645 (entitled "a wood floor structure having a sound-absorbing elastic material") discloses a wood floor structure comprising: a sound-absorbing elastic material having perforated adhesive holes to be filled with an elasticity-reinforcing adhesive; and a wood floor panel placed on the sound-absorbing elastic material after being filled with the elasticity-reinforcing adhesive.

[0007] Because the above-published wood materials comprise, in addition to wood, a separate material for improving sound-absorbing performance, these materials are difficult to realize and do not meet the eco-friendly trend. For this reason, the present inventor developed a method capable of improving the sound-absorbing performance of wood using wood anatomical approach and based on his through study of wood structure, thereby completing the present invention. The sound-absorbing performance will now be described in order to fully understand the present invention.

[0008] The absorption of sound is a process for removing or reducing the energy of sound. Sound absorption is achieved by contact with a sound-absorbing material having many pores, or by the vibration of a thin plate disposed on the wall surface with an air layer interposed therebetween, or by a sound-absorbing device including a single resonator. Although the absorbance of sound by the porous material varies depending on the thickness of the porous material, it shows an excellent effect in a wide frequency range, but the porous material needs structural support. Also, the plate vibration shows good sound absorbance only in low frequency range. In addition, the absorbance of sound by the single resonator shows high sound-absorbing effects only in a narrow frequency range.

[0009] Particularly, glass wool or rock wool is frequently used in buildings, owing to the advantages of good insulation properties in addition to sound-absorbing effects, but when exposed to air, during use, it can have a harmful effect on the human health due to dust. Also, this material has poor strength, and thus requires a supporting frame. Accordingly, the present inventor believes that there is a need to develop new materials, which have suitable levels of sound-absorbing and insulation properties and, at the same time, are not harmful to the humans, one of these materials being a wood material.

[Disclosure]

[Technical Problem]

[0010] The main objective of the present invention is to provide an eco-friendly, sound-absorbing material.

[0011] Another objective is to provide a method for improving the sound-absorbing properties of wood by re-

moving substances from wood cell walls through a wood anatomical approach.

[Technical Solution]

[0012] To achieve the above objects, the present invention provides a use of a deliguified wood as a material with improved sound absorbance. The deliguified wood is obtained by the following steps of processing normal wood into a wood disc; removing lignin from the wood disc; and drying the delignified wood disc under reduced pressure.

[0013] The kind of tree from which the wood used in the present invention is to be obtained is not specifically limited. Wood mainly consists of cellulose, hemicellulose and lignin, in which the lignin to be removed according to the present invention is a polymer having a molecular weight of more than 50,000 and including a phenylpropane-type carbon framework deposited between the cellulose microfibrillar structures of wood. Lignin accounts for 20-30% of the dry weight of wood.

[0014] The delignification step can be performed using a known method, such as the chlorine-monoethanolamine method, comprising chlorinating the wood discs, which renders wood discs brighter, or the peracetic acid method. It is preferable in the present invention to use the sodium chlorite method for oxidizing, degrading and dissolving out the lignin.

[0015] In order to minimize cracking of wood, the delignified wood discs are dried under reduced pressure conditions (pressure: 70-90 cmHg; and temperature: 30-50 °C) to a water content of 10-15%, which results in fine cracks on the surface of the wood discs. Although the present invention is described with respect to the improvement of sound-absorbing performance only for the wood discs, the inventive idea of improving sound absorbance by increasing the wood pores can likewise be applied to plywood, particle board and fiber board. Hereinafter, the present invention will be described in detail with examples, but it is to be noted that these examples are for illustrative purpose only and are not construed to limit the scope of the present invention.

[Advantageous Effects]

[0016] According to the inventive method for improving the sound absorbance of wood, a sound reflective wood material having a sound absorbance of about 5% can be significantly improved with respect to sound-absorbing performance in a frequency of 2 KHz-4 KHz, in which the human hearing sense is generally most sensitive. Also, rock wool, glass fiber and the like, which have been used as sound-absorbing internal materials, can be substituted with inexpensive wood. Furthermore, the sound-absorbing wood material according to the present invention is eco-friendly, and so can be used without fear of health hazard or damage to environment. In addition, the inventive material is recyclable so that it is superior to other materials in the efficiency of resource utilization, whereby it can contribute to the efficient utilization of resources and to an increase in the value of wood products.

[Description of Drawings]

[0017]

FIG. 1 is a photograph showing the result of visual observation for a wood disc treated with the inventive method of improving sound-absorbing properties.
FIG. 2 is an electron micrograph showing a portion of the cross section of the wood disc shown in FIG. 1.
FIG. 3 shows the sound-absorbing properties of a wood disc treated with the inventive method and an untreated wood disc. In FIG. 3, specimen 1 is a result for the wood disc treated with the inventive method, and specimen 2 is a result for the untreated wood disc.

[Mode for Invention]

Example

[0018] Larch wood was processed in the transverse direction (to a 100-mm diameter for a middle and low frequency specimen and a 29.9-mm diameter for a high frequency range specimen, and a 30-mm thickness), to prepare wood discs. Each of the wood discs was degreased with a mixture of alcohol and benzene and kept in a water bath with 1.21 of water containing 8 g of sodium chlorite and 1.6 ml of glacial acetic acid at 80 °C for 120 hours. Each of the delignified wood discs was dried to a moisture content of 12% in a vacuum dryer at a pressure of 76 cmHg and a temperature of 40 °C. Then, the structural features of the cross-sectional surface of each of the wood discs was observed and at the same time, the sound absorbance thereof was measured in a frequency range of 50-6400 Hz. The sound absorbance was measured using a two-microphone tube and pulse analyzer.

[0019] FIG. 1 is a photograph showing the result of visual observation for a wood disc treated with the inventive method for improving sound-absorbing properties, and FIG. 2 is an electron micrograph showing a portion of the cross section of the wood disc shown in FIG. 1.

[0020] As can be seen in FIG. 1, pluralities of fine cracks are distributed on the surface of the disc after treatment according to the present invention. This indicates that, on the surface having weak strength due to delignification, small splits were generated even under reduced-pressure drying conditions, which cause low drying stress. As can be seen from the electron micrograph of FIG. 1, intracellular substances between the wood cell walls were dissolved and removed. As a result of this microstructural change, the surface of the wood disc according to the present invention feels soft compared to untreated conventional wood discs. Also, because the portion between the wood cell walls, which has

a high content of lignin, showing an elastic behavior in wood, was removed, the wood has an increased porosity leading to a reduced reflectivity to sound waves, thus showing improved sound-absorbing properties.

[0021] FIG. 3 shows the sound-absorbing properties of a wood disc treated with the inventive method and an untreated wood disc. As shown in FIG. 3, the wood disc according to the present invention showed improved sound-absorbing performance over the entire measured frequency range, compared to the untreated wood disc. In a high frequency range of more than 1 KHz, the difference in sound-absorbing performance between the two wood discs was increased more, and in a frequency range around 4 KHz, the inventive wood disc showed a 30% higher sound absorbance than that of the untreated wood disc. In addition, in frequency ranges around 2 KHz and 6 KHz, the inventive wood disc was almost twice as high in sound absorbance as the untreated disc.

Claims

1. Use of a delignified wood as a material with improved sound absorbance.

2. Use according to Claim 1 **characterized in that** the delignified wood is obtained by the following steps of: processing normal wood into a wood disc;
removing lignin from the wood disc; and
drying the delignified wood disc under reduced pressure.

3. Use according to Claim 1 **characterized in that** the step of removing lignin is performed using sodium chlorite.

4. Use according to Claim 2 or 3 **characterized in that** it comprises the step of degreasing the wood disc with a mixture of alcohol and benzene prior the delignification.

5. Use according to one of claims 1 to 4, **characterized in that** the material is a sound-absorbing board.

Patentansprüche

1. Verwendung von delignifiziertem Holz als einen Stoff mit verbessertem Schallabsorbtionsgrad.

2. Verwendung gemäß Anspruch 1,
dadurch gekennzeichnet, dass
man das delignifizierte Holz durch die folgenden Schritte erhält: Verarbeitung von normalem Holz zu einer Holzscheibe;
Entfernen von Lignin aus der Holzscheibe; und
Trocknen der delignifizierten Holzscheibe bei vermindertem Druck.

3. Verwendung gemäß Anspruch 1,
dadurch gekennzeichnet, dass
der Schritt der Ligninentfernung durch die Verwendung von Natriumchlorit ausgeführt wird.

4. Verwendung gemäß Anspruch 2 oder 3,
dadurch gekennzeichnet, dass
vor der Delignifizierung der Schritt der Entfettung der Holzscheibe mit einem Gemisch aus Alkohol und Benzol enthalten ist.

5. Verwendung gemäß einem der Ansprüche 1 bis 4,
dadurch gekennzeichnet, dass
der Stoff eine schallabsorbierende Platte ist.

Revendications

1. Utilisation d'un bois délignifié en tant que matériau présentant une insonorisation accrue.

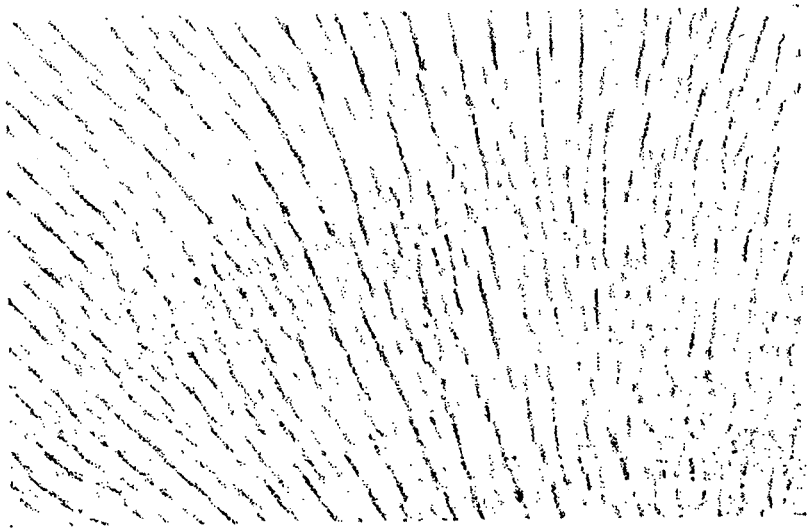
2. Utilisation selon la revendication 1, **caractérisée par le fait que** le bois délignifié est obtenu par les étapes suivantes consistant à :

   - traiter du bois normal pour obtenir un disque de bois ;
   - éliminer la lignine du disque de bois ; et
   - sécher le disque de bois délignifié sous pression réduite.

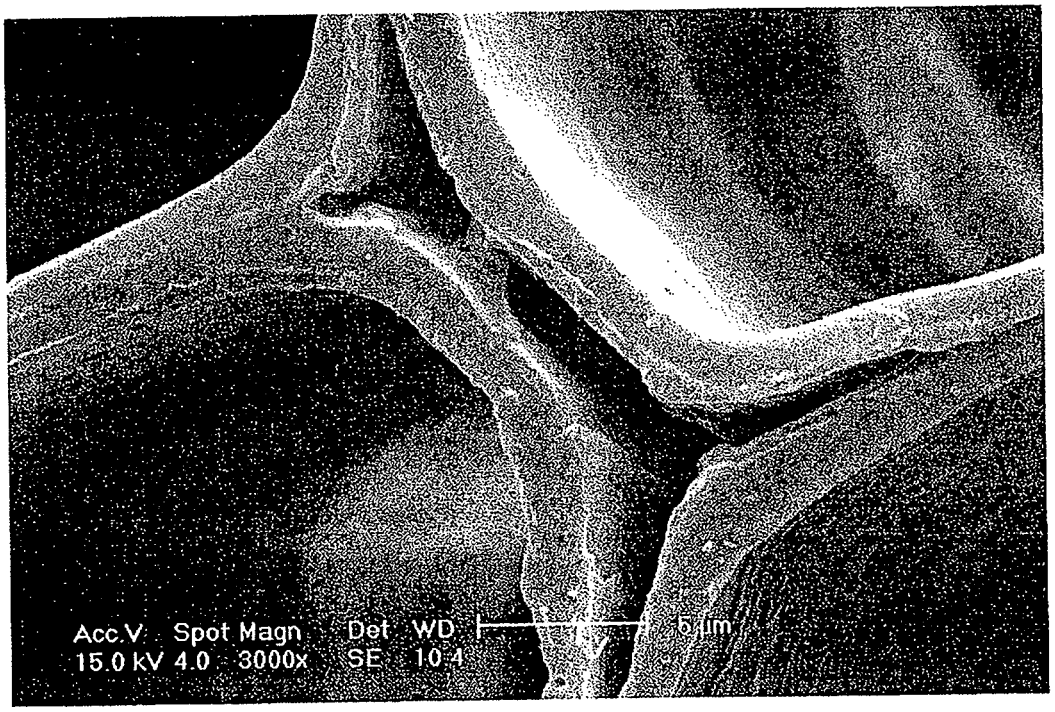
3. Utilisation selon la revendication 1, **caractérisée par le fait que** l'étape d'élimination de la lignine est réalisée à l'aide de chlorite de sodium.

4. Utilisation selon l'une des revendications 2 ou 3, **caractérisée par le fait qu'**elle comprend l'étape de dégraissage du disque de bois par un mélange d'alcool et de benzène avant la délignification.

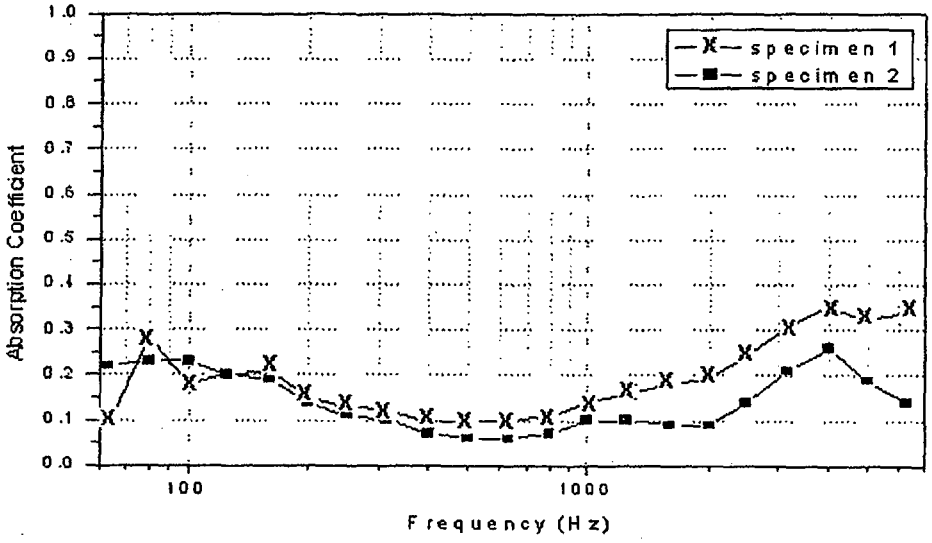
5. Utilisation selon l'une quelconque des revendications 1 à 4, **caractérisée par le fait que** le matériau est un panneau insonorisant.



[FIG. 1]



[FIG. 2]


specimen 1
specimen 2
Absorption Coefficient
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
100
1000
Frequency (Hz)

[FIG. 3]

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- KR 9938842 **[0006]**
- KR 200330645 **[0006]**