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54 **Lignocellulosic-material-based product and manufacturing method thereof.**

57 The invention concerns a ligno-cellulosic-material-based product and a manufacturing method thereof, in which method the product is formed from multiple plies of cellulosic fibers into a multi-ply product comprising a liner ply and at least one center ply interleaved between the liner plies. The invention is characterized by having said at least one center ply of the multi-ply product enriched with thick-walled summerwood fibers, and further having the liner ply of the multi-ply product advantageously enriched with thin-walled and/or band-shaped springwood fibers.

The present invention relates to a method in accordance with the preamble of claim 1 and a product structure for manufacturing a lignocellulosic-material based product.

Multi-ply products such as multi-ply paper, board or card-board comprise more than two plies. Typically, multi-ply board comprises three different plies so that the top-liner plies may have identical composition. Correspondingly, the center web ply may typically be formed by a web comprising one or more plies of identical composition which are couched together. As known, a multi-ply board acts as a hollow-core beam structure in which the maximum stiffness is attained by a composition having its center ply from a material of maximally high bulk and the outer plies of a liner material of maximally high Young's modulus. Optimally this concept can be utilized by forming the liner and center plies from entirely different types of pulps. A board having the maximum possible bulk is achieved by using mechanical or chemimechanical pulp in the center ply (conventional folding boxboard).

However, mechanical pulps do not offer as high brightness and strength as chemical pulps. Hence, foodstuff packaging and graphic art principally uses board grades made from groundwood-free pulp and having their center ply also made from chemical pulp. Resultingly, the manufacture of foodstuff packaging and graphic art boards have involved product lines requiring a high degree of conversion and special skills.

The manufacture of mechanical pulps uses softwood almost exclusively. In the pulping process, particularly in the grinding step, long softwood fibers are cut and shortened so that the formation of the center ply made thereof takes place in a satisfactory manner. By contrast, long softwood fibers undergoing the chemical pulping process are not subjected to such severe cutting, whereby the formation properties of the produced pulp are extremely unfavourable. To achieve proper formation, the center ply of board made from chemical pulp is formed from hardwood pulp although its bulk (particularly that of deciduous wood pulp) is generally inferior and thus adverse to the goal of achieving an advantageous structure for the beam structure of the board center ply.

Softwood pulp, particularly pinewood pulp, contains fibers which give advantageous properties to the outer and center plies of a three-ply board. However, softwood pulp at the fiber level is not a homogeneous raw material, but rather, comprises two entirely different fiber types: thick-walled summerwood fibers and thin-walled springwood fibers. With the exception of the fiber length, summerwood fibers of softwood pulp are an ideal raw material for the center ply of a board made from chemical pulp. The bulk of a sheet made therefrom is approx. 40 % better than that of a sheet made from birch pulp. Again with the exception of the fiber length, springwood fibers of softwood pulp are an extremely advantageous raw

material for the liner ply of a board, particularly if the board will be coated. Such band-shaped fibers form a well closed surface, do not increase the roughness of the surface texture in the same manner as conventional softwood pulp (relative to birch pulp), and additionally, improve the Young's modulus of the liner ply thus contributing to the achievement of maximum stiffness.

According to the invention is has recently been discovered that the different properties required for the liner and center plies of a multi-ply board can be achieved by utilizing the characteristics of the extremely different fiber types contained in the annual growth of softwood. Although currently known industrial-scale processes fail to achieve completely pure fractions, it is possible to prove on the basis of properties offered by fractions purified through a fractionation process that the stiffness of, e.g., a three-ply board made from chemical pulp can be improved by approx. 30 % relative to conventional board grades. The fibers of softwood pulp can be cut so effectively through refining that a multi-ply product according to the invention can be made using very high proportions of softwood pulp without impairing the properties of the board. It is an object of the invention to improve the fractionation techniques suited for essentially improving the properties of softwood pulp as a raw material of a multi-ply product such as three-ply board made from chemical pulp.

The production of a multi-ply product according to the invention aims at maximally effective fractionation summerwood and springwood fibers. For the liner ply, such fractionated pulp is used which is enriched maximally pure in springwood fibers. The characterizing properties of the method and product structure according to the invention are disclosed in the appended claims.

The invention is characterized by having the at least one center ply of the multi-ply product enriched with thick-walled summerwood fibers, further advantageously having the liner ply of the multi-ply product enriched with thin-walled and/or band-shaped springwood fibers. A particularly advantageous embodiment of the method and product structure according to the invention is characterized by having the liner ply of a multi-ply product, most preferably a multiply board, formed from softwood pulp or a mixture of softwood and hardwood pulp, whereby the softwood pulp fraction is enriched with thin-walled springwood fibers, and further having the at least one center ply of a multi-ply board formed from softwood pulp or a mixture of softwood and hardwood pulp, whereby reject fraction resulting from the separation of the springwood fibers is enriched with thick-walled summerwood fibers.

To one skilled in the art it is obvious that the different embodiments of the invention are not limited by the exemplifying embodiments described above, but

rather, can be varied within the scope and spirit of the annexed claims.

Claims

1. A method for manufacturing a lignocellulosic-material-based product, in which method the product is formed from multiple plies of cellulosic fibers into a multi-ply product comprising a liner ply and at least one center ply interleaved between the liner plies, **characterized** in that said at least one center ply of the multi-ply product is enriched with thick-walled summerwood fibers.
2. A method as defined in claim 1, **characterized** in that the liner ply of the multi-ply product is enriched with thin-walled and/or band-shaped springwood fibers.
3. A method as defined in claim 1 or 2, **characterized** in that the fractions of summerwood and springwood fibers are obtained from softwood pulp, advantageously pinewood pulp.
4. A method as defined in any foregoing claim, **characterized** in that said multi-ply product is multi-ply board, cardboard or paper.
5. A method as defined in any foregoing claim, **characterized** in that the liner ply of the multi-ply product, advantageously multi-ply board, is formed from is formed from a softwood fraction enriched with thin-walled springwood fibers and that the at least one center ply of the multi-ply board is formed from the reject fraction resulting from the separation of springwood fibers, said reject fraction being enriched with thick-walled summerwood fibers.
6. A method as defined in any foregoing claim, **characterized** in that the liner ply of the multi-ply product, advantageously multi-ply board, is formed from a mixture of softwood and hardwood pulps having the softwood fraction enriched with thin-walled springwood fibers and that the at least one center ply of the multi-ply board is formed from a mixture of softwood and hardwood pulps, said reject fraction of softwood pulp resulting from the separation of springwood fibers and thus being enriched with thick-walled summerwood fibers.
7. Lignocellulosic material based product formed from multiple plies of cellulosic fibers into a multi-ply product comprising a liner ply and at least one center ply interleaved between said liner plies, **characterized** in that said at least one center ply

of the multi-ply product is enriched with thick-walled summerwood fibers.

8. Lignocellulosic-material-based product as defined in claim 7, **characterized** in that the liner ply of said multi-ply product is enriched with thin-walled and/or band-shaped springwood fibers.
9. Multi-ply product as defined in claims 7 - 8, **characterized** in that said multi-ply product is multi-ply board, cardboard or paper.
10. Multi-ply product as defined in claims 7 - 9, **characterized** in that the liner ply of the multi-ply product, advantageously multi-ply board, is formed from a softwood fraction enriched with thin-walled springwood fibers and that the at least one center ply of the multi-ply board is formed from the reject fraction resulting from the separation of springwood fibers, said traction being enriched with thick-walled summerwood fibers.
11. Multi-ply product as defined in claims 7 - 10, **characterized** in that the liner ply of the multi-ply product, advantageously multi-ply board, is formed from a mixture of softwood and hardwood pulps having the softwood fraction enriched with thin-walled springwood fibers and that the at least one center ply of the multi-ply board is formed from a mixture of softwood and hardwood pulps, said reject fraction of softwood pulp resulting from the separation of springwood fibers and thus being enriched with thick-walled summerwood fibers.



**European Patent
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EUROPEAN SEARCH REPORT

Application Number
EP 94 85 0175

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
A	EP-A-0 484 101 (JAMES RIVER CORPORATION) ---		D21F11/04
A	EP-A-0 312 512 (SCA DEVELOPMENT AKTIEBOLAG) ---		
A	US-A-5 147 505 (ALTMAN) ---		
A	US-A-1 718 096 (F. B. WELLS) -----		
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.6) D21F
Place of search	Date of completion of the search	Examiner	
THE HAGUE	14 December 1994	De Rijck, F	
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	