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(72) Inventors:
• **Montanari, Stefano**
42122 Reggio Emilia (IT)
• **Buriani, Ernesto**
42123 Reggio Emilia (IT)

(71) Applicant: **Xilopan S.p.A.**
27040 Cigognola (Pavia) (IT)

(74) Representative: **Ferreccio, Rinaldo**
Botti & Ferrari S.r.l.
Via Cappellini, 11
20124 Milano (IT)

(54) **Low density multilayer chipboard panel and process for making said panel**

(57) The present invention provides a so-called "ultralight" multilayer chipboard panel (1), comprising at least one first layer (2) having a density value d_1 and a thickness s_1 , and a second layer (3) adjacent to the first layer (2) having a density value $d_2 < d_1$ and a thickness $s_2 > s_1$, wherein the panel comprises chips of vegetal material agglomerated through at least one adhesive substance, in which the chips consist for at least 85% by

weight over the weight of the vegetal material of essentially flat chips of wood-based material from planting, obtained from cuts along the axis of the fibre of the wood-based material, in which the grain of said wood-based material extends in the longitudinal direction of the flat chips, in which the chips of the first layer (2) have a first size and the chips of the second layer (3) have a second size greater than the first size that makes a woven mesh structure.

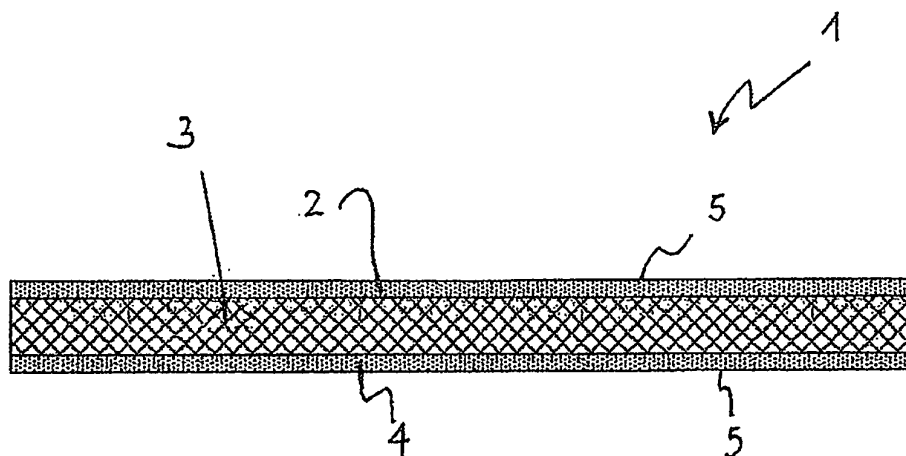


Fig. 1

DescriptionField of application

5 **[0001]** In its most general aspect the present invention refers to the field of chipboard panels made from wood-based material.

[0002] In particular, the invention refers to a multilayer chipboard panel of the aforementioned type, having a particularly low density value, and to a process for making said panel.

10 Prior art

[0003] Chipboard panels made from wood fibre are made up of chips generally coming from the scrap of wood construction, and to a lesser extent from the processing of logs or other portions of trees, mixed with binding materials that are pressed, normally under heat.

15 **[0004]** In order to satisfy the numerous and different requirements of the market, the prior art has provided chipboard panels that differ, for example, in mechanical characteristics such as bending strength, density values, thickness, appearance.

[0005] Things that determine the aforementioned characteristics, as well as other properties of a chipboard panel, are the type of wood used, the chip size or particle size, the degree of homogeneity of the chips size, their shape, the structure in layers, the type and amount of binding substance used and possibly the presence of additives, as well as some aspects of the process for making it such as the orientation, distribution and pressing of the chips.

20 **[0006]** So-called "light" panels for application in some specific fields, like for example interior furnishing, i.e. furniture, are of particular interest.

[0007] Indeed, furniture is generally assembled, and if necessary also disassembled, through manual operations, and therefore the lightness of the components that make up the furniture is particularly appreciated.

25 **[0008]** Moreover, in recent years it has become increasingly common for furniture to be sold in kits, in other words products sold in packs to be transported, moved and assembled by the end user, and as can easily be imagined, also in this case, the lightness of the panels making up the furniture is a highly appreciated and desirable characteristic.

[0009] The lightness of the panels making up a piece of furniture is also important for the components intended to be moved repeatedly over time, like for example doors and drawers, in particular to reduce the stress and wearing of the mechanical parts like hinges and runners to the minimum.

[0010] Another field in which light panels are widely used is the building industry for making panel structures of various kinds, for example for sound and heat insulation, or floor supports, and also the nautical and aeronautical field in which excessive weight of a panel undoubtedly constitutes a drawback.

35 **[0011]** Although the prior art has provided low-density panels, i.e. the aforementioned light panels, there is a limit below which it has not yet been possible to go, for example there are known panels with thickness of 19-20 mm, having a density of no less than 560 kg/m³, and panels with 16 mm thickness, with average density equal to or greater than 600 kg/m³.

[0012] It should also be considered that a low density generally has a negative effect on the technical-performance characteristics of panels according to the prior art, and therefore it limits the possibilities of use, or in any case limits its resistance to wear and stress.

[0013] Vice-versa, panels with high technical-performance characteristics are obtained according to the prior art with high density values and therefore, although used, are not particularly satisfactory and suitable for the specific purposes and uses.

45 **[0014]** Basically, the prior art still comes up against the fact that it is impossible to provide chipboard panels made from wood fibre having particularly low density values and, at the same time, having high mechanical strength.

[0015] The technical problem forming the basis of the present invention is to provide a chipboard panel made from wood fibre having structural and functional characteristics such as to overcome the quoted drawbacks with reference to the prior art, and in particular a so-called "ultralight" chipboard panel, having a lower density, and greater or in any case comparable technical-performance characteristics, with respect to those of known panels of equal thickness made from similar wood-based material.

Summary of the invention

55 **[0016]** The solution idea forming the basis of the present invention is to transfer the typical and natural characteristics of a so-called light wood, and in particular its specific weight and mechanical properties, into a multilayer chipboard panel made from wood fibre, or at least into a layer of the panel, typically the layer having greater thickness, reducing to the minimum the thickness of the layer intended to remain in view, or in any case of the outer layers of the panel.

[0017] Based on such solution idea the aforementioned technical problem is solved by a chipboard panel comprising at least two layers, and in particular a first layer having a density value d_1 and a thickness s_1 , and a second layer adjacent to the aforementioned first layer having a density value $d_2 < d_1$ and a thickness $s_2 > s_1$, in which the aforementioned first and second layers comprise chips of vegetal material agglomerated through at least one adhesive substance, wherein the aforementioned chips consist for at least 85% by weight over the total weight of the aforementioned vegetal material of essentially flat chips of wood-based material from planting obtained from cuts along the axis of the fibre or grain of the aforementioned wood-based material, in which the aforementioned chips of the aforementioned first layer have a first size (fine particle size), and the aforementioned chips of the aforementioned second layer have a second size (large particle size) greater than the aforementioned first size such as to make a woven mesh structure that gives the panel lightness and strength.

[0018] Basically, a multilayer chipboard panel is provided, in which it has surprisingly been found that a vegetal matrix - the aforementioned chips - comprising mainly wood-based material coming directly from planting, therefore not recycled, not deriving from scrap, and also not of spontaneous origin, in the form of flat chips obtained from cuts along the axis of the fibre or grain of the wood-based material in logs, in other words cuts essentially parallel to the axis of the log, most likely thanks to the essentially long and flat shape of the flat chips and the orientation of the grain or fibre of the wood in the direction of the length of the flat chips (in the longitudinal direction), allows an optimal distribution of the adhesive substance in the wood matrix of the panel and makes an optimal adhesion between adhesive substance and flat chips, therefore requiring less amounts of adhesive substance with respect to known panels, and also makes a greater cohesion between the flat chips themselves that essentially allows the characteristics of the wood-based material used in flat chips, particularly density and mechanical strength, to be conserved in the panel, or at least in its layer with large particle size.

[0019] Advantageously, the aforementioned panel is of the so-called faceable type, the aforementioned chips and therefore the aforementioned flat chips with fine particle size making a compact and essentially smooth outer surface, in other words a surface suitable for being faced through application of a sheet of paper that may have been treated or a film of another material.

[0020] In particular, the aforementioned surface of the first layer has a roughness no greater than that which can be obtained by smoothing with abrasive means having a grain of 100 ANSI (American National Standard Institute).

[0021] Preferably, the present panel comprises, in addition to the aforementioned two layers, also a third layer, adjacent to the aforementioned second layer and arranged on the opposite side to the aforementioned first layer, having characteristics essentially corresponding to those of the aforementioned first layer.

[0022] Preferably, the aforementioned flat chips are made of at least one from the wood-based materials of the group comprising poplar, balsa, linden tree and similar low-density wood-based materials.

[0023] In accordance with a particularly high-performance embodiment of the invention, 100% by weight of the aforementioned vegetal material, in other words all of the chips of the panel, consists of essentially flat chips of the aforementioned type.

[0024] In accordance with a particularly strong embodiment of the invention, at least 75% by weight of the aforementioned flat chips is made from poplar wood material.

[0025] In accordance with a particularly advantageous embodiment of the invention, 100% by weight of the aforementioned vegetal material, in other words all of the chips of the panel, consists of flat chips of the aforementioned poplar type.

[0026] In accordance with a particularly light embodiment of the invention, in other words with low density, the aforementioned vegetal material comprises, for a percentage equal to or less than 15% by weight over the total weight of the vegetal material, chips of flax shives, in other words chips obtained from woody flax waste.

[0027] In any case, in the present panel, in accordance with the different embodiments outlined above, preferably at least 90% by weight of the aforementioned flat chips having a first size has a thickness comprised between 0.1 mm and 0.3 mm.

[0028] Preferably, at least 85% by weight of the flat chips having a first size has a width comprised between 0.3 mm and 1.3 mm, and a length comprised between 2.0 mm and 5.0 mm.

[0029] Preferably, at least 90% by weight of the aforementioned flat chips having a second size has a thickness comprised between 0.1 mm and 1.0 mm.

[0030] Preferably, at least 85% by weight of the aforementioned flat chips having a second size has a width comprised between 2.0 mm and 6.0 mm, and a length comprised between 4.0 mm and 28 mm.

[0031] Furthermore, concerning possible vegetal material in chips different from the aforementioned flat chips, in other words chips not obtained from cuts of logs carried out parallel to the grain of the wood-based material, for example the aforementioned flax shives chips, it should be added that they have sizes substantially corresponding to those indicated above for the flat chips of first and second size, in particular concerning width and length.

[0032] Furthermore, according to the invention and in accordance with the different embodiments outlined above, the ratio between the aforementioned density values d_1 and d_2 is preferably equal to 2 ± 0.7 , whereas the ratio between the weight of the adhesive substance and the weight of the vegetal material is equal to about 8/92.

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[0033] Advantageously, in the different embodiments outlined above, the present panel has an average density d , inverse function of the thickness s , as indicated in table 1 shown hereafter:

Table 1

Thickness ranges [mm]	Average density [kg/m ³]
$8 \leq s < 10$	$d \leq 580$
$10 \leq s < 14$	$d \leq 570$
$14 \leq s < 16$	$d \leq 555$
$16 \leq s < 19$	$d \leq 535$
$19 \leq s < 38$	$d \leq 525$
$38 \leq s < 50$	$d \leq 515$
$50 \leq s < 60$	$d \leq 500$
$60 \leq s < 70$	$d \leq 480$
$70 \leq s$	$d \leq 470$

[0034] The aforementioned correlation is inverse since as the thickness of the panel increases, the thickness s_2 of the layer with large particle size and density d_2 increases in greater proportion with respect to the layer or to the layers of thickness $s_1 < s_2$ with fine particle size and density $d_1 > d_2$.

[0035] Advantageously, the present panel, for a content of poplar flat chips equal to at least 75% by weight over the total weight of the flat chips, for the thicknesses considered above, displays exceptionally low density values, as indicated in particular in table 2 shown below, and unexpectedly satisfactory technical-performance characteristics, in accordance with the international standard provisions UNI EN 312 of 2010, incorporated here for reference, and in particular a mechanical strength in its different forms that can be determined as bending or static strength, modulus of elasticity in bending, internal bond and surface soundness, equal at least to the values given in the aforementioned European Standard provisions for woodchip panels of so-called Type P2, that is, panels for interior furnishings, including furniture, for use in dry conditions, as indicated in table 3 given below.

Table 2

Thickness ranges [mm]	Average density [kg/m ³]
$8 \leq s < 10$	$500 \leq d \leq 580$
$10 \leq s < 14$	$480 \leq d \leq 570$
$14 \leq s < 16$	$475 \leq d \leq 555$
$16 \leq s < 19$	$455 \leq d \leq 535$
$19 \leq s < 38$	$440 \leq d \leq 525$
$38 \leq s < 50$	$420 \leq d \leq 515$
$50 \leq s < 60$	$405 \leq d \leq 500$
$60 \leq s < 70$	$390 \leq d \leq 480$
$70 \leq s$	$380 \leq d \leq 470$

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Table 3

Property	Test method	Unit	Requirement								
			Thickness range (mm. nominal)								
			<3	3 to 4	>4 t 6	>6 to13	>13 to 20	> 20 to 25	<25 to 32	> 32 to 40	> 40
Bonding strength	EN 310	N/mm ²	13	13	12	11	11	10,5	9,5	8,5	7
Modulus of elasticity in bending	EN 310	N/mm ²	18000	1800	1950	1800	1600	1500	1350	1200	1050
Internal bond	EN 319	N/mm ²	0.45	0,45	0,45	0,40	0,35	0,39	0,25	0,20	0,20
Surface soudness	EN 311	N/mm ²	0,8	0,8	0,8	0,8	0,8	0,8	0,8	0,6	0,8
NOTE The 65 % and a temperature values are of 20 °C. characterised b by a mc moisture content in the material corresponding to a relative humidity of											

[0036] The aforementioned density values indicated in tables 1 and 2 are determined for a humidity content equal to $9 \pm 4\%$, substantially corresponding to the humidity contained in a panel in the storage site.

[0037] Advantageously, the present panel can comprise additives such as flame retardants to increase its resistance to fire, hydrophobic compounds or substances to improve its resistance to water absorption, and in general additives of the known type usually used in the field to improve specific characteristics and give the panel desired performance properties.

[0038] The present chipboard panel is made through a process that in accordance with the invention essentially comprises the steps of:

providing a plurality of logs coming from planting and having a predetermined diameter of at least one wood-based material having Average Dry Unit Weight (DUW) equal to or less than 500 kg/m³;

chipping each log through knives or blades having a cutting axis essentially parallel to the axis of the log, so as to obtain wood-based material in essentially flat chips in which the grain or fibre of the wood-based material extends, in other words is oriented, in the direction of the length of the aforementioned chips;

drying the aforementioned wood-based material in flat chips;

screening the aforementioned dried wood-based material, separating a fraction of flat chips having a first size (fine particle size), a fraction of flat chips having a second size (large particle size) and a fraction of oversized flat chips;

refining the aforementioned fraction of oversized flat chips of the aforementioned screened wood-based material reducing their dimensions;

further screening the aforementioned refined wood-based material separating a fraction of flat chips having the aforementioned first size and a fraction of flat chips having the aforementioned second size;

mixing the aforementioned fractions of flat chips having first size and second size, respectively, with at least one adhesive substance;

forming at least two layers one on top of the another, one layer with the aforementioned flat chips of wood-based material having a first size mixed with the aforementioned at least one adhesive substance, the other layer with the aforementioned flat chips of wood-based material having a second size mixed with the aforementioned at least one adhesive substance, making a mat comprising two adjacent layers;

pressing the aforementioned mat;

subjecting the aforementioned pressed mat to a baking heat treatment obtaining a multilayer chipboard panel comprising a layer with fine particle size having a thickness s_1 and a density value d_1 , and a layer having large particle size having a thickness $s_2 > s_1$, a woven mesh structure, and a density value $d_2 < d_1$.

- 5 **[0039]** Preferably, the present process also comprises a step of smoothing the surface of the aforementioned layer with fine particle size obtaining a first faceable surface.
- [0040]** Preferably, the aforementioned mat is formed by making a first layer with the aforementioned flat chips having a first size, and making a second layer with the aforementioned flat chips having a second size on top of the aforementioned first layer.
- 10 **[0041]** Preferably, after the aforementioned second layer has been made, a third layer with the aforementioned flat chips having a first size mixed with the aforementioned at least one adhesive substance is made on top of it, obtaining a mat of the sandwich type comprising three layers.
- [0042]** Advantageously, after the aforementioned baking heat treatment, the present process can comprise a step of smoothing also the surface of the aforementioned third layer, obtaining a second faceable surface.
- 15 **[0043]** If necessary, before or after the smoothing step, the present process can comprise a step of cutting the aforementioned panel to size.
- [0044]** Advantageously, after the smoothing step, the present process can comprise a facing step of the aforementioned first faceable surface and possibly of the aforementioned second faceable surface, through application of a sheet of paper that has possibly been treated or a film of another material.
- 20 **[0045]** Advantageously, the present process can also involve a refining step between the chipping and drying steps, in which at least one fraction of the aforementioned flat chips is reduced in size.
- [0046]** Preferably, the aforementioned refining step comprised between the chipping and drying steps is carried out through coarse mesh hammermills having openings with a width comprised between 14 mm and 24 mm and a length comprised between 60 mm and 110 mm.
- 25 **[0047]** Preferably, the aforementioned logs consist of at least one of the wood-based materials of the group comprising poplar, balsa, linden tree and similar low-density wood materials.
- [0048]** Preferably, the aforementioned logs have a diameter comprised between 150 mm and 250 mm, more preferably comprised between 180 mm and 220 mm.
- [0049]** Preferably, at least 90% by weight of the aforementioned flat chips having a first size has a thickness comprised
- 30 between 0.1 mm and 0.3 mm.
- [0050]** Preferably, at least 85% by weight of the aforementioned flat chips having a first size has a width comprised between 0.3 mm and 1.3 mm, and a length comprised between 2.0 mm and 5.0 mm.
- [0051]** Preferably, at least 90% by weight of the aforementioned flat chips having a second size has a thickness comprised between 0.1 mm and 1.0 mm.
- 35 **[0052]** Preferably, at least 85% by weight of the aforementioned flat chips having a second size has a width comprised between 2.0 mm and 6.0 mm, and a length comprised between 4.0 mm and 28 mm.
- [0053]** Preferably, the pressure exerted on the aforementioned mat is comprised between 2.7 and 5.0 Mpa.
- [0054]** Preferably, the aforementioned baking treatment lasts about 9 seconds for every millimetre of thickness of the aforementioned pressed mat, and it is carried out at a temperature comprised between 180°C and 220°C.
- 40 **[0055]** Advantageously, the pressing step and the baking heat treatment of the aforementioned mat can take place consecutively or simultaneously.
- [0056]** Advantageously, the chipping step can be carried out through chipping machines with a mobile spindle moving alternately with the aforementioned logs still, and/or with chipping machines with a fixed spindle and moving logs, or furthermore through knife mills.
- 45 **[0057]** Advantageously, the present process can involve a step of adding one or more additives of the known type, preferably carried out at the same time as the step of mixing with the aforementioned at least one adhesive substance.
- [0058]** In accordance with the invention and as described above, the present panel can comprise up to a maximum of 15% by weight over the total weight of the vegetal material of chips having different characteristics from the aforementioned flat chips, in other words chips of vegetal material not obtained from cuts along the axis of the grain of logs
- 50 coming from planting.
- [0059]** In particular, it has been found that an amount no more than the aforementioned 15% of chips of vegetal material different from the aforementioned flat chips can be advantageous to give the present panel particular characteristics without penalizing its mechanical properties.
- [0060]** Therefore, in accordance with an embodiment of the invention that allows a particularly light panel to be obtained, in other words a low-density one, the present process can involve drying, along with the aforementioned flat chips, a predetermined amount of chips of another vegetal material, preferably chips of flax shives, in other words chips obtained from woody flax waste, so that the amount of the aforementioned flat chips constitutes at least 85% by weight over the total weight of the dried vegetal material.
- 55

[0061] Advantageously, the aforementioned chips of flax shives, or other vegetal material in chips, are thus added to the aforementioned flat chips in the drying step, and are then subjected to all of the steps of the present process mixed with the flat chips themselves.

[0062] Consequently, the aforementioned chips have substantially the same size obtained for the flat chips, in particular concerning the width and length of the fractions with fine particle size and with large particle size, respectively.

[0063] Chips of flax shives are particularly preferred both due to the low Average Dry Unit Weight (DUW) value of flax, and because the chips obtained from woody flax waste, for example through scutching, generally come in an elongated form that is advantageously essentially conserved during the course of all the steps of the present process, and that therefore adapts well to the elongated and substantially flat shape of the aforementioned flat chips.

[0064] Further characteristics and advantages of the present invention shall become clearer from the following description of some example embodiments, made with reference to the attached drawing, provided for illustrating and not limiting purposes.

Brief description of the drawings

[0065]

Figure 1 schematically shows a chipboard panel comprising three layers in accordance with an embodiment of the invention;

Figure 2 schematically shows a process for making the panel of figure 1, in accordance with a preferred embodiment of the invention.

Detailed description of the invention

[0066] With reference to figure 1, a multilayer chipboard panel according to the present invention is wholly indicated with 1.

[0067] The panel 1, of the sandwich type, comprises three layers essentially consisting of chips of vegetal and in particular woody material, agglomerated by an adhesive substance of the known type, for example a glue or a resin, and in particular it comprises a first outer layer 2, a second intermediate layer 3, and a third outer layer 4, opposite the first layer 2.

[0068] The first layer 2 and the third layer 4 in the example of figure 1 have the same thickness s_1 , not however ruling out the possibility of foreseeing outer layers with different thicknesses, and they have substantially the same density value equal to d_1 .

[0069] The second layer 3, located between the first and third outer layers 2, 4, has a thickness $s_2 > s_1$ and a density $d_2 < d_1$.

[0070] In accordance with a first characteristics of the invention, the chips of the outer layers and of the inner layer have a first size (fine particle size) and a second size (large particle size), respectively, and they consist entirely of essentially flat chips of wood-based material from planting, in other words flat chips obtained from logs coming from planting through cuts carried out along the direction of the grain or axis of the log, not however excluding the possibility of foreseeing up to 15% by weight over the total weight of the vegetal material of the present panel of chips of vegetal material obtained differently from the aforementioned flat chips.

[0071] In detail, the flat chips are so to say oriented along the fibre of the wood-based material, in other words in the essentially flat form of the flat chips, the grain or fibre of the wood-based material extends longitudinally, i.e. in the direction of the length of the flat chips.

[0072] The flat chips consist of wood-based material that has not been recycled or deriving from scrap, and also not of spontaneous origin, and preferably they are obtained from low-density wood-based material, in other words with Dry Unit Weight (DUW) equal to or less than 500 kg/m^3 , preferably poplar, balsa, linden tree, alone or in combination with each other.

[0073] In particular, the flat chips of first size essentially have a thickness comprised between 0.1 mm and 0.3 mm, and the flat chips having a second size have a thickness essentially comprised between 0.1 mm and 1.0 mm.

[0074] The flat chips of first size also have width and length dimensions comprised between 0.3 mm and 1.3 mm, and comprised between 2.0 mm and 5.0 mm, respectively, whereas the flat chips of second size have width and length dimensions comprised between 0.3 mm and 1.3 mm and comprised between 2.0 mm and 5.0 mm, respectively, substantially corresponding to the dimensions of possible chips of first and second size, respectively, obtained differently from the aforementioned flat chips, as considered previously, for example chips obtained by scutching.

[0075] In detail, in the panel 1, the vegetal material of first size makes, in the first layer 2 and in the third layer 4 - i.e. in the outer layers, respective essentially compact and smooth outer surfaces 5, able to be faced for example with a

sheet of paper that may possibly have been treated or with a film of another suitable material, whereas the vegetal material of second size makes a woven mesh structure in the intermediate layer or second layer 3 that gives the panel 1 lightness and mechanical strength.

[0076] In particular, the faceable surfaces 5 have a surface finish of a quality not inferior to that obtained by smoothing with abrasive means having a grain of 100 ANSI.

[0077] Again in accordance with the invention, in the panel 1, the ratio between the density value d_1 of the outer layers, first 2 and third 4, and the density value d_2 of the second inner layer 3 is equal to 2 ± 0.7 .

[0078] In accordance with the invention, the panel 1 described above is made through a process, schematically illustrated in the example of figure 2, which comprises:

providing a plurality of logs coming from planting of at least one wood-based material having an Average Dry Unit Weight (DUW) equal to or less than 500 kg/m^3 ;

the logs of predetermined diameter, comprised between 150 mm and 250 mm, are subjected to a chipping step, i.e. a cutting step;

in particular, the chipping step is carried out by cutting each log with knives or blades having a cutting axis essentially parallel to the axis of the log, so as to obtain chips in the form of essentially flat chips in which the grain of the wood extends longitudinally in the flat chips;

thereafter the flat chips are subjected to a drying step to eliminate at least part of the humidity contained in the wood-based material, possibly together with chips of another vegetal material, as considered earlier, in a proportion such that the aforementioned flat chips constitute at least 85% by weight over the total weight of the dried vegetal material;

then the dried vegetal material is subjected to a screening step;

in the screening step a fraction of vegetal material having fine particle size (first size), a fraction of vegetal material having a large particle size (second size), and a fraction of oversized vegetal material are separated;

then the oversized vegetal material is subjected to a refining step reducing their size;

thereafter the refined vegetal material is subjected to a screening step in which at least one fraction of vegetal material having the aforementioned first size, and a fraction of vegetal material having the aforementioned second size is separated;

then the aforementioned fractions of vegetal material of first and of second size are mixed with at least one adhesive substance, for example a glue or a resin of the known type and commonly used in the field;

then a forming step is foreseen in which the vegetal material of first size and that of second size of the respective fractions mixed with the adhesive substance, is used to make three stacked layers, and in particular to make a mat that in accordance with the example of figure 1 comprises a first layer having fine particle size, a second layer having large particle size and a third layer again having fine particle size;

thereafter the multilayer mat is subjected to a pressing step and to a baking heat treatment that can take place simultaneously, as shown in the example of figure 2, not however excluding the possibility of foreseeing the baking heat treatment step after the pressing step;

then there is a step of smoothing the outer surfaces of the layers with fine particle size, obtaining a multilayer chipboard panel as described above, in other words the panel 1 comprising outer layers 2, 4, having a density value d_1 and smooth and compact outer surfaces 5 with finish of around 100 ANSI, between which there is an intermediate layer 3, of thickness s_2 that is greater than s_1 and density d_2 that is less than d_1 , having a woven mesh structure.

[0079] As stated above, the wood-based material used for the flat chips is preferably a wood selected from the group comprising at least one from poplar, balsa, linden tree and similar low-density woods.

[0080] In accordance with a variant embodiment of the invention that is not illustrated in the figures, the present process can also comprise a refining step comprised between the chipping and drying steps, in which at least one portion of the flat chips is reduced in size.

[0081] In other words, prior to drying, the present process can foresee the refining of a fraction of flat chips obtained

from the chipping step, comprised between zero and 100% of the flat chips, depending on the wood-based material used and the desired characteristics of the panel.

[0082] The panel is also cross-cut to size, possibly prior to the smoothing, then if necessary faced through the application of a sheet of paper that may have been treated or of a film of another material, preferably after smoothing.

Example

[0083] Logs of poplar having a diameter comprised between 150 mm and 200 mm were chipped through chipping machines using knives with alternate motion, obtaining essentially flat chips with a thickness comprised between 0.1 mm and 1 mm.

[0084] The flat chips were refined to decrease their dimensions, through coarse mesh hammer mills, in other words with mills each equipped with a rotor having articulated hammers, having a fixed annular contrast mesh equipped with openings of dimensions equal to 16 mm in width and 85 mm in length.

[0085] The refined flat chips were dried in a drying drum for a time period of about 25 minutes, going from an initial humidity of 100% to a final humidity of 2.5%.

[0086] Then the dried chips were screened, separating three fractions, the first fraction of which has fine particle size consisting for 95% by weight of the first fraction itself of flat chips having a thickness comprised between 0.2 mm and 0.3 mm, a length comprised between 3 mm and 4 mm and a width comprised between 0.4 and 1.2 mm, the second fraction has a large particle size consisting for 95% by weight of the second fraction itself of flat chips having a thickness comprised between 0.2 mm and 1 mm, a length comprised between 5 mm and 28 mm and a width comprised between 3 and 5 mm, whereas the remaining third fraction comprising oversized flat chips was further refined to reduce their dimensions, and then the refined flat chips were further screened obtaining a further fraction of flat chips with fine particle size analogous to the fraction with fine particle size described earlier, and a fraction with large particle size analogous to the fraction with large particle size described earlier.

[0087] The flat chips having fine particle size and separately the flat chips with large particle size of the respective fractions were mixed with a urea glue in proportions equal to 10% by weight of glue and 90% by weight of flat chips of wood-based material.

[0088] Then a first layer with fine particle size was made, and on top of the first layer a second layer with large particle size, and on top of the second layer a third layer with fine particle size, using respective flat chips with fine and large particle size mixed with the urea glue, forming a three-layer mat.

[0089] The three-layer mat was pressed with a hot flat press, exerting a pressure equal to 3,8 Mpa on the surface of the third layer, while at the same time it was baked at a temperature of 180°C for a time period of 160 seconds, obtaining a multilayer chipboard panel, with average density equal to 500 kg/m³, height equal to 20.2 mm in total, and mechanical strength in line with the values given in the Standard provisions UNI EN 312 of 2010.

[0090] The panel was cross-cut to size and smoothed, bringing the thickness to the value of 18.8 mm and obtaining faceable outer surfaces that were faced with respective sheets of resin-coated melamine paper applied by pressing with a hot plane.

[0091] After the application of the sheets of paper the thickness of the panel was 19.0 mm.

[0092] The advantages of the present invention, already made clear in the description given above, can be summarised by noting that a so-called ultralight multilayer chipboard panel, which is strong, faceable or faced (laminated) is provided, suitable for being used in various fields and applications, either by itself, for example in making furniture or various structures, or to make composite panels to be used in building, of the type comprising for example layers of flame retardant or sound-proofing material.

[0093] With regard to furniture, it should be added that the lightness of the components making up a piece of furniture is a highly appreciated characteristic and in particular the end user greatly appreciates the feeling of lightness perceived in moving the parts such as doors and drawers.

[0094] It should also be noted how it is possible to use, for those parts of furniture, for example brackets, shelves and doors, often in the prior art made from "hollow core" wood or "honeycomb" wood, a light chipboard panel according to the present invention, with the advantage of having a structurally homogeneous panel without the constraint of having to adapt the structure of the panel itself, as occurs in hollow core structures through reinforcements, to elements that provide mechanical stresses, such as hinges, runners and the like.

[0095] Concerning the aforementioned composite panels, it should be added that it is possible to foresee a panel according to the invention comprising two layers, coupled with a layer of flame retardant or sound-proofing material associated with the layer having large particle size of the present panel, advantageously leaving the faceable or laminated layer in view, or else composite panels comprising two three-layer panels according to the invention, between which there is a layer of flame retardant or sound-proofing material.

[0096] A further advantage of the invention is the fact that the present process makes it possible to make panels of the desired size, even of large thickness, for example panels having a thickness of 70 mm, which still conserve a

characteristic lightness (low density) and good mechanical properties due also to the high thickness.

[0097] The thicknesses of the panels for the uses quoted earlier made according to the prior art do not generally exceed 50 mm since high thicknesses mean excessive weights for convenient use.

[0098] A further advantage is the fact that the present process, and therefore the present panel, can be made using smaller amounts of adhesive substance with respect to the prior art, benefiting the environment both in terms of the production of the panel and in terms of its disposal, and also allowing the wood-based material used to be recycled.

[0099] In particular it is possible to use up to 15% less adhesive substance with respect to the amounts generally used for the panels according to the prior art, with considerable economic savings.

[0100] A further advantage of the invention is the fact that the present process allows processing with low sawdust production, which means greater safety and less waste with respect to conventional processes.

[0101] A man skilled in the art can bring numerous modifications and variants to the panel described and illustrated above and to the process for making said panel, in order to satisfy specific and contingent requirements, all of which are in any case covered by the scope of protection of the invention, as defined by the following claims.

Claims

1. Multilayer chipboard panel (1) comprising at least one first layer (2) having a density value d_1 and a thickness s_1 and a second layer (3) adjacent to said first layer (2) having a density value $d_2 < d_1$ and a thickness $s_2 > s_1$, wherein said panel comprises chips of vegetal material agglomerated through at least one adhesive substance, **characterised in that** said chips consist for at least 85% by weight over the weight of the vegetal material of essentially flat chips of wood-based material from planting obtained from cuts along the axis of the fibre of said wood-based material in which the grain of said wood-based material extends in the longitudinal direction of said flat chips, in which said chips of said first layer (2) have a first size and said chips of said second layer (3) have a second size that is greater than said first size that makes a woven mesh structure.
2. Panel according to claim 1, wherein said first layer (2) has a roughness that is not greater than that obtained by smoothing with abrasive material with 100 ANSI grain.
3. Panel according to claim 1 or 2, further comprising a third layer (4) adjacent to said second layer (3) on the opposite side to said first layer (2), wherein said third layer (4) has characteristics essentially corresponding to those of said first layer (2).
4. Panel according to any one of the previous claims, wherein the ratio between said density values d_1 and d_2 is equal to 2 ± 0.7 .
5. Panel according to any one of the previous claims, wherein at least 90% by weight of said flat chips with first size has a thickness comprised between 0.1 mm and 0.3 mm.
6. Panel according to any one of the previous claims, wherein at least 90%, by weight of said flat chips having second size has a thickness comprised between 0.1 mm and 1.0 mm.
7. Panel according to any one of the previous claims, wherein at least 85% by weight of said flat chips having first size has a width comprised between 0.3 mm and 1.3 mm, and a length comprised between 2.0 mm and 5.0 mm.
8. Panel according to any one of the previous claims, wherein at least 85% by weight of said flat chips having second size has a width comprised between 2.0 mm and 6.0 mm, and a length comprised between 4.0 mm and 28 mm.
9. Panel according to any one of the previous claims, wherein said flat chips consist of at least one of the wood-based materials of the group comprising poplar, balsa, linden tree and similar low-density wood materials.
10. Panel according to claim 8, wherein at least 75% by weight of said flat chips consists of poplar wood material.
11. Panel according to claim 10, wherein said flat chips consist solely of poplar wood material.
12. Panel according to any one of claims 1-10, wherein said vegetal material comprises chips of flax shives in a quantity lower than or equal to 15% by weight over the weight of the vegetal material.

13. Panel according to any one of the previous claims, having an average density d , inverse function of the thickness s , equal to:

$8 \text{ mm} \leq s < 10 \text{ mm} / d \leq 580 \text{ kg/m}^3$
 $10 \text{ mm} \leq s < 14 \text{ mm} / d \leq 570 \text{ kg/m}^3$
 $14 \text{ mm} \leq s < 16 \text{ mm} / d \leq 555 \text{ kg/m}^3$
 $16 \text{ mm} \leq s < 19 \text{ mm} / d \leq 535 \text{ kg/m}^3$
 $19 \text{ mm} \leq s < 38 \text{ mm} / d \leq 525 \text{ kg/m}^3$
 $38 \text{ mm} \leq s < 50 \text{ mm} / d \leq 515 \text{ kg/m}^3$
 $50 \text{ mm} \leq s < 60 \text{ mm} / d \leq 500 \text{ kg/m}^3$
 $60 \text{ mm} \leq s < 70 \text{ mm} / d \leq 480 \text{ kg/m}^3$
 $70 \text{ mm} \leq s / d \leq 470 \text{ kg/m}^3$

14. Panel according to claim 10 or 11, having an average density d , inverse function of the thickness s , equal to:

Thickness ranges [mm]	Average density [kg/m ³]
$8 \leq s < 10$	$500 \leq d \leq 580$
$10 \leq s < 14$	$480 \leq d \leq 570$
$14 \leq s < 16$	$475 \leq d \leq 555$
$16 \leq s < 19$	$455 \leq d \leq 535$
$19 \leq s < 38$	$440 \leq d \leq 525$
$38 \leq s < 50$	$420 \leq d \leq 515$
$50 \leq s < 60$	$405 \leq d \leq 500$
$60 \leq s < 70$	$390 \leq d \leq 480$
$70 \leq s$	$380 \leq d \leq 470$

and bending strength values, modulus of elasticity in bending, internal bond and surface soundness in accordance with standard provision UNI EN 312 of 2010 for Type P2 panels.

15. Panel according to any one of the previous claims wherein the weight ratio between said at least one adhesive substance and said vegetal material is approximately equal to 8/92.

16. Process for making a multilayer chipboard panel, comprising the steps of:

providing a plurality of logs coming from planting, having a predetermined diameter, of at least one wood-based material having an Average Dry Unit Weight (DUW) equal to or lower than 500 kg/m^3 ;
 chipping each log through knives or blades having cutting axis essentially parallel to the axis of the log, obtaining vegetal material in essentially flat chips;
 drying said vegetal material in flat chips possibly with chips of another vegetal material, said flat chips constituting at least 85% by weight of the dried vegetal material;
 screening said dried vegetal material separating a fraction of vegetal material having a fine particle size, a fraction of vegetal material having a large particle size, and an fraction of oversized vegetal material;
 refining said fraction of oversized vegetal material;
 screening said refined vegetal material by separating a fraction of vegetal material having said fine particle size and a fraction of vegetal material having said large particle size;
 mixing said fractions of vegetal material having fine particle size and large particle size, respectively, with at least one adhesive substance;
 forming at least two layers one on top of the another, one layer with said vegetal material having fine particle size mixed with said at least one adhesive substance, the other layer with said vegetal material having large particle size mixed with said at least one adhesive substance, making a mat comprising two adjacent layers;
 pressing said mat;
 subjecting said pressed mat to a baking heat treatment obtaining a multilayer chipboard panel comprising a first layer with fine particle size having a first density value d_1 and a second layer with large particle size having

a woven mesh texture and a second density value $d_2 < d_1$.

- 5 **17.** Process according to claim 16, wherein said mat is made by forming a first layer with said vegetal material having fine particle size and forming, on top of said first layer, a second layer with said vegetal material having large particle size, further comprising the step of making, on top of said second layer, a third layer with said vegetal material having fine particle size mixed with said at least one adhesive substance, obtaining a mat comprising three layers.
- 10 **18.** Process according to claim 16 or 17, further comprising a step of smoothing the surface of said layer made with said vegetal material having fine particle size, said smoothing step being carried out with abrasive means having a grain equal to or greater than 100 ANSI.
- 15 **19.** Process according to any one of claims 16-18, further comprising a refining step included between the chipping step and the drying step, wherein at least one fraction of said flat chips is reduced in size.
- 20 **20.** Process according to any one of claims 16-19, wherein said logs have a diameter of between 150 mm and 250 mm, preferably between 180 mm and 220 mm.
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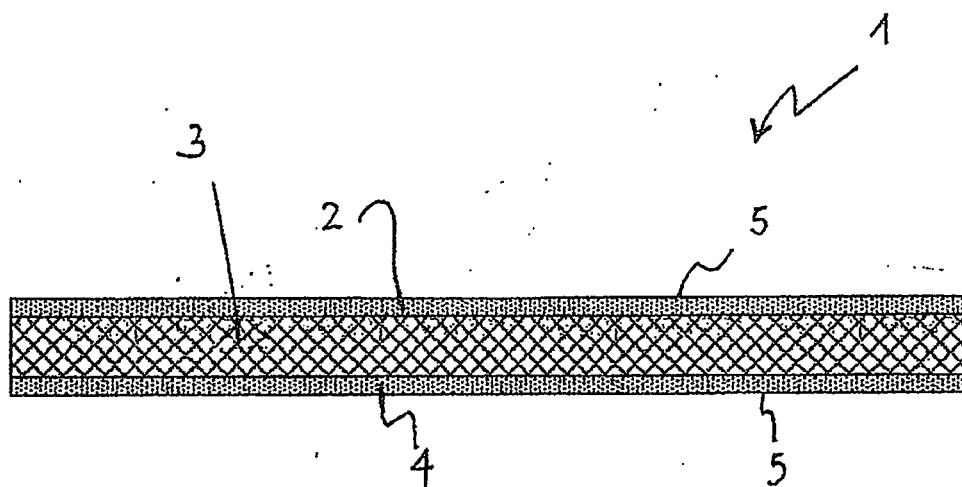


Fig. 1

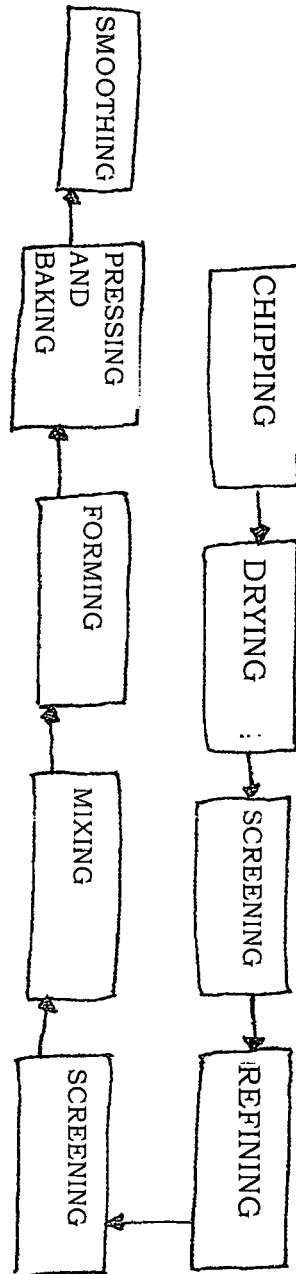


Fig. 2



EUROPEAN SEARCH REPORT

Application Number
EP 11 42 5136

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Place of search The Hague		Date of completion of the search 12 October 2011	Examiner Söderberg, Jan-Eric
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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