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

(11) **EP 3 152 016 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
14.11.2018 Bulletin 2018/46

(21) Application number: **14739497.7**

(22) Date of filing: **04.06.2014**

(51) Int Cl.:
B27D 1/04 *(2006.01)*

(86) International application number:
PCT/FI2014/050453

(87) International publication number:
WO 2015/185789 (10.12.2015 Gazette 2015/49)

(54) METHOD FOR MANUFACTURING PLYWOOD AND PLYWOOD

VERFAHREN ZUR HERSTELLUNG VON SPERRHOLZ SOWIE SPERRHOLZ

PROCÉDÉ DE FABRIQUER UN CONTREPLAQUÉ, ET CONTREPLAQUÉ

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(43) Date of publication of application:
12.04.2017 Bulletin 2017/15

(73) Proprietor: **UPM Plywood Oy**
15140 Lahti (FI)

(72) Inventors:
- **KOPONEN, Simo**
  FI-15880 Hollola (FI)
- **KIURU, Jani**
  FI-54100 Joutseno (FI)

(74) Representative: **Papula Oy**
P.O. Box 981
00101 Helsinki (FI)

(56) References cited:
EP-A1- 2 705 950
DE-U1-202013 103 959
FR-A- 960 545
US-A- 2 158 907
US-A- 2 158 908
US-A- 3 511 737
US-A1- 2005 153 150

EP 3 152 016 B1

Printed by Jouve, 75001 PARIS (FR)

Description

FIELD OF THE INVENTION

[0001] The invention relates to a method for manufacturing plywood from wood veneers. The invention also relates to plywood comprising a plurality of veneer layers stacked on top of another and glued together with a thermosetting adhesive including water or an adhesive composition including water. Further, the invention relates to the use of plywood according to the present invention.

BACKGROUND OF THE INVENTION

[0002] In general, plywood consists of three or more veneer layers, most of which are laid with their grain at right angle to their adjacent veneer layers so that the veneer layers form a cross-bonded structure. In distinction from plywood, laminated veneer lumber (LVL) is a strongly orientated wooden product, having normally the grain direction of all the veneer layers in parallel to each other.

[0003] Document EP 2 705 950 A1 discloses plywood and a method for manufacturing plywood. The method comprises forming veneer layers of the plywood by laying veneers of wood material on top of the other such that each veneer layer of the plywood comprises at least one veneer, the number of the veneer layers in the plywood being 12 to 44, applying an adhesive between the veneer layers when the veneers are laid on top of the other, and hot-pressing the veneer layers together, wherein the veneers are laid such that in 25 to 38.4% of the veneer layers a grain direction in the veneer layers is perpendicular to the first principal strength direction of the plywood and the grain direction of the veneer(s) in at least one veneer layer among three topmost veneer layers or among three bottorn veneer layers is crosswise to a grain direction of the veneer(s) in at least one other veneer layer among the three topmost or three bottom veneer layers.

SUMMARY OF THE INVENTION

[0004] The invention is defined by the features of the independent claims.

[0005] According to the invention, plywood is manufactured from wood veneers using a method that comprises:

- applying an adhesive on some of the veneers, the adhesive comprising a thermosetting resin including water or an adhesive composition including water,
- laying the veneers on top of another to produce a plywood billet which comprises a surface veneer at the bottom and on the top of the plywood billet, the surface veneers having their grain running in a first direction; from two to four oriented veneers next to each surface veneer, the oriented veneers having their grain running in a second direction which is perpendicular to said first direction; and a plurality of interior veneers having their grain alternately in the first direction and the second direction so that the interior veneers form a cross-bonded structure; wherein the veneers are selected so that the average density of the oriented veneers is higher than the average density of the plurality of interior veneers,
- hot pressing the plywood billet to glue the veneers together, in which connection water from the adhesive vaporizes, penetrates into the veneers and finally escapes therefrom, which causes compression of the veneers, and
- sanding plywood to reach a desired plywood thickness.

[0006] In an embodiment of the method, the average density (as measured before adhesive application and hot pressing) of the veneers included in the plywood billet is at least 550 kg/m^3, preferably at least 570 kg/m^3.

[0007] In an embodiment of the method, the veneers are sorted so that the average density (as measured before adhesive application and hot pressing) of the veneers used as oriented veneers is at least 3%, preferably at least 4%, more preferably at least 5% higher than the average density of the veneers used as interior veneers.

[0008] In an embodiment of the method, the number of veneers included in the plywood billet is at least 9, preferably at least 13, more preferably at least 15.

[0009] In an embodiment of the method, the number of veneers included in the plywood billet is from 11 to 15. This kind of plywood is suitable for use in concrete forms.

[0010] In another embodiment of the method, the number of veneers included in the plywood billet is from 15 to 29, preferably from 17 to 25. This kind of plywood is suitable for use in floorings of the cargo space of trucks, trailers and railway carriages.

[0011] In an embodiment of the method, the number of oriented veneers laid next to each surface veneer is identical. The number of oriented veneers laid next to each surface veneer can be four, three or two, most preferably three.

[0012] In an embodiment of the method, all the veneers included in the plywood billet are of the same wood species. This wood species can be, for instance, birch or beech, most preferably birch.

[0013] In an embodiment of the method, each veneer of the plurality of interior veneers is laid so that it has a grain direction which is perpendicular to the grain of both its adjacent veneers. This structure is normally used when the number of interior veneers is odd.

[0014] In an alternative embodiment, two veneers of the plurality of interior veneers are laid so that they have a grain direction which is parallel to that of an adjacent veneer, whereas all the other veneers of the plurality of interior veneers are laid so that they have a grain direction which is perpendicular to the grain of their adjacent veneers. This structure is normally used when the number

of interior veneers is even.

[0015] The adhesive may comprise a thermosetting resin.

[0016] The adhesive includes water.

[0017] The adhesive may comprise a thermosetting resin including water.

[0018] In an embodiment of the method the adhesive is a phenolic resin in liquid form. The water content of the liquid binder composition used for gluing together the veneers can be 40 - 60%, preferably 43 - 55%.

[0019] In an embodiment of the method, a coating is provided on at least one side of plywood, preferably on both sides. Plywood can be coated with a thermosetting resin, or a cellulose film impregnated with a thermosetting resin.

[0020] In an embodiment of the method, the coating comprises thermosetting resin. The thermosetting resin can comprise, for instance, a phenolic resin.

[0021] The plywood comprises a plurality of veneer layers stacked on top of another and glued together with a thermosetting adhesive including water or an adhesive composition including water, the veneer layers comprising:

- a surface veneer layer on both opposite sides of plywood, the surface veneer layers having their grain running in a first direction;
- from two to four oriented veneer layers next to each surface veneer layer, the oriented veneer layers having their grain running in a second direction, which is perpendicular to said first direction;
- a plurality of interior veneer layers having their grain running alternately in the first direction and the second direction so that the interior veneer layers form a cross-bonded structure;

wherein the average density of the oriented veneer layers is higher than the average density of the plurality of interior veneer layers, wherein the average density represents the density of dried veneers before they are stacked into a plywood billet.

[0022] In an embodiment of plywood, the number of oriented veneer layers on both sides of plywood is identical. The number of oriented veneer layers next to each surface veneer layer can be four, three or two, most preferably three.

[0023] In an embodiment of plywood, the density of plywood is at least 630 kg/m^3, preferably at least 650 kg/m^3, more preferably at least 670 kg/m^3.

[0024] In an embodiment of plywood, the density of the oriented veneer layers is at least 2%, preferably at least 4%, more preferably at least 5% higher than the average density of the interior veneer layers.

[0025] In an embodiment of the invention, a flooring for a cargo space of a freight transport vehicle or a freight transport unit of a freight transport vehicle, which flooring is fastened to a chassis of the freight transport vehicle or to a chassis of the freight transport unit of a freight transport vehicle, comprises a plywood board formed of plywood panels according to the present invention or plywood panels manufactured by a method according to the present invention.

[0026] In an embodiment of the invention, a flooring for a cargo space of a freight transport vehicle or a freight transport unit of a freight transport vehicle, which flooring is fastened to a chassis of the freight transport vehicle or to a chassis of the freight transport unit of a freight transport vehicle, comprises a plywood board formed of two or more plywood panels manufactured by a method according to the present invention.

[0027] In an embodiment of the invention, in a concrete form comprising plywood board fastened to a framework, the plywood board consists of two or more plywood panels according to the present invention or plywood panels manufactured according to the present invention.

[0028] The adhesive may be a thermosetting resin. In an embodiment of plywood, the adhesive is an adhesive composition including water. In an embodiment of plywood, the adhesive is a thermosetting adhesive including water. In an embodiment of plywood, the adhesive is a phenolic resin in liquid form.

[0029] In an embodiment of plywood, a coating is provided on at least one side of plywood, preferably on both sides of plywood. In an embodiment of plywood, the coating comprises thermosetting resin. In an embodiment of plywood, the thermosetting resin is impregnated in a cellulose film. In an embodiment of plywood, the coating comprises phenolic resin.

[0030] In an embodiment of plywood, the thickness of plywood is at least 10 mm, preferably at least 15 mm, more preferably at least 17 mm. In an embodiment of plywood, the thickness of plywood is from 15 mm to 20 mm. In an embodiment of plywood, the thickness of plywood is from 20 mm to 40 mm, preferably from 25 mm to 35 mm.

[0031] The plywood can be manufactured by a method according to the present invention.

[0032] The embodiments of the invention described hereinbefore may be used in any combination with each other. Several of the embodiments may be combined together to form a further embodiment of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] The accompanying drawings, which are included to provide a further understanding of the invention and constitute a part of this specification, illustrate embodiments of the invention and together with the description help to explain the principles of the invention. In the drawings:

Figure 1 schematically shows an embodiment of plywood.

Figure 2 illustrates the compression of veneers at different positions during hot pressing of plywood.

Figures 3(a) to 3(f) schematically show six other em-

bodiments of plywood.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0034] Herein, the term "veneer" is used to refer to a thin sheet of wood material peeled from a log. In case of hardwood veneers, the veneer thickness is normally 0.8-2.0 mm, more preferably 1.0-1.8 mm, most preferably 1.2-1.6 mm. A typical thickness of birch veneer is 1.4 mm.

[0035] The "average density" of veneers has been measured from a plurality of veneers dried into a moisture content of about 3%, before gluing and hot pressing. That is to say, the average density represents the density of dried veneers before they are stacked into a plywood billet. It is well known that the density of individual veneers peeled from the same log can vary widely.

[0036] Herein, the term "veneer layer" is used to refer to a veneer layer in plywood after gluing and hot-pressing. Consequently, the density of veneer layers is influenced by the adhesive applied between the veneers and compression of the veneers during hot pressing.

[0037] Herein, the term "cross-bonded structure" is used to denote a plywood structure in which either all the veneers are cross-bonded or all but one pair of veneers are cross-bonded. When the number of veneers is even and the goal is to reach a nearly symmetric structure, there has to be one pair of veneers with parallel grains in the otherwise cross-bonded plywood structure.

[0038] Herein, the terms "oriented veneers" and "oriented veneer layers" are used to refer to a group of adjacent veneers or veneer layers having a similar orientation of grain.

[0039] Figure 1 schematically shows one embodiment of plywood. Plywood 1 comprises, from face to center X, a surface veneer layer A in which the grain is in a first direction, three oriented veneer layers B in which the grain is in a second direction, which is perpendicular to the grain of the surface veneer layer A, and a plurality of interior veneer layers C in which the grain is alternately in the first direction and the second direction so that the interior veneer layers C form a cross-bonded structure. In this illustration, the first grain direction (indicated with vertical stripes) is perpendicular to the plane of paper, and the second direction (non-striped area) is parallel to the plane of paper. Further, there is thermosetting adhesive between the veneer layers. The thermosetting adhesive can be, for instance, a phenolic resin. Both faces of plywood are provided with a coating 2, which can be, for instance, in the form of a cellulose film impregnated with a thermosetting resin including water. The thermosetting resin can be, for instance, a phenolic resin.

[0040] Plywood is manufactured from veneers which have been peeled from a log and dried to a desired moisture content. Some of the veneers are passed through a glue spreader where a thermosetting adhesive is applied on both sides of the veneer. Veneers are stacked on top of another in a preselected order and orientation to produce a laid-up assembly of veneers, so called plywood billet. The plywood billet is subjected to hot pressing which is carried out between heated metal plates. During hot pressing the veneers are consolidated and the thermosetting adhesive between them is cured. After hot pressing plywood is sanded to reach a desired thickness. Finally, a coating can be applied on one or both surfaces of plywood. The coating material can be applied in liquid form or in the form of a cellulose film, or paper, impregnated with the coating material. Further, at least one of the coated surfaces can be provided with a surface profiling to increase the friction of the surface.

[0041] Hot pressing has two main objectives: to press the glue into a thin layer over (and into) each veneer, and to activate the thermosetting adhesive. At the same time, water contained in the adhesive evaporates and penetrates into the veneers. The veneers first swell and then, after the vapor starts to release from the plywood billet, shrink.

[0042] Hot pressing can be carried out with a stepwise or a steplessly lowering pressure. In general, there are three main steps in hot pressing. First, a high peak pressure is applied for a short time to bring the veneers together and to spread the adhesive between the veneers. Then, the pressure is reduced to about half of the peak pressure. Finally, a low end pressure is applied in order that water vapor can escape from the plywood billet.

[0043] In hot pressing of birch veneer, the temperature of press plates is typically around 130°C. The pressure and duration of pressing depend on the number of veneers and, thus, the thickness of plywood. The target is to raise the temperature in the center of the plywood billet to at least 100°C so that all the free water can be made to evaporate.

[0044] The number of veneer sheets stacked into a plywood billet is generally selected so that a predetermined plywood thickness can be reached after hot pressing. The fine adjustment of plywood thickness is then to be carried out by sanding plywood in a finishing step.

[0045] One problem of the prior art is that the plywood thickness tends to vary after hot pressing even though the number of veneers included in the plywood billet is kept constant. For example, when producing a plurality of birch plywood panels consisting of 13 veneer layers, the thickness of the plywood panel after 30 minutes of hot pressing was discovered to vary in a range from 16.9 mm to 18.4 mm.

[0046] Figure 2 shows how a veneer's location in a plywood lay-up influences on the compression of the veneer during hot pressing. The test was carried out with a plurality of cross-bonded plywood lay-ups, each consisting of 13 birch veneers. The target thickness of plywood after hot pressing was 18 mm. Figure 2 clearly shows that the second, third and fourth veneers from the surface are compressed the most. In this test all the veneers were cross-bonded. If the second, third and fourth veneers were oriented (with the same grain direction), their compression would have been even higher.

[0047] High density veneers are able to absorb more water vapor than low density veneers. On the other hand, high density veneers compress less during the high pressure stage (pressure over 1 MPa) when they dry. The compressibility of the selected high density veneers is also more predictable than the compressibility of randomly selected interior veneers.

[0048] The compressibility of individual veneers has been found to depend on their density and their location in the veneer lay-up. Hence, if veneers of low density and veneers of high density are randomly used at a position where the compression of the veneer tends to be high, the variation of plywood thickness after hot pressing can be expected to be high.

[0049] By selecting the oriented veneers disposed next to a surface veneer so that their average density is higher than the average density of the interior veneers, it is possible to reduce the thickness variations in plywood. When the thickness variation is reduced, less sanding is needed to reach the desired final thickness. Hence, surface veneer layers A can be kept more intact, and the risks of cracking of the surface veneers A or delamination of coating 2 are reduced.

[0050] Plywood according to the present invention is preferably manufactured from veneers with a density of at least 550 kg/m^3, preferably 570 kg/m^3 (measured at moisture content of 3%). Suitable wood species include, for instance, birch and beech. Preferably all the veneers of plywood are of the same wood species. The veneers used as oriented veneers can have an average density which is at least 3%, preferably at least 4%, more preferably at least 5% higher than the average density of the veneers used as interior veneers.

[0051] The density of the plywood according to the present invention can be at least 630 kg/m^3, preferably at least 650 kg/m^3, more preferably at least 670 kg/m^3 (measured at moisture content of 10%). The average density of the oriented veneer layers can be at least 2%, preferably at least 4%, more preferably at least 5% higher than the average density of the interior veneer layers.

[0052] Figure 1 shows one possible embodiment of plywood structure. It has to be noted that the structure need not be fully symmetrical if warping of plywood can be prevented by other means. It is of higher importance that the number of oriented high-density veneer layers is the same next to each surface veneer layer.

[0053] Figures 3(a) to 3(f) schematically show six further embodiments of plywood. In these figures, horizontal strokes denote veneer layers having their grain direction oriented parallel to the plane of paper, and vertical strokes denote veneer layers having their grain direction oriented at perpendicular to the plane of paper.

[0054] Figure 3(a) schematically shows plywood having a surface veneer layer A on each side, four oriented veneer layers B next to each surface veneer layer A, and 11 interior veneer layers C which are cross-bonded. The grain of the oriented veneer layers B is perpendicular to the grain of the surface veneer layers A. Each interior veneer layer C has a grain direction which is perpendicular to the grain direction of its two closest veneer layers. The average density of the oriented veneer layers B is higher than the average density of the interior veneer layers C. The total number of veneer layers is 21.

[0055] Figure 3(b) schematically shows plywood which differs from plywood of Figure 3(a) in that the number of oriented veneer layers B next to each surface veneer layer A is three. The total number of veneer layers is 19.

[0056] Figure 3(c) schematically shows plywood which differs from plywood of Figure 3(a) in that the number of oriented veneer layers B next to each surface veneer layer A is two. The total number of veneer layers is 17.

[0057] Figure 3(d) schematically shows plywood which differs from plywood of Figure 3(a) in that the number of interior veneer layers C is an even number. Consequently, there needs to be two interior veneer layers next to each other arranged to have parallel grain direction. The veneer layers having parallel grain direction need not be the middlemost veneer layers. The total number of veneer layers is 20.

[0058] Figure 3(e) schematically shows plywood which differs from plywood of Figure 3(d) in that the number of oriented veneer layers B next to each surface veneer layer A is three. The total number of veneer layers is 18.

[0059] Figure 3(f) schematically shows plywood which differs from plywood of Figure 3(d) in that the number of oriented veneer layers B next to each surface veneer layer A is two. The total number of veneer layers is 16.

[0060] The number of interior veneer layers C can be different from those shown in Figure 1 or Figures 3(a) to 3(f). A minimum of three interior layers C is needed to produce a cross-bonded plywood structure. Consequently, the number of veneer layers is at least 9, preferably at least 13, more preferably at least 15. In plywood that is suitable for use in concrete forms the number of veneer layers can range from 11 to 15. In plywood that is suitable for use in cargo space floorings the number of veneer layers can range from 17 to 25.

[0061] Sanding reduces the thickness of surface veneer layers A, thus the total thickness of plywood is also reduced. As a result of thinning, the surface veneer layers A tend to form an unstable base for coating. When plywood is repeatedly exposed to wear and tear, the instability of the surface veneer layer can lead to cracking of the surface veneer layer A or delamination of the coating 2. If the thickness of the surface veneer layer A can be kept as intact as possible by minimizing the need for sanding, a uniform and stable coating 2 can be obtained.

[0062] The predictability of plywood thickness after hot pressing can be improved by selecting the oriented veneers so that their average density is higher than the average density of the plurality of interior veneers. Consequently, the compressibility of the plywood billet comes up to expectations, less extra veneers are needed to reach a desired plywood thickness, and sanding of plywood to reach a desired nominal thickness can be kept at a minimum.

[0063] The present invention allows minimizing material losses due to sanding. Normally the sanding loss is about 0.6-2 mm, but the new method enables lowering the sanding loss to about 0.3-1 mm.

[0064] Plywood according to the present invention is suitable for use as flooring in the cargo space of a freight transport vehicle or a freight transport unit of a freight transport vehicle, which flooring is fastened to a chassis of the freight transport vehicle or to a chassis of the freight transport unit of a freight transport vehicle. Typically, a trailer or another similar freight transport unit of a freight transport vehicle is loaded and unloaded with a forklift, which is driven on and off the cargo space of the trailer. The surface of the flooring is subjected to repeated abrasion, wear and tear and alternating stresses. Further, the surface of the flooring, which consists of two or more plywood panels joined side by side, must be free of steps or dents.

[0065] Plywood according to the present invention is also suitable for use in the manufacture of concrete forms in which plywood panels are fastened to a framework, which supports plywood against the pressure of concrete poured on the opposite side of plywood.

[0066] It is obvious to a person skilled in the art that with the advancement of technology, the basic idea of the invention may be implemented in various ways. The invention and its embodiments are thus not limited to the examples described above; instead they may vary within the scope of the claims.

Claims

1. Method for manufacturing plywood from wood veneers, the method comprising:

   - applying an adhesive on some of the veneers, the adhesive comprising a thermosetting resin including water or an adhesive composition including water,
   - laying the veneers on top of another to produce a plywood billet which comprises a surface veneer (A) at the bottom and on the top of the plywood billet, the surface veneers (A) having their grain running in a first direction; from two to four oriented veneers (B) next to each surface veneer (A), the oriented veneers (B) having their grain running in a second direction which is perpendicular to said first direction; and a plurality of interior veneers (C) having their grain alternately in the first direction and the second direction so that the interior veneers (C) form a cross-bonded structure; wherein the veneers are selected so that the average density of the oriented veneers (B) is higher than the average density of the plurality of interior veneers (C),
   - hot pressing the plywood billet to glue the veneers together, in which connection water from the adhesive vaporizes, penetrates into the veneers and finally escapes therefrom, and the veneers compress, and
   - sanding plywood to reach a desired plywood thickness.

2. A method according to claim 1, wherein the veneers are sorted so that the average density (as measured before adhesive application and hot pressing) of the veneers used as oriented veneers (B) is at least 3%, preferably at least 4%, more preferably at least 5% higher than the average density of the veneers used as interior veneers (C).

3. A method according to any one of claims 1 to 2, wherein all the veneers included in the plywood billet are of the same wood species.

4. A method according to claim 3, wherein all the veneers included in the plywood billet are of birch.

5. A method according to any one of claims 1 to 4, wherein each veneer of the plurality of interior veneers (C) is laid so that it has a grain direction which is perpendicular to the grain of both its adjacent veneers, or all but two interior veneers are laid so that they have a grain direction which is perpendicular to the grain of both their adjacent veneers, in which case two veneers of the plurality of interior veneers (C) are laid so that they have a grain direction which is parallel to the grain of one of their adjacent veneers.

6. A method according to claim 5, wherein each veneer of the plurality of interior veneers (C) is laid so that it has a grain direction which is perpendicular to the grain of both its adjacent veneers.

7. A method according to claim 5, wherein two veneers of the plurality of interior veneers (C) are laid so that they have a grain direction which is parallel to that of an adjacent veneer, whereas all the other veneers of the plurality of interior veneers (C) are laid so that they have a grain direction which is perpendicular to the grain of their adjacent veneers.

8. Plywood comprising a plurality of veneer layers stacked on top of another and glued together with a thermosetting adhesive including water or an adhesive composition including water, the veneer layers comprising:

   - a surface veneer layer (A) on both opposite sides of plywood (1), the surface veneer layers (A) having their grain running in a first direction;
   - from two to four oriented veneer layers (B) next to each surface veneer layer (A), the oriented veneer layers (B) having their grain running in a

second direction, which is perpendicular to said first direction;
- a plurality of interior veneer layers (C) having their grain running alternately in the first direction and the second direction so that the interior veneer layers (C) form a cross-bonded structure;

characterized in that the average density of the oriented veneer layers (B) is higher than the average density of the plurality of interior veneer layers (C), wherein the average density represents the density of dried veneers before they are stacked into a plywood billet.

9. Plywood according to claim 8, wherein all the veneer layers (A, B, C) are of the same wood species.

10. Plywood according to claim 9, wherein all the veneer layers (A, B, C) are of birch.

11. Plywood according to any one of claims 8 to 10, wherein the density of plywood (1) is at least 630 kg/m^3, preferably at least 650 kg/m^3, more preferably at least 670 kg/m^3.

12. Plywood according to any one of claims 8 to 10, wherein the average density of the oriented veneer layers (B) is at least 2%, preferably at least 4%, more preferably at least 5% higher than the average density of the interior veneer layers (C).

13. Plywood according to any one of claims 8 to 12, wherein each veneer layer of the plurality of interior veneer layers (C) has a grain direction which is perpendicular to the grain of its both adjacent veneer layers, or all but two of the plurality of interior veneer layers (C) have a grain direction which is perpendicular to the grain of their both adjacent veneer layers, the two anomalous veneer layers having a grain direction which is parallel to the grain of one of their adjacent veneer layers.

14. Plywood according to claim 13, wherein each veneer layer of the plurality of interior veneer layers (C) has a grain direction which is perpendicular to the grain of its both adjacent veneer layers.

15. Plywood according to claim 13, wherein two veneer layers of the plurality of interior veneer layers (C) have a grain direction which is parallel to a veneer layer next to it, whereas all the other veneer layers of the plurality of interior veneer layers (C) have a grain direction which is perpendicular to the grain of their both adjacent veneer layers.

16. A flooring for a cargo space of a freight transport vehicle or a freight transport unit of a freight transport vehicle, which flooring is fastened to a chassis of the freight transport vehicle or to a chassis of the freight transport unit of a freight transport vehicle, wherein the flooring comprises a plywood board formed of two or more plywood panels according to any one of claims 8 to 15.

17. A concrete form comprising plywood board fastened to a framework, wherein the plywood board consists of two or more plywood panels according to any one of claims 8 to 15.

Patentansprüche

1. Verfahren zur Herstellung von Sperrholz aus Holzfurnieren, wobei das Verfahren umfasst:

- Auftragen eines Haftstoffs bzw. Klebstoffs auf einige der Furniere, wobei der Klebstoff ein wärmehärtbares bzw. thermohärtendes Harz, das Wasser enthält, oder eine Klebstoffzusammensetzung, die Wasser enthält, umfasst,
- Aufeinanderlegen der Furniere, zur Herstellung eines Sperrholzklobens, der ein Oberflächenfurnier (A) an der Unterseite und an der Oberseite des Sperrholzklobens aufweist, wobei die Maserung der Oberflächenfurniere (A) in eine erste Richtung verläuft; zwei bis vier ausgerichtete bzw. orientierte Furniere (B) neben jedem Oberflächenfurnier (A) aufweist, wobei die Maserung der orientierten Furniere (B) in eine zweite Richtung verläuft, die senkrecht zu der ersten Richtung ist; und eine Vielzahl von Innenfurnieren (C) aufweist, wobei deren Maserung alternierend bzw. abwechselnd in die erste Richtung und die zweite Richtung verläuft, so dass die Innenfurniere (C) eine kreuzweise verleimte Struktur bilden; wobei die Furniere derart ausgewählt sind, dass die mittlere Dichte der orientierten Furniere (B) höher ist als die mittlere Dichte der Vielzahl der Innenfurniere (C);
- Heißpressen des Sperrholzklobens, um die Furniere zusammenzukleben, wobei Verbindungswasser bzw. Bindewasser aus dem Klebstoff verdampft, in die Furniere eindringt und schließlich aus diesen entweicht und die Furniere zusammengedrückt werden, und
- Schleifen von Sperrholz, um eine gewünschte Sperrholzdicke zu erreichen.

2. Verfahren gemäß Anspruch 1, wobei die Furniere derart sortiert werden, dass die mittlere Dichte (gemessen vor dem Auftragen des Klebstoffs und dem Heißpressen) der Furniere, die als orientiere Furniere (B) verwendet werden, mindestens 3%, vorzugsweise mindestens 4%, besonders bevorzugt mindestens 5% höher ist als die mittlere Dichte der Furniere, die als Innenfurniere (C) verwendet werden.

3. Verfahren gemäß einem der Ansprüche 1 bis 2, wobei alle Furniere, die in dem Sperrholzkloben enthalten sind, aus derselben Holzart bestehen.

4. Verfahren gemäß Anspruch 3, wobei alle Furniere, die in dem Sperrholzkloben enthalten sind, aus Birke bzw. Birkenholz sind.

5. Verfahren gemäß einem der Ansprüche 1 bis 4, wobei jedes Furnier der Vielzahl von Innenfurnieren (C) derart verlegt wird, dass es eine Maserungsrichtung aufweist, die senkrecht zu der Maserung der beiden benachbarten Furniere ist, oder alle bis auf zwei Innenfurniere derart verlegt werden, dass sie eine Maserungsrichtung aufweisen, die senkrecht zu der Maserung ihrer beiden benachbarten Furniere ist, wobei in diesem Fall zwei Furniere aus der Vielzahl von Innenfurnieren (C) derart verlegt werden, dass sie eine Maserungsrichtung aufweisen, die parallel zu der Maserung eines ihrer benachbarten Furniere ist.

6. Verfahren gemäß Anspruch 5, wobei jedes Furnier der Vielzahl von Innenfurnieren (C) derart verlegt wird, dass es eine Maserungsrichtung aufweist, die senkrecht zu der Maserung der beiden benachbarten Furniere ist.

7. Verfahren gemäß Anspruch 5, wobei zwei Furniere der Vielzahl von Innenfurnieren (C) derart verlegt werden, dass sie eine Maserungsrichtung aufweisen, die parallel zu der eines benachbarten Furniers ist, während alle anderen Furniere der Vielzahl von Innenfurnieren (C) derart verlegt werden, dass sie eine Maserungsrichtung aufweisen, die senkrecht zu der Maserung ihrer benachbarten Furniere ist.

8. Sperrholz, das eine Vielzahl von Furnierschichten aufweist, die aufeinander gestapelt und miteinander mit einem wämehärtbaren bzw. thermohärtenden Harz,
das Wasser enthält, oder mit einer Klebstoffzusammensetzung, die Wasser enthält, verklebt sind, wobei die Furnierschichten umfassen:

- eine Oberflächenfurnierschicht (A) auf beiden gegenüberliegenden Seiten des Sperrholzes (1), wobei die Maserung der Oberflächenfurnierschichten (A) in einer ersten Richtung verläuft;
- zwei bis vier orientierte Furnierschichten (B) neben jeder Oberflächenfurnierschicht (A), wobei die Maserung der orientierten Furnierschichten (B) in einer zweiten Richtung verläuft, die senkrecht zu der ersten Richtung ist;
- eine Vielzahl von Innenfurnierschichten (C), wobei die Maserung alternierend bzw. abwechselnd in die erste Richtung und die zweite Richtung verläuft, so dass die Innenfurnierschichten (C) eine kreuzweise verleimte Struktur bilden;

dadurch gekennzeichnet, dass
die mittlere Dichte der orientierten Furnierschichten (B) höher ist als die mittlere Dichte der Vielzahl von Innenfurnierschichten (C), wobei die mittlere Dichte die Dichte von getrockneten Furnieren repräsentiert, bevor diese zu einem Sperrholzknüppel gestapelt wurden.

9. Sperrholz gemäß Anspruch 8, wobei alle Furnierschichten (A, B, C) aus demselben Holz bestehen.

10. Sperrholz gemäß Anspruch 9, wobei alle Furnierschichten (A, B, C) aus Birke bzw. Birkenholz bestehen.

11. Sperrholz gemäß einem der Ansprüche 8 bis 10, wobei die Dichte des Sperrholzes (1) mindestens 630 kg/m^3, vorzugsweise mindestens 650 kg/m^3, besonders bevorzugt mindestens 670 kg/m^3 ist.

12. Sperrholz gemäß einem der Ansprüche 8 bis 10, wobei die mittlere Dichte der orientierten Furnierschichten (B) mindestens 2%, bevorzugt mindestens 4%, besonders bevorzugt mindestens 5% höher als die mittlere Dichte der Innenfurnierschichten (C) ist.

13. Sperrholz gemäß einem der Ansprüche 8 bis 12, wobei jede Furnierschicht der Vielzahl von Innenfurnierschichten (C) eine Maserungsrichtung aufweist, die senkrecht zu der Maserung ihrer beiden benachbarten Furnierschichten ist, oder alle bis auf zwei der Vielzahl von Innenfurnierschichten (C) eine Maserungsrichtung aufweisen, die senkrecht zu der Maserung ihrer beiden benachbarten Furnierschichten ist, wobei die zwei anormalen bzw. abweichenden Furnierschichten eine Maserungsrichtung aufweisen, die parallel zu der Maserung eines ihrer benachbarten Furnierschichten ist.

14. Sperrholz gemäß Anspruch 13, wobei jede Furnierschicht der Vielzahl von Innenfurnierschichten (C) eine Maserungsrichtung aufweist, die senkrecht zu der Maserung ihrer beiden benachbarten Furnierschichten ist.

15. Sperrholz gemäß Anspruch 13, wobei zwei Furnierschichten der Vielzahl von Innenfurnierschichten (C) eine Maserungsrichtung aufweisen, die parallel zu einer benachbarten Furnierschicht ist, während alle anderen Furnierschichten der Vielzahl von Innenfurnierschichten (C) eine Maserungsrichtung aufweisen, die senkrecht zu der Maserung ihrer beiden benachbarten Furnierschichten ist.

16. Bodenbelag für einen Laderaum eines Frachttransportfahrzeugs oder einer Frachttransporteinheit ei-

nes Frachttransportfahrzeugs, dessen Bodenbelag an einem Chassis des Frachttransportfahrzeugs oder an einem Chassis der Frachttransporteinheit eines Frachttransportfahrzeugs befestigt ist, wobei der Bodenbelag ein Sperrholzbrett umfasst, das aus zwei oder mehr Sperrholzplatten gemäß einem der Ansprüche 8 bis 15 gebildet ist.

17. Eine konkrete Form bzw. Betonform, die ein Sperrholzbrett aufweist, das an einem Rahmen befestigt ist, wobei das Sperrholzbrett aus zwei oder mehr Sperrholzplatten bzw. Sperrholzpaneelen gemäß einem der Ansprüche 8 bis 15 besteht.

Revendications

1. Procédé de fabrication d'un contreplaqué à partir de placages de bois, le procédé comprenant :

- l'application d'un adhésif sur certains des placages, l'adhésif comprenant une résine thermodurcissable incluant de l'eau ou une composition adhésive incluant de l'eau,
- la disposition des placages les uns sur les autres afin de produire un rondin en contreplaqué qui comprend un placage de surface (A) dans le fond et sur le haut du rondin de contreplaqué, les placages de surface (A) ayant leur grain orienté dans une première direction ; de deux à quatre placages orientés (B) près de chaque placage de surface (A), les placages orientés (B) ayant leur grain orienté dans une seconde direction qui est perpendiculaire à ladite première direction ; et une pluralité de placages intérieurs (C) ayant leur grain alternativement dans la première direction et dans la seconde direction de sorte que les placages intérieurs (C) forment une structure réticulée ; dans lequel les placages sont sélectionnés de sorte que la densité moyenne des placages orientés (B) soit supérieure à la densité moyenne de la pluralité des placages intérieurs (C),
- une pression à chaud du rondin en contreplaqué pour coller les placages ensemble, dans lequel l'eau de connexion provenant de l'adhésif se vaporise, pénètre dans les placages et enfin s'en échappe, et les placages se compriment, et
- le sablage du contreplaqué pour atteindre l'épaisseur souhaitée de contreplaqué.

2. Procédé selon la revendication 1, dans lequel les placages sont triés de sorte que la densité moyenne (telle que mesurée avant l'application de l'adhésif et la pression à chaud) des placages utilisés comme des placages orientés (B) soit au moins de 3 %, de préférence au moins de 4 %, de manière davantage préférée au moins de 5 % supérieure à la densité moyenne des placages utilisés comme placages intérieurs (C).

3. Procédé selon l'une quelconque des revendications 1 à 2, dans lequel tous les placages inclus dans le rondin de contreplaqué sont de la même espèce de bois.

4. Procédé selon la revendication 3, dans lequel tous les placages inclus dans le rondin de contreplaqué sont en bouleau.

5. Procédé selon l'une quelconque des revendications 1 à 4, dans lequel chaque placage de la pluralité de placages intérieurs (C) est disposé de sorte qu'il ait une direction de grain perpendiculaire au grain de ses deux placages adjacents, ou tous sauf deux placages intérieurs sont disposés de sorte qu'ils aient une direction de grain perpendiculaire au grain de leurs deux placages adjacents, auquel cas deux placages de la pluralité de placages intérieurs (C) sont disposés de façon à avoir une direction de grain parallèle au grain de l'un de leurs placages adjacents.

6. Procédé selon la revendication 5, dans lequel chaque placage de la pluralité de placages intérieurs (C) est disposé de façon à avoir une direction de grain qui est perpendiculaire au grain de ses deux placages adjacents.

7. Procédé selon la revendication 5, dans lequel deux placages de la pluralité de placages intérieurs (C) sont disposés de façon à avoir une direction de grain qui est parallèle à celle d'un placage adjacent, tandis que tous les autres placages de la pluralité de placages intérieurs (C) sont disposés de façon à avoir une direction de grain qui est perpendiculaire au grain de leurs placages adjacents.

8. Contreplaqué comprenant une pluralité de couches de placage empilées les unes sur les autres, et collées ensemble avec un adhésif thermodurcissable incluant de l'eau ou une composition adhésive incluant de l'eau, les couches de placage comprenant :

- une couche de placage de surface (A) des deux côtés opposés du contreplaqué (1), les couches de placage de surface (A) ayant leur grain orienté dans une première direction ;
- de deux à quatre couches de placages orientés (B) près de chaque couche de placage de surface (A), les couches de placages orientés (B) ayant leur grain orienté dans une seconde direction, qui est perpendiculaire à ladite première direction ;
- une pluralité de couches de placages intérieurs (C) ayant leur grain orienté alternativement dans

la première direction et dans la seconde direction de sorte que les couches de placages intérieurs (C) forment une structure réticulée ;

caractérisé en ce que
la densité moyenne des couches de placages orientés (B) soit supérieure à la densité moyenne de la pluralité de couches de placages intérieurs (C) dans lequel la densité moyenne représente la densité des placages séchés avant qu'ils ne soient empilés dans un rondin de contreplaqué.

9. Contreplaqué selon la revendication 8, dans lequel toutes les couches de placage (A, B, C) sont de la même espèce de bois.

10. Contreplaqué selon la revendication 9, dans lequel toutes les couches de placage (A, B, C) sont en bouleau.

11. Contreplaqué selon l'une quelconque des revendications 8 à 10 dans lequel la densité du contreplaqué (1) est d'au moins 630 kg/m^3, de préférence d'au moins 650 kg/m^3, de manière davantage préférée d'au moins 670 kg/m^3.

12. Contreplaqué selon l'une quelconque des revendications 8 à 10, dans lequel la densité moyenne des couches de placages orientés (B) est d'au moins 2 %, de préférence d'au moins 4 %, de manière davantage préférée d'au moins 5 % supérieure à la densité moyenne des couches de placages intérieurs (C).

13. Contreplaqué selon l'une quelconque des revendications 8 à 12, dans lequel chaque couche de placage de la pluralité de couches de placages intérieurs (C) a une direction de grain qui est perpendiculaire au grain de ses deux couches de placage adjacentes, ou tous sauf deux parmi la pluralité des couches de placages intérieurs (C) ont une direction de grain qui est perpendiculaire au grain de leurs deux couches de placage adjacentes, les deux couches de placage anormales ayant une direction de grain qui est parallèle au grain de l'une de leurs couches de placage adjacentes.

14. Contreplaqué selon la revendication 13, dans lequel chaque couche de placage de la pluralité des couches de placages intérieurs (C) a une direction de grain qui est perpendiculaire au grain de ses deux couches de placage adjacentes.

15. Contreplaqué selon la revendication 13, dans lequel deux couches de placage de la pluralité des couches de placages intérieurs (C) ont une direction de grain qui est parallèle à une couche de placage proche d'elles, tandis que toutes les autres couches de placage de la pluralité de couches de placages intérieurs (C) ont une direction de grain qui est perpendiculaire au grain de leurs deux couches de placage adjacentes.

16. Revêtement de sol pour un espace de chargement d'un véhicule de transport de fret ou d'une unité de transport de fret d'un véhicule de transport de fret, ledit revêtement de sol étant fixé à un châssis du véhicule de transport de fret ou à un châssis de l'unité de transport de fret d'un véhicule de transport de fret, dans lequel le revêtement de sol comprend un panneau en contreplaqué formé de deux panneaux ou plus de contreplaqué selon l'une quelconque des revendications 8 à 15.

17. Forme de béton comprenant un panneau de contreplaqué fixé à un cadre, dans lequel le panneau de contreplaqué est constitué de deux panneaux de contreplaqué ou plus selon l'une quelconque des revendications 8 à 15.

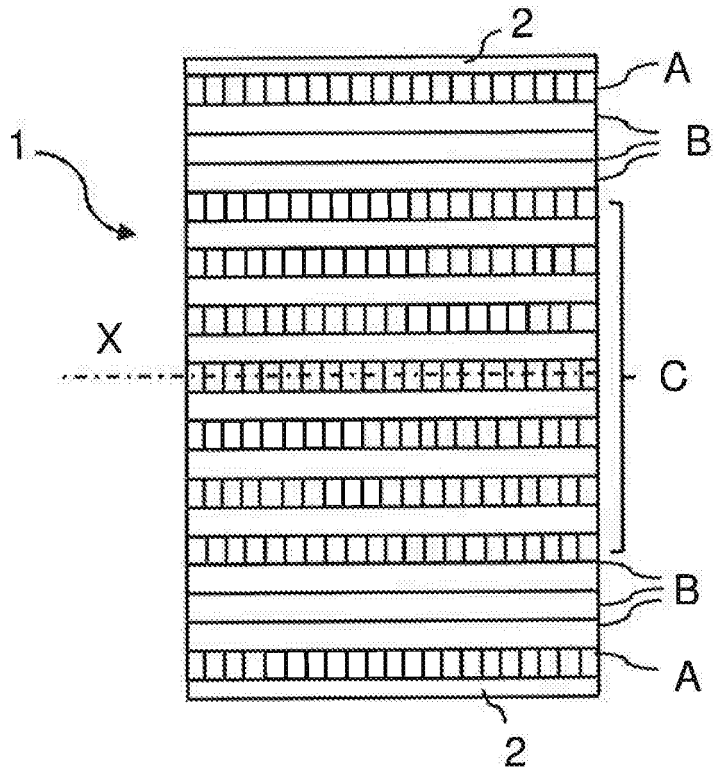
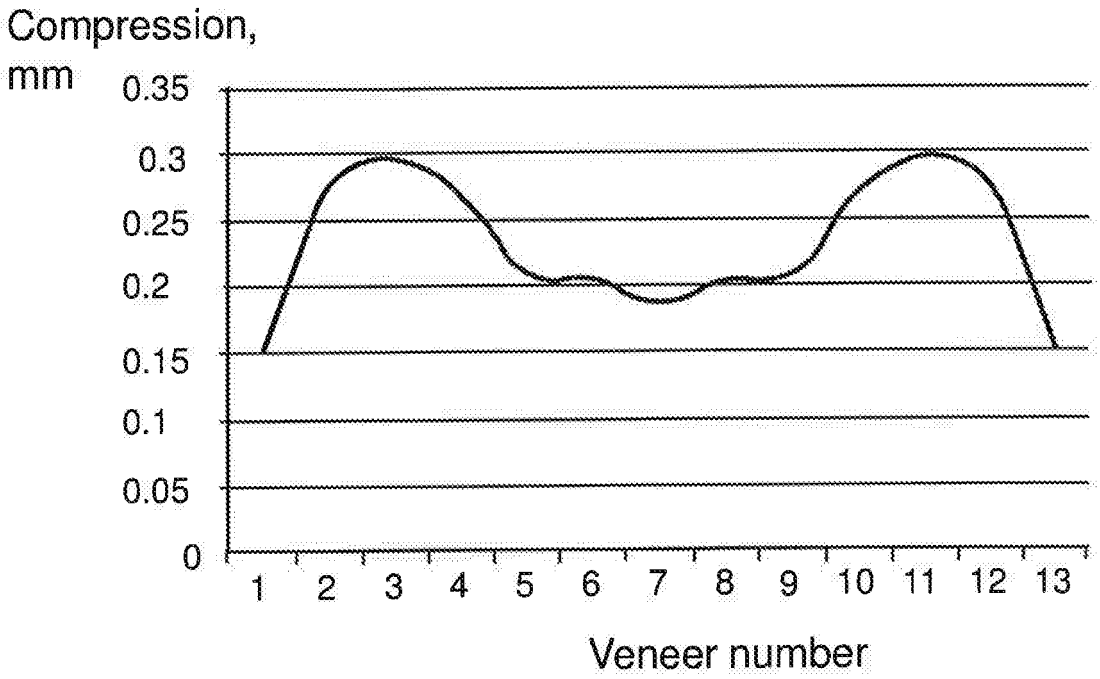

2
A
B
1
X
C
B
A
2

FIG. 1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mm
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5
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Veneer number

FIG. 2

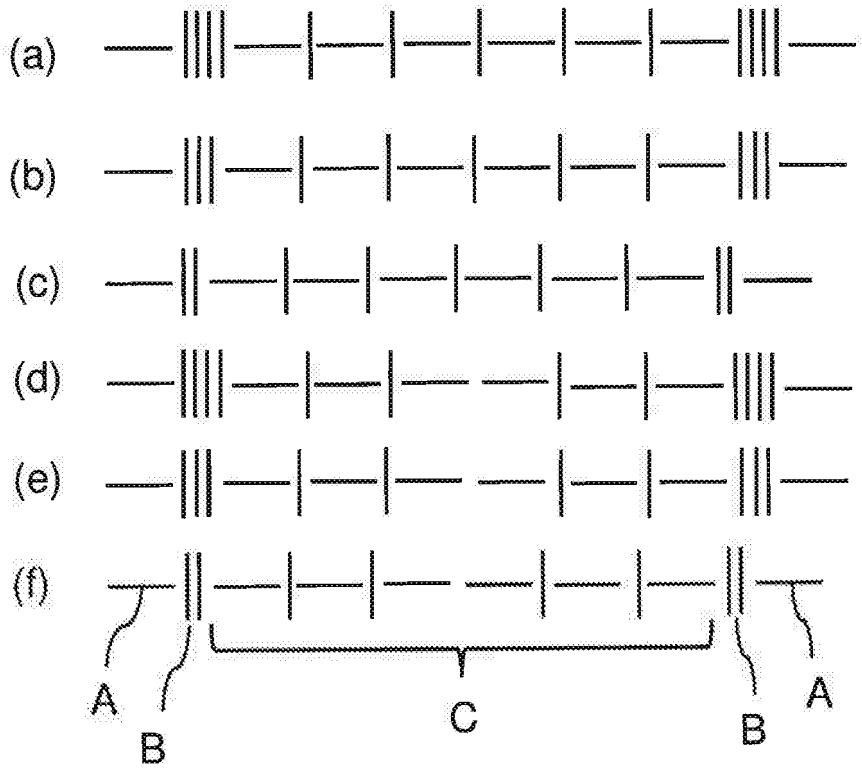

FIG. 3

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2705950 A1 **[0003]**