



(11) **EP 3 059 344 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
24.08.2016 Bulletin 2016/34

(51) Int Cl.:
D21H 27/00 (2006.01) D21H 19/82 (2006.01)

(21) Application number: **16397503.0**

(22) Date of filing: **22.02.2016**

(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
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(71) Applicant: **UPM-Kymmene Corporation**
00100 Helsinki (FI)

(72) Inventors:
• **Antila, Janne**
13100 Hämeenlinna (FI)
• **Kotilainen, Jukka**
37630 Valkeakoski (FI)
• **Leinonen, Jussi**
37630 Valkeakoski (FI)

(30) Priority: **23.02.2015 FI 20155119**
23.02.2015 FI 20155118
23.02.2015 FI 20155117

(74) Representative: **Tampereen Patenttitoimisto Oy**
Visiokatu 1
33720 Tampere (FI)

(54) **A METHOD FOR MANUFACTURING PAPER COMPRISING BLEACHED CHEMITHERMO-MECHANICAL PULP SUITABLE FOR A RELEASE LINER AND PRODUCTS AND USES THEREOF**

(57) The invention relates to paper and method for manufacturing paper suitable for use as a layer of a release liner, the paper having density equal to or less than 1200 kg/m³, the paper having a ratio of grammage to thickness of the paper in micrometres equal to or higher than 1.0, wherein the grammage refers to the weight of the paper in grams per square meter, the paper comprising cellulose fibres from
- bleached chemical pulp and
- bleached chemithermomechanical pulp,
wherein the bleached chemithermomechanical pulp comprises cellulose fibres from hardwood and softwood.

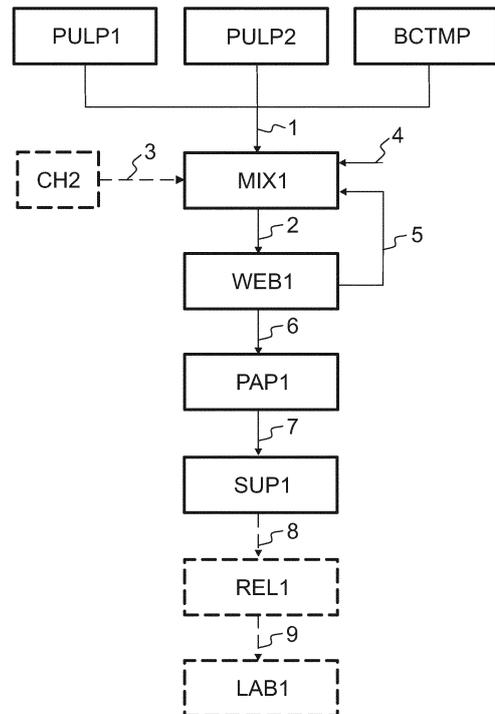


Fig. 1b

EP 3 059 344 A1

DescriptionField of the Invention

5 **[0001]** The invention relates to a method for obtaining low weight high quality paper comprising bleached chemithermomechanical pulp, the paper suitable for use as a layer of a release liner. The invention further relates to low weight high quality paper comprising bleached chemithermomechanical pulp, the paper suitable for use as a layer of a release liner. The invention further relates to a method for manufacturing bleached chemithermomechanical pulp, which is suitable for use in a layer of a release liner. The invention further relates to use of bleached chemithermomechanical pulp when manufacturing paper suitable for use as a layer of a release liner. The invention further relates to use of bleached chemithermomechanical pulp in a release liner.

Background

15 **[0002]** A release liner refers to a product comprising a substrate layer and a release coating, such as a silicon polymer based compound, applied on at least one side of the substrate layer. The substrate layer comprises a support layer and a primer layer applied on at least one side of the support layer. Conventionally, the support layer is made of paper comprising cellulose fibers from bleached chemical pulp, such as bleached Kraft pulp. Conventionally, the substrate layer comprises a surface sized or coated layer applied on the paper. The amount of hardwood in the paper manufacturing process is typically high, in order to obtain release liner having a high transparency level. A particular use for a release liner is as backing material in labelling applications with adhesive labels. Adhesive labels may be, for example, self-adhesive labels or pressure sensitive labels. A release liner comprising a plurality of adhesive labels, referred to as a label stock, is typically wound on a roll and used in a labelling process. The number of products to be labelled in a labelling process may be very large. A roll of release liner may comprise even several kilometres of winded release liner.

20 **[0003]** Environmental aspects drive the manufacturers to develop more sustainable products. Recyclability and use of less raw materials is valued in the production. Often, a substrate layer for a release liner is transported from a paper manufacturer to a label manufacturer, wherein a release coating may be applied on the substrate layer, thereby finishing the release liner, on which the label stock is manufactured. The label stock comprising the release liner may be further transported to an end user prior to labelling of products. A single roll of release liner should therefore be manufactured in a manner configured to reduce the life cycle costs of the release liner, without reducing the quality of the release liner for the intended purpose. In release liner manufacturing, there is a demand for a lighter release liner roll weight, which would reduce the costs of transportation, as described above.

25 **[0004]** One option to reduce the weight of a release liner is to reduce the grammage of the paper. This, however, may often result in adverse effects, since typically paper having less grammage is also thinner and has less strength, and may not therefore be suitable for the intended purpose, such as use as a backing material in an automated high speed labelling process. The release liner should withstand the functional requirements set by the end purpose, such as a labelling system. In particular, the mechanical properties of the release liner, such as surface smoothness, surface density and tearing resistance, should be suitable for the release liner to function properly. Typically, for example, the substrate layer is coated by applying a silicone based release coating on the substrate layer in a quantity of equal to or less than 2 g/m² per side, to provide a functional release coating on the substrate layer.

30 **[0005]** When the grammage is reduced, the specific volume and tearing resistance of a conventional paper are typically also reduced. The smoothness of the paper surface may thus decrease, which has a negative effect on the subsequent release coating. An option to improve the surface smoothness could be to calender the paper more. Calendering, however, further reduces the specific volume and the paper thickness. Reduction in the paper thickness may lead to problems in the label manufacturing process, as the stencils used to die cut the label stock are typically designed to operate at predefined paper thickness. This would necessitate new stencils to replace the previously used stencils, which would be an extra cost and extra operation for a label manufacturer.

Summary of the Invention

35 **[0006]** The problems mentioned above may be solved by providing paper comprising bleached chemithermomechanical pulp. Chemithermomechanical pulp may be manufactured by a hybrid process wherein wood chips are first pretreated with chemicals, heated for a short period and subsequently refined by mechanical means. The manufacturing method of chemithermomechanical pulp produces high yield pulp, typically having a yield in the range of 80 to 95 wt.-%, wherein compounds other than cellulose fibers present in the wood material have been preserved to a large extent. Bleached chemithermomechanical pulp may be obtained from the chemithermomechanical pulp by bleaching with chemicals, such as sodium hydroxide and/or hydrogen peroxide. Bleached chemithermomechanical pulp has high light scattering properties in paper. Bleached chemithermomechanical pulp has conventionally been used in paper manufacturing to

increase stiffness and opacity, which in release liners is undesired.

5 [0007] As described above, the properties of the bleached chemithermomechanical pulp differ from bleached chemical pulp, such as Kraft pulp. Bleached chemithermomechanical pulp may be configured to increase the amount of cellulose fibers in a specific volume of the paper, without increasing the grammage of the paper. In particular, a paper comprising
10 bleached chemithermomechanical pulp may have the same thickness as a paper comprising only bleached chemical pulp, but wherein the grammage has been reduced compared to the paper comprising only bleached chemical pulp, while preserving the density of the paper sufficient for a release coating. Advantageously, bleached chemithermomechanical pulp may be configured to increase the bulk of the paper, while maintaining a desired ratio between the grammage and thickness of the paper. The composition of the bleached chemithermomechanical pulp may be configured to increase
15 the bulk of the paper such that sufficient transparency of the paper is maintained. This enables providing paper suitable for existing labelling processes, wherein less raw materials, when measured by the weight of the raw materials, may be used for manufacturing paper having the same thickness as earlier. The formed paper has a lighter mass per unit area and a sufficient quality such as transparency, surface smoothness and strength, for a subsequent release coating.

15 [0008] Bleached chemithermomechanical pulp may thus be used to change the ratio of the bulk to the grammage in the paper, such that the density of the paper surface remains suitable for release coating purposes. Bleached chemithermomechanical pulp may further be used to replace at least some of bleached chemical pulp, such as bleached Kraft pulp, in the paper.

20 [0009] Advantageously, bleached chemithermomechanical pulp may be arranged to have a composition configured to optimize the process conditions of a paper manufacturing process, where said bleached chemithermomechanical pulp is used. In particular, bleached chemithermomechanical pulp may comprise cellulose fibers from both hardwood and softwood. Bleached chemithermomechanical pulp comprising a mixture of hardwood and softwood may be used to improve the manufacturing process conditions of paper comprising bleached chemithermomechanical pulp, such that
25 the production time of the paper on the machine may be extended. Furthermore, bleached chemithermomechanical pulp comprising a mixture of hardwood and softwood, may be used to improve the internal bond strength of the paper web during manufacturing process. Furthermore, bleached chemithermomechanical pulp comprising a mixture of hardwood and softwood, may be used to reduce the brittleness of paper formed from the paper web during manufacturing process.

30 [0010] The method of manufacturing bleached chemithermomechanical pulp may thus be used to obtain a pulp composition comprising a blend of cellulose fibers of different origin. The bleached chemithermomechanical pulp may be manufactured in an alkaline pH, such as equal to or higher than pH 7, to improve the runnability of the paper manufacturing process. When an amount of said pulp composition is added to a pulp mixture used in forming a paper web, the runnability of the paper web on the paper machine may be improved, such that the manufacturing process of the paper may be continued longer, such as several days or even weeks. The composition of the bleached chemithermomechanical pulp may be used to improve paper quality, such as the tearing strength of the paper manufactured on the machine.

35 [0011] In particular, the presence of softwood fraction, such as spruce, in the bleached chemithermomechanical pulp has been observed to improve the characteristics of the bleached chemithermomechanical pulp in the paper manufacturing process. The percentage of the softwood in the bleached chemithermomechanical pulp may be varied. The amount of bleached chemithermomechanical pulp in a pulp mixture used for making paper suitable for a release liner layer may be varied. By varying the proportion of bleached chemithermomechanical pulp in the pulp mixture, the specific volume
40 of paper formed from the pulp mixture may be changed. The density of the paper may be configured to decrease as a function of the content of the bleached chemithermomechanical pulp in the paper. When the content of bleached chemithermomechanical pulp in a pulp mixture is increased, the bulk of paper manufactured from the pulp mixture may be increased. A pulp mixture may comprise cellulose fibers of bleached chemithermomechanical pulp equal to or less than 50 wt.-% of the weight of the paper. The bleached chemithermomechanical pulp may be used for example in a range
45 of 1 to 50 wt.-%, such in the range of 5 to 45 wt.-%, or in the range of 10 to 35 wt.-%. A bleached chemithermomechanical pulp may comprise softwood equal to or less than 50 wt.-% of the bleached chemithermomechanical pulp. Already an amount of few percentages, such as equal to or higher than 1%, preferably equal to or higher than 5%, of bleached chemithermomechanical pulp comprising softwood has been observed to improve the paper manufacturing process. Bleached chemithermomechanical pulp may comprising softwood for example in a range of 1 to 50 wt.-%, such in the
50 range of 5 to 45 wt.-%, or in the range of 10 to 35 wt.-%.

55 [0012] A pulp mixture comprising bleached chemithermomechanical pulp, wherein the bleached chemithermomechanical pulp comprises a combination of aspen as hardwood and spruce as softwood, has particularly been noticed to promote runnability of the paper manufacturing process such that the production time of the paper on the machine may be extended, such that the manufacturing process of the paper may be continued for several days or more, even weeks. The use of bleached chemithermomechanical pulp comprising both aspen and spruce, enables production of paper suitable for release liner layer, where the ratio of the bulk to the grammage in the paper has been increased.

[0013] Due to the presence of bleached chemithermomechanical pulp, the paper manufacturing process may be configured to use less refining, which saves energy. The paper surface may further be calendered into a desired thickness,

such that the ratio of grammage to thickness of the paper in micrometres is maintained at a level equal to or higher than 1.0. This enables manufacturing of low grammage paper, which has a high surface density suitable for a release coating, and a thickness equal to or less than 100 micrometers, preferably equal to or less than 80 micrometers, most preferably equal to or less than 60 micrometres. Due to high surface density, also the amount of other raw materials beside fibers, such as primer layer pigments and additives used in the release liner manufacturing process, may be reduced. The surface density in this context refers to the smoothness and/or porosity of paper surface determinable by the Bekk method (ISO 5627 standard).

[0014] According to a first aspect, there is provided a paper suitable for use as a layer of a release liner, the paper having density equal to or less than 1200 kg/m³, preferably in the range of 1000 to 1200 kg/m³, most preferably in the range of 1050 to 1150 kg/m³, the paper having a ratio of grammage to thickness of the paper in micrometres equal to or higher than 1.0, wherein the grammage refers to the weight of the paper in grams per square meter, the paper comprising cellulose fibres from

- bleached chemical pulp and
- bleached chemithermomechanical pulp,

wherein the bleached chemithermomechanical pulp comprises cellulose fibres from hardwood and softwood.

[0015] According to a second aspect, there is provided a method for manufacturing paper suitable for use as a layer of a release liner, the method comprising:

- mixing
 - o bleached chemical pulp and
 - o bleached chemithermomechanical pulp from hardwood and softwood, thereby forming a pulp mixture,
- forming a paper web from the pulp mixture,
- reducing moisture content of the paper web in a press section, and
- drying the paper web in a drying section, thereby forming paper having
 - o a density equal to or less than 1200 kg/m³, preferably in the range of 1000 to 1200 kg/m³, most preferably in the range of 1050 to 1150 kg/m³, and
 - o a ratio of grammage to thickness of the paper in micrometres equal to or higher than 1.0, wherein the grammage refers to the weight of the paper in grams per square meter.

[0016] According to a further aspect, there is provided a paper suitable for use as a layer of a release liner and/or a method for manufacturing paper suitable for use as a layer of a release liner, the paper further having a grammage equal to or higher than 30 grams per square meter.

[0017] According to a yet further aspect, there is provided a paper suitable for use as a layer of a release liner and/or a method for manufacturing paper suitable for use as a layer of a release liner, the paper further having a transparency level of equal to or higher than 28%.

[0018] According to a yet further aspect, the paper further comprises cellulose fibers of bleached chemithermomechanical pulp equal to or less than 50 wt.-% of the weight of the paper, such as in the range of 1 to 50 wt.-%, preferably in the range of 5 to 45 wt.-%, most preferably in the range of 10 to 35 wt.-%.

[0019] According to a yet further aspect, the bleached chemithermomechanical pulp further comprises softwood equal to or less than 50 wt.-%, such as in the range of 1 to 50 wt.-%, preferably in the range of 5 to 45 wt.-%, most preferably in the range of 10 to 35 wt.-%.

[0020] According to yet another aspect, there is provided a paper suitable for use as a layer of a release liner, the paper having a grammage equal to or higher than 30 grams per square meter and a transparency level of equal to or higher than 28%, the paper comprising cellulose fibers from bleached chemical pulp and bleached chemithermomechanical pulp made of hardwood and softwood, wherein the amount of cellulose fibers in a specific volume of the paper is increased by the bleached chemithermomechanical pulp such that the density of the paper is equal to or less than 1200 kg/m³, preferably in the range of 1000 to 1200 kg/m³, most preferably in the range of 1050 to 1150 kg/m³, and the ratio of grammage to thickness of the paper in micrometers is equal to or higher than 1.0.

[0021] According to yet another aspect, there is provided a method for manufacturing paper suitable for use as a layer of a release liner, the method comprising:

- forming a pulp mixture comprising cellulose fibers by mixing

- o bleached chemical pulp and
- o bleached chemithermomechanical pulp made of hardwood and softwood,

- forming a paper web from the pulp mixture,
- reducing moisture content of the paper web in a press section, and

drying the paper web in a drying section, thereby forming paper having a grammage equal to or higher than 30 grams per square meter and a transparency level of equal to or higher than 28%, wherein the amount of cellulose fibers in a specific volume of the paper is increased by the bleached chemithermomechanical pulp such that the density of the paper is equal to or less than 1200 kg/m³, preferably in the range of 1000 to 1200 kg/m³, most preferably in the range of 1050 to 1150 kg/m³, and the ratio of grammage to thickness of the paper in micrometres is equal to or higher than 1.0.

[0022] According to yet another aspect, there is provided a paper suitable for use as a layer of a release liner, the paper comprising cellulose fibers from bleached chemical pulp and bleached chemithermomechanical pulp, wherein the bleached chemithermomechanical pulp comprises cellulose fibres from hardwood and softwood, and the bleached chemithermomechanical pulp is configured to increase the ratio of the bulk to the grammage in the paper, such that the ratio of grammage to thickness of the paper in micrometres is equal to or higher than 1.0, wherein the grammage refers to the weight of the paper in grams per square meter.

[0023] According to yet another aspect, there is provided a method for manufacturing paper suitable for use as a layer of a release liner, the method comprising:

- forming a pulp mixture comprising cellulose fibers by mixing
 - o bleached chemical pulp and
 - o bleached chemithermomechanical pulp from hardwood and softwood,

- forming a paper web from the pulp mixture,
- reducing moisture content of the paper web in a press section, and
- drying the paper web in a drying section, thereby forming paper, where the bleached chemithermomechanical pulp is configured to increase the ratio of the bulk to the grammage in the paper, such that the ratio of grammage to thickness of the paper in micrometres is equal to or higher than 1.0, wherein the grammage refers to the weight of the paper in grams per square meter.

[0024] According to yet another aspect, there is provided a method for manufacturing bleached chemithermomechanical pulp comprising cellulose fibers from hardwood and softwood, the method comprising:

- producing wood chips by debarking and chipping,
- impregnating the wood chips with a chemical solution, thereby producing impregnated wood chips,
- heating the impregnated wood chips by steam, thereby producing heated and impregnated wood chips,
- refining the heated and impregnated wood chips, thereby forming chemithermomechanical pulp,
- washing the chemithermomechanical pulp, and
- bleaching the chemithermomechanical pulp to form bleached chemithermomechanical pulp,

wherein the amount of softwood in the bleached chemithermomechanical pulp is equal to or less than 50 wt.-% of the weight of the bleached chemithermomechanical pulp, such that the formed bleached chemithermomechanical pulp has a Canadian Standard Freeness value in the range of 90 to 500 ml, and a pH of aqueous extracts measured from the formed bleached chemithermomechanical pulp above pH 7.0.

[0025] Objects and embodiments of the invention are further described in the independent and dependent claims.

Description of the Drawings

[0026]

Figure 1a shows, by way of an example, a three-dimensional structure of a substrate layer for a release liner.

Figure 1b shows, by way of an example, a method according to the invention for manufacturing low weight high quality paper comprising bleached chemithermomechanical pulp suitable for use as a layer of a release liner,

- Figures 2a and 2b, show by way of an example, comparative data showing a difference in distribution of fiber length and fine particle content between bleached chemical pulp and bleached chemithermo-mechanical pulp made of aspen,
- 5 Figures 3a, 3b and 3c are trend diagrams representing by way of examples the development of paper transparency (%), top side roughness (PPS) and back side water absorptiveness (CobbA60) as a function of time in a paper manufacturing process, wherein the pulp suspension comprises 25 wt.-% of bleached chemithermomechanical pulp made of aspen,
- 10 Figures 4a, 4b and 4c are trend diagrams representing by way of examples the development of paper transparency (%), top side roughness (PPS) and back side water absorptiveness (CobbA60) as a function of time in a paper manufacturing process, wherein the pulp suspension comprises 25 wt.-% of bleached chemithermomechanical pulp made of aspen and spruce,
- 15 Figures 5 to 8 show, by way of examples, embodiments according to the invention for manufacturing bleached chemithermomechanical pulp comprising hardwood and softwood, the bleached chemithermomechanical pulp being suitable for manufacturing process of low weight high quality paper for a release liner.
- 20 **[0027]** In the Figure 1 a, Sx and Sz represent coordinate directions orthogonal to each other.

Detailed Description of the Invention

25 **[0028]** A release liner support layer in this context refers to paper comprising cellulose fibers, which has been manufactured on a paper machine. A release liner substrate layer in this context refers to paper comprising a primer layer, such as a sizing layer or a coating layer, applied on at least one side of the paper. A release liner in this context refers to paper comprising a release coating applied on at least one side of the paper. The paper is typically manufactured of cellulose fibers containing pulp, wherein the pulp originates from wood. Wood species differ from each other in their mechanical properties and chemical compositions. Wood species typically used in paper manufacturing may be divided

30 into two main groups denoted as softwood and hardwood, wherein hardwoods have a more complex structure than softwoods. In temperate and boreal latitudes deciduous and/or angiosperm trees are typically hardwood, whereas coniferous trees are typically softwood. Softwood and hardwood have distinguished mechanical characteristics and chemical composition, which differ from each other. By selection of the wood species and the wood processing method, different types of pulp having different qualities may be obtained. Softwood and hardwood therefore may be used to

35 provide different pulp compositions, each composition having a different purpose in paper manufacturing. When manufacturing paper, the wood material is first chipped and further processed into more fibrous form by mechanical or chemical method. When manufacturing paper for a release liner, wood is typically treated in a chemical process, such as Kraft process, to separate cellulose fibers from the other compounds and to obtain essentially wood free pulp comprising cellulose fibers. In papers used for release liners, a high transparency level of the paper is desirable. Bleaching is typically used to improve the brightness and whiteness of the pulp and to remove any remaining compounds from the

40 pulp, such as lignin, which may cause darkening of the pulp.

[0029] Due to the desired brightness and transparency, the amount of hardwood in the manufacturing process of paper used for release liners is high. A paper suitable for a release liner layer typically has a transparency level of equal to or higher than 40%, preferably equal to or higher than 60%, such as in the range of 40% to 85%, when grammage is less than 70 grams per square meter. A paper suitable for a release liner support layer typically has a transparency level of equal to or higher than 28%, preferably equal to or higher than 33%, such as in the range of 28% to 85%, when grammage is equal to or higher than 70 grams per square meter. Conventionally, the paper support for release liner support layer may have been made essentially of bleached chemical pulp, such as bleached Kraft pulp. While hardwood is advantageous for increasing the brightness of the paper, softwood having a longer average fiber length is typically

50 used together with the hardwood in bleached Kraft pulp to improve the internal bond strength and facilitate the formation of the paper web suitable for release liner. The combination of bleached chemical pulp comprising hardwood and softwood may also be used to improve the burst strength and tensile strength of the paper.

[0030] The processing method, while providing strong cellulose fibers from bleached chemical pulp, however, requires large amounts of wood. The bleached chemical pulp is furthermore generally refined to a high level, to improve the smoothness and density of the paper surface, which is a cost factor in manufacturing.

55 **[0031]** A drawback of the refining is, that while reduction of the average fiber length of the cellulose fibers in the pulp improves the subsequent surface density of a paper, refining also decreases the specific volume of the formed paper, as shorter fibers may be packed closer in the paper web. Refining also increases the moisture uptake of the pulp, such

that larger amounts of water needs to be removed from the paper web. The refining requires energy, which also increases the production costs.

Pulp types

5 **[0032]** In this context, cellulose pulp refers to material originating from wooden material, which has been processed into fibrous form, such as fibers. Depending of the processing method, the cellulose pulp may have been obtained via mechanical methods, chemical methods, or by using a semi-chemical method, wherein a combination of mechanical and chemical methods is used.

10 **[0033]** Chemical pulp refers to cellulose pulp obtained from a process wherein fibers have been produced through chemical methods. Chemical pulp may be bleached to form bleached chemical pulp. When forming chemical pulp, heat and chemicals are used to break down lignin, which binds the cellulose fibers together, such that the cellulose fibers are degraded to a less degree than in mechanical pulp. Chemical methods may be used to provide fibers having increased strength. Chemical pulp is typically stronger than pulp produced via other methods. Examples of a chemical methods are, for example, Sulphite process and Kraft process. Kraft process uses sodium sulphide to separate cellulose fibers from other compounds in the wood material. Unbleached kraft pulp typically has a dark brown color. For release paper purposes, unbleached chemical pulp is bleached to further remove residual lignin, which increases the pulp whiteness and brightness, and improves the transparency of paper made of the bleached chemical pulp.

15 **[0034]** Mechanical pulp refers to cellulose pulp obtained from a process wherein fibers have been produced through mechanical methods. An example of a mechanical method is, for example, grinding-stone ground wood (SGW). When the wood is steamed prior to grinding it is known as pressure ground wood pulp (PGW). Steam treatment may be used to reduce the amount of energy needed in pulping and to decrease the mechanical damage of the process to the fibers. Compared to chemical pulping, mechanical pulping typically gives a higher yield of cellulose in a pulp form. The yield of mechanical pulp may be in the range of 85 to 95 wt.-% of the raw material. As pulping by a mechanical method does not comprise a chemical treatment, mechanical pulp contains large amount of fine particles, hemicellulose and lignin compounds. Mechanical pulp therefore has a high opacity level. Mechanical pulp may also have limited brightness, at least compared to chemical pulps. Mechanical pulp containing lignin compounds may react with light and oxygen, which leads to darkening of the pulp colour, denoted as photo yellowing. Mechanical pulp has a broad fiber size distribution, which may be used to improve paper surface smoothness. Mechanical pulp may also be used to improve the bulk of the paper. The tensile and tear strength of mechanical pulp is relatively weak; as such it typically is not suitable for release liners.

20 **[0035]** Thermomechanical pulp, abbreviated as TMP, is pulp produced by processing wood chips using heat and a mechanical refining. In thermomechanical pulping, mechanical force such as crushing or grinding is applied to wood chips having a moisture content in the range of 25 to 30 wt.-%, such that heat and water vapour is generated, which softens the lignin in the chips such that the chips are separated into fibers. The pulp may be then screened and cleaned, and the operation may be repeated to remaining chips until a desired fibrillation level is obtained. The yield of thermomechanical pulp may be in the range of 85 to 95 wt.-% of the raw material. Compared to a chemical pulping process, when manufacturing thermomechanical pulp, the aim is to facilitate the refining of the fibers, not to remove lignin. Due to the lignin present in the thermomechanical pulp, the fibers are hard and rigid.

25 **[0036]** Chemithermomechanical pulp, abbreviated as CTMP, is a hybrid process wherein the wood chips are first pretreated by applying chemicals on the chips and then refined to pulp by mechanical means. In chemithermomechanical pulping, wood chips are pretreated with sodium carbonate, sodium hydroxide, sodium sulphite and/or other chemicals prior to mechanical refining, such that heat and water vapour is generated, which softens the lignin in the chips such that the chips are separated into fibers. The mechanical refining may be done with equipment similar to used when obtaining mechanical pulp. When manufacturing chemithermomechanical pulp, the conditions of the chemical treatment are less vigorous than in a chemical pulping process. Typically, a lower temperature, shorter duration and less extreme pH is used. As in thermomechanical pulp, the aim is to facilitate the refining of the fibers, not to remove lignin. Chemithermomechanical pulp therefore may comprise lignin and other wood originating compounds in addition to cellulose fibers.

30 **[0037]** Bleached chemithermomechanical pulp, abbreviated as "BCTMP", may be produced from chemithermomechanical pulp by bleaching, to increase the brightness and whiteness of the paper produced from the pulp. The chemicals used to bleach pulp may comprise various oxidising compounds such as chlorine dioxide, oxygen, ozone and/or hydrogen peroxide.

35 **[0038]** Unless otherwise stated, the following standards refer to methods which may be used in obtaining stated values of parameters representing paper or pulp quality:

55

Parameter	Standard
Grammage	ISO 536

EP 3 059 344 A1

(continued)

Parameter	Standard
Thickness	ISO 534
Smoothness, Bekk	ISO 5627
Water absorptiveness, Cobb	ISO 535
Tensile strength, strain at break, tensile energy absorption	ISO 1924-3
Internal fiber bond strength (i.e. z-direction tensile strength)	TAPPI T541
Roughness, PPS	ISO 8791
ISO brightness	ISO 2470
CIE whiteness (D65/10°)	ISO 11475
CIE tint (D65/10°)	ISO 11475
Transparency	ISO 2469
Opacity	ISO 2471
colour of paper (C/2°)	ISO 5631
colour of paper (D65/10°)	SCAN-P 72:95
pH of aqueous extracts	DIN 53124 (BS 2924: Part 1:1983, ISO 3588-1981)
Dry content	SCAN-P 39:80
Viscosity	SCAN-P 50:84
Klemm	ISO 8787

[0039] Thickness of a paper, unless otherwise stated, refers to the apparent thickness, determined as single sheet thickness of a paper according to ISO 534:2011. When a release coating is applied on a support layer, referring to an uncoated paper, the thickness of the paper denotes the final thickness of the support layer in micrometers. When a release coating is applied on a substrate layer, referring to a paper having a primer layer such as a surface sized or coated layer, the thickness of the paper denotes the final thickness of the substrate layer comprising the support layer in micrometers. The final thickness denotes the thickness of a substrate or support layer after a calendering treatment prior to applying a release coating, when calendering is used such that the thickness of the support or substrate layer is reduced, respectively. Typically papers used in release liners are calendered to a final thickness before forming a release liner by applying the release coating.

[0040] When the substrate or the support layer is, however, not calendered prior to applying a release coating such that a release liner is formed, the final thickness refers to the thickness of the substrate or the support layer, respectively. The thickness of a paper is also referred to as the caliper of a paper. The thickness is expressed in micrometers (μm). A paper manufactured on a paper machine has compressibility and inhomogeneity, therefore the thickness may be given as an averaged value of several measurements results from a paper sample, as described in the standard ISO 534. The thickness of a paper is related to the grammage of paper. To compare the thickness of papers with different grammage, the specific volume may be used. Thickness of a release liner, unless otherwise stated, refers to the apparent thickness, determined as single sheet thickness of a paper according to ISO 534:2011, of the release liner comprising the layers present in the release liner. Typically the release liner comprises a release coating and a substrate layer, wherein the substrate layer comprises a support layer and one or more primer layers. The release liner may comprises a release coating and a support layer without a primer layer. When no primer layer is applied on the support layer, the thickness of a release liner refers to the apparent thickness of the release liner comprising the release coating and the support layer. In a release liner, the thickness of the substrate layer and/or support layer may be determined by subtracting the thickness of the release coating from the thickness of the release liner.

[0041] Specific volume, denoted as bulk, is measured as volume per unit mass, typically expressed in cubic centimeters per gram (cm^3/g). Specific volume in this context refers to apparent specific sheet volume. Specific volume therefore represents inverse of the paper density. Paper density in this context refers to mass per unit volume of a paper, typically expressed in kilograms per cubic meters (kg/m^3). The specific volume and density are calculated from a single sheet thickness of paper according to ISO 534:2011. The density of a paper comprising bleached chemithermomechanical pulp may be equal to or less than $1200 \text{ kg}/\text{m}^3$, preferably in the range of 1000 to $1200 \text{ kg}/\text{m}^3$, most preferably in the

range of 1050 to 1150 kg/m³.

[0042] Paper grammage in this context refer to the basis weight of the paper, given in grams per square meter (g/m²) of very smooth paper types, such as glassine paper or super calendared paper. The paper types comprising bleached chemithermomechanical pulp suitable for a release liner preferably have a grammage equal to or less than 120 g/m², preferably equal to or less than 80 g/m², most preferably equal to or less than 70 g/m². Typically, paper types comprising bleached chemithermomechanical pulp suitable for a release liner preferably have a grammage equal to or higher than 30 g/m², such as equal to or higher than 40 g/m², for example in the range of, 30 to 120 g/m², or in the range of, 40 to 100 g/m². In view of labelling applications paper types comprising bleached chemithermomechanical pulp, and having a grammage in the range of 40 to 80 g/m², most preferably in the range of 50 to 70 g/m², benefit of the increase in bulk.

[0043] Roughness of the paper can be determined by Parker Print-Surf (PPS) method according to ISO 8791, for example by using a PPS tester. A PPS tester uses a contact air leak principle, which measures airflow between substrate in a ring having an aperture.

[0044] Paper water absorptiveness can be given as Cobb values determined according to ISO 535. The standard specifies a method of determining the water absorptiveness of sized paper under standard conditions.

[0045] Fiber furnish analysis according to ISO standards ISO 9184-1 and 9184-4:1990 may be used in identification of papermaking fibers from a paper. The analysis may be used, for example, to distinguish cellulose fibers produced by chemical, semi-chemical, such as chemithermomechanical, or mechanical method from each other. The analysis may further be used, for example, in differentiation of cellulose fibers produced by kraft or sulphite process in hardwood pulps and in differentiation of cellulose fibers from softwood and hardwood from each other. Metso Fiber Image Analyzer (Metso FS5) is an example of a device, which can be used according to the manufacturer's instructions to perform the fiber furnish analysis. For example, a high resolution camera may be used to acquire a greyscale image of a sample, of which image the properties of the fibers in the sample may be determined. The greyscale image may be acquired from a sample placed in a transparent sample holder, such as a cuvette, using a 0.5 millimetre depth of focus according to ISO 16505-2 standard. The wood species used in a paper may be distinguished by comparison method, wherein a sample fiber is compared against a known reference fiber. Fiber length may be determined according to ISO 16065-N.

Paper types

[0046] In this context, a paper suitable for use as a layer of a release liner refers to paper manufactured on a paper machine. In release liner manufacturing, paper quality and suitability for coating with a silicon polymer based compound (i.e. release coating) may be determined based on the smoothness, density, porosity and transparency of the paper. Bekk method may be used for determining the smoothness and/or porosity of paper for release liner. For the Bekk method, ISO 5627 standard may be used. Gurley method may be used for determining the air permeability of paper. For the Gurley method, ISO 5636-5:2013 standard may be used.

[0047] Other characteristics typical for a paper suitable for release liner are smoothness of at least 900 sec/min (ISO 5627), density of at least 1.0, such as in the range of 1.0 to 1.2, wherein the density refers to grammage (ISO536) per thickness (ISO534), porosity equal to or less than 15000 pm/Pas (ISO11004) and transparency of equal to or higher than 40%, preferably equal to or higher than 44% when the paper grammage is less than 70 g/m², or equal to or higher than 28%, preferably equal to or higher than 33% when the paper grammage is equal to or higher than 70 g/m² (ISO2470), the parameter values corresponding to ISO standards referred in parentheses. In practice, paper types lending themselves for release liner applications are vegetable parchment, greaseproof paper, coated papers and glassine. Of these, glassine is preferred for industrial manufacturing of high quality release liner, due to the mechanical properties of the paper obtained in the manufacturing process.

[0048] Vegetable parchment paper is a paper typically made of waterleaf sheet (unsized sheet of paper, made from chemical wood pulp) by treating it in a bath of sulfuric acid. The treated paper is washed thoroughly to remove the acid and then dried. This chemical treatment forms a very tough, stiff paper with an appearance similar to a genuine parchment. However, paper treated in this manner has a tendency to become brittle and to wrinkle upon drying.

[0049] Vegetable parchment is therefore often treated with a plasticizing agent, such as glycerine or glucose.

[0050] Coated papers comprise variety of papers, having in common a coating layer applied on the paper surface and then calendared to modify the surface properties of the product. Coated paper which may be used as release liner is typically woodfree coated paper, made of chemical pulp, such as Kraft pulp. A coat weight in the range of 5 to 12 g/m² per side is generally used. The coating layer typically comprises pigments, such as calcium carbonate and/or kaolin and binders, such as starch, polyvinyl alcohol and/or latex.

[0051] Glassine is widely used in release liner for self-adhesive materials. Glassine is paper typically made of bleached chemical pulp, having a grammage in the range of 30 to 160 g/m². Glassine used for manufacturing a release liner is coated with a primer layer which is compatible with a silicone polymer based release coating. A primer layer coating in the range of 1 to 10 g/m² per side, typically in the range of 2 to 5g/m² per side, is used. A mixture used to form a primer layer for glassine may comprise water soluble binders such as starch, polyvinyl alcohol and/or carboxymethyl cellulose.

When producing glassine paper, the pulp is refined to obtain a fiber fineness, which enables a dense, nearly unporous, paper surface to be obtained. Such a surface is resistant to air and liquids such as oil and water. When manufacturing glassine paper, the pulp slurry is first refined to a high level, the formed paper web is then pressed and dried, and a primer layer coating is applied on the paper web surface. Glassine is calendered with a multi-nip calender or a supercalender before or after applying the primer layer, to obtain a product having high density surface, high impact strength, high tear resistance and transparency. Glassine, however, has a lower dimensional stability than a conventional coated paper. Therefore, shrinkage of the formed fiber web when manufacturing glassine paper is higher than with conventional coated paper.

[0052] Greaseproof paper is similar to glassine in grammage. The main difference between greaseproof paper and glassine is in the calendering treatment. While glassine is typically supercalendered, greaseproof paper is not. Hence, greaseproof paper has a diminished tearing resistance when compared to glassine.

[0053] Figure 1 a shows, by way of an example, a three-dimensional structure of a paper PAP1 manufactured on a paper machine on a machine direction DIR_{MD} , which refers to the travelling direction of the paper web and paper on the machine. The properties of the paper may be different in the machine direction and in a direction perpendicular to the machine direction along the surface of the paper. The paper PAP1 may be used as a support layer SUP1, for a release liner. The paper PAP1 surface may be coated, for example by applying a size coating on at least one side of the paper. When the paper PAP1 is uncoated, the thickness of the paper may be equal to the thickness D_{SUP1} of the support layer SUP1. The paper PAP1 may be coated by a first primer layer PL1 and/or by a second primer layer PL2. The first primer layer PL1 and the second primer layer PL2 may be located on opposite sides of the paper. When the paper PAP1 is coated only from the first side by the first primer layer PL1, the thickness of the paper may be equal to the combined thickness of the support layer D_{SUP1} and the primer layer D_{PL1} . When the paper PAP1 is coated from both the first side by the primer layer PL1 and from the second side by the primer layer PL2, the thickness of the paper PAP1 may be equal to the combined thickness of the support layer D_{SUP1} and the primer layers D_{PL1} , D_{PL2} . The thickness of the paper PAP1 refers to the apparent thickness D_{app} of a single sheet of a paper after calendering to a final thickness, measured according to ISO 534:2011 as described above.

A release liner comprising bleached chemithermomechanical pulp

[0054] When bleached chemithermomechanical pulp is used in paper for a release liner, the grammage of the paper is typically equal to or less than 120 g/m^2 . The grammage may be, for example, equal to or less than 80 g/m^2 , preferably equal to or less than 70 g/m^2 , such as in the range of 30 to 120 g/m^2 . Advantageously the grammage of the paper may be in the range of 35 to 80 g/m^2 , most preferably in the range of 50 to 70 g/m^2 .

[0055] A paper manufactured to have a grammage higher than 70 g/m^2 , typically has a transparency level of equal to or higher than 28%, preferably equal to or higher than 33%, such as in the range of 28% to 85%. A paper manufactured to have a grammage equal to or less than 70 g/m^2 , typically has a transparency level of equal to or higher than 40%, preferably equal to or higher than 45%, most preferably equal to or higher than 60%, such as in the range of 40% to 85%.

[0056] The grammage of the paper is to a large extent defined already when the paper web is formed on the paper machine, when the pulp slurry is fed to the wire. When manufacturing paper comprising bleached chemithermomechanical pulp suitable for a release liner, the bleached chemithermomechanical pulp is mixed with bleached chemical pulp, such that a pulp mixture comprising bleached chemical pulp and bleached chemithermomechanical pulp is formed. The presence of the bleached chemithermomechanical pulp in the pulp mixture changes the composition of the pulp mixture such that the bulk of paper formed from the pulp mixture is increased. Bleached chemithermomechanical pulp comprises different fiber length distribution and higher stiffness compared to bleached chemical pulp. Bleached chemithermomechanical pulp may therefore be arranged to increase the specific volume per unit area of the forming paper web. In other words, bleached chemithermomechanical pulp can be used to increase the ratio of the paper bulk to the grammage of the paper, when compared to similar paper made of only bleached chemical pulp. Furthermore, bleached chemithermomechanical pulp can be configured to increase the bulk such that the grammage of the paper can be decreased, while maintaining the thickness of the paper in micrometres at the same level as in a paper made of only bleached chemical pulp. Bleached chemithermomechanical pulp can therefore be used to produce paper having the same thickness in micrometers, but less grammage as paper made of only bleached chemical pulp. Bleached chemithermomechanical pulp typically comprises a fiber length distribution, wherein the content of fine particles is increased in comparison to a similar bleached chemical pulp. Mechanical refining increases the amount of fine particles, i.e. particles such as fibers typically having a fiber length equal to or less than 0.6 millimeters. When adding bleached chemithermomechanical pulp into a pulp mixture comprising bleached chemical pulp, the amount of fibers in a specific volume in a formed paper web may therefore increase. However, the increased amount of fine particles also enables maintaining the paper surface density sufficient, such that similar or even less amounts of release coating can be used on the paper comprising bleached chemithermomechanical pulp, as with paper made of only bleached chemical pulp. In particular, the bleached chemithermomechanical pulp provided means to increase the ratio of the bulk to the grammage in the paper, such that the ratio

of grammage to thickness of the paper in micrometres could be retained equal to or higher than 1.0.

[0057] Figure 1 b shows, by way of an example, a method for manufacturing paper PAP1 comprising bleached chemithermomechanical pulp BCTMP, the paper PAP1 suitable for use as a layer of a release liner REL1. In the method, a pulp mixture MIX1 comprising cellulose fibers may be formed by mixing 1 together different pulps. The mixing may be performed, for example by homogenising pulp mixture MIX1 in a mixer. The pulp mixture MIX1 may comprise bleached chemical pulp PULP1, PULP2 and bleached chemithermomechanical pulp BCTMP. The amount of bleached chemithermomechanical pulp in the pulp mixture may be varied. Typically, the amount of bleached chemithermomechanical pulp BCTMP in the pulp mixture is equal to or less than 50 wt.-% of the weight of the pulp mixture, such that the pulp mixture MIX1 also comprises bleached chemical pulp PULP1, PULP2. To increase the bulk of the paper PAP1, the pulp mixture may comprise bleached chemithermomechanical pulp BCTMP an amount of 5 wt.-% or more, such as equal to or higher than 10 wt.-%, or equal to or higher than 25 wt.-%. In addition to increasing the bulk, the amount of bleached chemithermomechanical pulp BCTMP in the pulp mixture may be used to change the production cost structure of the release liner REL1.

[0058] The bleached chemical pulp may comprise hardwood pulp PULP1, such as bleached hardwood pulp from a Kraft process. The presence of cellulose fibers from chemically treated hardwood in the pulp mixture MIX1 is advantageous for the brightness and transparency of the product. Advantageously, the bleached chemical pulp comprises both hardwood pulp PULP1 and softwood pulp PULP2. The chemically treated softwood in the pulp mixture MIX1 in general has a longer average fiber length than chemically treated hardwood, and is advantageous for the strength properties of the formed paper web WEB1. Typically, the hardwood pulp PULP1 and the softwood pulp PULP2 are bleached pulp from a Kraft process. The bleached chemical pulp PULP1, PULP2 and/or the bleached chemithermomechanical pulp BCTMP may be refined separately at a refining section of a paper machine prior to forming the pulp mixture MIX1. Alternatively, or in addition, the bleached chemical pulp, which may comprise hardwood pulp PULP1 and softwood pulp PULP2, and the bleached chemithermomechanical pulp BCTMP may be refined together when forming the pulp mixture MIX1 by mixing 1. When refining the pulp mixture MIX1 comprising bleached chemical pulp and bleached chemithermomechanical pulp, the fiber length distribution in pulp mixture MIX1 is different. The pulp mixture MIX1 refining may be used to prevent the fibers from being refined excessively, such that the amount of fine particles in the pulp mixture MIX1 may be reduced. After refining, the pulp mixture MIX1 may have a Schopper-Riegler value equal to or less than 70, preferably equal to or less than 50, such as in the range of 25 to 55, preferably in the range of 30 to 50. After refining, the pulp mixture MIX1 may have a Canadian Standard Freeness value of equal to or more than 90 ml, preferably equal to or more than 180ml, such as in the range of 180 to 500 ml, preferably in the range of 215 to 425 ml. After refining, the pulp mixture MIX1 may have a Canadian Standard Freeness value, for example, equal to or higher than 130 ml, preferably equal to or higher than 140 ml, such as equal to or higher than 300, preferably equal to or higher than 325 ml. At the refining section, pulp which comprises water is subjected to shear and stress forces. As a result of the refining, cutting and fibrillation of the cellulose fibers is obtained. Refining may be performed by means of mechanical action, for example by using bars, drums, beaters or refiners. Refining, and in particular refining to a high degree, may sometimes be referred to as beating. Therefore, the bleached chemical pulp PULP1, PULP2 and/or the bleached chemithermomechanical pulp BCTMP may have a Schopper-Riegler value equal to or less than 70, preferably equal to or less than 50, such as in the range of 25 to 55, preferably in the range of 30 to 50. The bleached chemical pulp PULP1, PULP2 and/or the bleached chemithermomechanical pulp BCTMP may have a Canadian Standard Freeness value of equal to or more than 90 ml, preferably equal to or more than 180ml, such as in the range of 180 to 500 ml, preferably in the range of 215 to 425 ml. The bleached chemical pulp PULP1, PULP2 and/or the bleached chemithermomechanical pulp BCTMP may have a Canadian Standard Freeness value, for example, equal to or higher than 130 ml, preferably equal to or higher than 140 ml, such as equal to or higher than 300, preferably equal to or higher than 325 ml.

[0059] Schopper Riegler (SR) Freeness and Canadian Standard Freeness are tests used to measure the extent of refining of a pulp. Refining, and in particular refining to a high degree, may sometimes be referred to as beating. Refining reduces the average fiber length of cellulose, which decreases the tear strength of a paper formed from the pulp. Refining also leads to fibrillation, wherein the cellulose fiber bundles conventionally tightly bound by hydrogen bonds become separated to some extent. The detachment of hydrogen bonds between fibers increases the pulp surface area and enables hydrogen bonding between fibers and water. The increased pulp surface area leads to hydration and the pulp absorbs water and swells. Refining increases the tensile and reduces the tearing strength of a paper formed from the pulp due to higher surface areas and increased hydrogen bonding between fibers. The amount of mechanical energy used in refining correlates with the reduction of fiber length and fibrillation. By using more energy, fibers having shorter average fiber length and increased surface area may be obtained. This enables formation of a dense and smooth paper surface. The amount of mechanical energy used in refining correlates with the water drainage resistance, which may be measured by the Schopper Riegler (SR) Freeness test. The Schopper Riegler (SR) Freeness test provides an empirical measurement value of the drainage resistance of a pulp slurry. A higher Schopper Riegler (SR) Freeness test value indicates higher amount of water to be removed from a formed paper web during the release liner manufacturing process. The Schopper Riegler (SR) Freeness value represents the inverse of the volume of water collected divided by

ten. The Schopper Riegler (SR) Freeness value may be determined using a SCAN-C 19:65 test method. The Canadian Standard Freeness represents the drainability of a pulp suspension in water in millilitres (ml). The Canadian Standard Freeness value may be determined using an ISO 5267-2:2001 test method.

5 [0060] The refined pulp mixture MIX1 is further mixed with water to form a pulp suspension. The basic qualities of the paper PAP1, such as paper type and suitability for different applications, are already determined to a large extent when forming 2 the paper web WEB1 from the pulp mixture MIX1. Filler chemicals CH2, such as viscosity modifiers, pigments or binder material, may be introduced 3 directly to the pulp mixture MIX1. When manufacturing glassine paper for release liner, however, filler chemicals are not added as such into the pulp mixture MIX1. Minor amounts of recycled filler chemicals may be end up into the pulp mixture MIX1 through reject recycling 4, when refined reject fiber material is reused by addition of the recycled reject fiber material into the pulp mixture MIX1.

10 [0061] At a forming section of the paper machine, paper web WEB1 is formed 2 from the pulp mixture MIX1. When manufacturing release liner paper, the pulp mixture MIX1 is typically introduced in a concentration between 0.25 and 3 wt.-%, such as in the range of 0.3 and 2 wt.-%, preferably less than 1 wt.-%, such as in the range of 0.3 to 0.8wt.-%. The weight percentage (wt.-%) refers to the dry content of the mixture. The dry content of the mixture is defined as the concentration of solids by weight in a mixture. The dry content of a paper web is defined as the concentration of solids by weight in a paper web. The dry content of a paper web formed from the pulp mixture MIX1, comprises both fibers any chemicals such as pigments or binder material introduced into the pulp mixture MIX1 through recycling 4, of refined reject fiber material, which remains in the formed paper web WEB1.

15 [0062] On the forming section of the paper machine, positioned after the refining section in the travelling direction of the paper web, the paper web WEB1 is formed from the pulp suspension and dewatered. During the dewatering process, the formed paper web is typically forced against the forming wire. The solid particles in the suspension are to a certain degree trapped initially by the wire and later by the accumulating wet web. A part of the solid particles, referred to as fine particles, may flow through the wire, and are recycled 5 back to the pulp suspension. These recycled fine particles have an impact on the manufacturing process, in particular when forming a paper web. The recycling arrangement is referred to as the short circulation of the pulp suspension. The amount of recycled fine particles defines a retention level, which describes the ability of the formed paper web to retain fine particles on the web, and therefore the balance between drainage and formation of the paper web. Fine particles in this context refer to particles having a maximum dimension equal to or less than 0.2 millimetres, when determined by an optical analyser. The content of fine particles in a bleached chemical pulp, such as kraft pulp varies depending of the used wood species and extent of refining. For example in aspen, the content of fine particles in a bleached chemical pulp may be in the range of 14 wt.-% or less. The content of fine particles in a mechanical and chemithermomechanical pulp is typically higher than in bleached chemical pulp, such as equal to or higher than 20 wt.-%. When the retention level of the initially forming paper web is high, the drainage of water from the paper web may be too slow, and the moisture content of the paper web remains too high. On the other hand, a low retention level is an indication of a high amount of fine particles flowing through the formed paper web and through the wire into the short circulation, which may lead to accumulation of the particles in the pulp suspension.

20 [0063] After dewatering, the paper web is moved on a press section to reduce the moisture content of the paper web further. The press section of a paper machine typically comprises a number of rolls for guiding and/or pressing the paper web. The paper web is then moved from the press section to a drying section of a paper machine. In the drying section, the paper web is heated to evaporate most of the remaining moisture in the paper web. After drying section, the paper web may have a dry content level equal to or more than 90 wt.-%, for example in the range of 90 to 95 wt.-%. The method therefore comprises a step for reducing moisture content 6 of the paper web WEB1 in a press section, and a step for drying the paper web WEB1 in a drying section, thereby forming paper PAP1.

25 [0064] The finishing 7 of the paper PAP1 can be done by surface sizing and calendering treatment. The surface sizing and calendering treatment improve the smoothness of the paper surface. A surface sizing refers to a primer layer applied on the formed paper PAP1. Surface sizing and calendering treatment may be used to reduce the thickness of the paper. Therefore surface sizing and calendering treatment may be used in reducing the specific volume of the paper PAP1. Advantageously, the ratio of grammage to thickness of the paper in micrometres is maintained equal to or higher than 1.0. A paper having a surface sizing may also be denoted as a substrate layer, comprising a paper support SUP1 and one or more primer layers applied on the paper support. A primer layer may be applied on one side or on both sides of the paper PAP1. The primer layer typically comprises size coating, pigments and/or filler chemicals, such as described above for glassine paper. The primer layer coating may be applied in the range of 1 to 10 g/m² per side, typically the amount of applied primer layer is in the range of 2 to 5 g/m² per side. The calendering treatment may be done on the formed paper PAP1 before or after applying the primer layer. The calendaring treatment may comprise use of a calender, multi-nip calender or super calender to modify the surface properties of the paper PAP1 and to reach the final thickness for the paper PAP1.

30 [0065] In release liners, paper having a thickness in the range of 35 to 100 micrometres is typical. Advantageously, paper comprising bleached chemithermomechanical pulp may have a thickness less than 70 micrometres, such as in the range of 40 to 68 micrometres, most preferably in the range of 45 to 60 micrometres. A sufficient density at such

thickness values is typically equal to or less than 1200 kg/m³, such as in the range of 1000 to 1200 kg/m³ or in the range of 1050 to 1150 kg/m³. For example, with bleached chemithermomechanical pulp having a grammage equal to or less than 100 grams per square meter, the thickness of a paper comprising bleached chemithermomechanical pulp may be equal to or less than 100 micrometres.

5 [0066] A release liner REL1 may be obtained from the substrate layer comprising a paper support SUP1 and one or more primer layers applied on the paper support by applying a release coating 8 on the substrate layer. A release liner may be used, for example, to form a combination comprising the release liner and an adhesive label or label stock LAB1. A typical example of a release coating contains silicone polymer, and the coating is applied in a quantity of equal to or less than 2 g/m² per side, such as in the range of 0.7 to 2 g/m², preferably in the range of 0.8 to 1.5 g/m².

10 The effect of bleached chemithermomechanical pulp composition in the paper manufacturing process

[0067] Typically, bleached chemithermomechanical pulp used in paper manufacturing is made of hardwood. Some examples of hardwood suitable for manufacturing chemithermomechanical pulp comprise aspen and eucalyptus. Eucalyptus belongs to the genus *Eucalyptus*, of which an example species used in pulp processing is *Eucalyptus globulus*. Aspen belongs to the genus *Populus*, comprising species such as *Populus tremuloides* and *Populus tremula*. In the northern hemisphere, aspen is a widely used hardwood, which is suitable for bleached chemithermomechanical pulp. Aspen is a tall, fast growing deciduous tree, which is widely available. The wood of aspen has a homogeneous structure with good mechanical properties for both mechanical and chemical pulping. The bark of aspen is easy to remove, which facilitates the processability of the logs. The aspen fibers, while of hardwood, are flexible and promote inter-fiber bonding in a paper web. The vessels of aspen are large compared to the fibers and may comprise 20 to 30% by volume of the wood. In mechanical pulps, aspen is advantageous compared to many softwoods, due to lower yellowing of the fibers. When manufacturing paper for a release liner, bleached chemithermomechanical pulp made of a hardwood such as aspen may be mixed with bleached chemical pulp, such as Kraft pulp, to modify the ratio of the bulk to the grammage of the paper, as described above, such that the amount of fibers per unit area may be increased to improve the density of the paper surface, without increasing the grammage of the paper. The increase in bulk produced with the bleached chemithermomechanical pulp may thus be used for calendaring the paper into a final thickness having a sufficient density, typically equal to or less than 1200 kg/m³, suitable for a release coating and a sufficient transparency, typically equal to or higher than 35%, such as equal to or higher than 40%, to be used as a release liner.

30 [0068] Aspen fibers have small average fiber length, and have a large specific surface (m²/g) that scatter light. This increases the brightness and opaqueness in a paper. When the amount of fibers having small average fiber length is increased in paper, the scattering of light typically increases. The refining of bleached chemithermomechanical pulp made of aspen should therefore be minimized, to preserve the fiber length of the individual fibers in the formed pulp. The scattering of light may also be reduced by calendaring the paper such that the thickness of the paper is reduced, which improves the transparency. The transparency of the paper is dependent of the thickness of the paper, such that papers having a thickness and grammage equal to or higher than 70 g/m² typically have a lower transparency level than papers having less thickness.

[0069] Figures 2a and 2b, show by way of an example, comparative data showing a difference in distribution of fiber length and fine particle content between bleached chemical pulp and bleached chemithermomechanical pulp. Figure 2a is a measurement of bleached chemical pulp made of aspen. In a sample comprising 6613 measured fibers of a total amount of 28245 fibers, the number weighted average length L(n) is 0.67 millimeters, the length weighted average length L(l) is 0.88 millimeters and the weight weighted average length L(w) is 1.04 millimeters. The number weighted average amount of fine particles is 14.03% and the length weighted average amount of fine particles is 2.15%. The average coarseness is 0.100 mg/m. Figure 2b is a measurement of bleached chemithermomechanical pulp made of aspen. In a sample comprising 6884 measured fibers of a total amount of 27377 fibers, the number weighted average length L(n) is 0.54 millimeters, the length weighted average length L(l) is 0.77 millimeters and the weight weighted average length L(w) is 0.92 millimeters. The number weighted average amount of fine particles is 21.11% and the length weighted average amount of fine particles is 4.56%. The average coarseness is 0.143 mg/m. The fiber analysis was done by using a Metso Fiber Image Analyzer (Metso FS5). The figures 2a and 2b show that in aspen, as in many hardwood species having similar fiber length, that bleached chemithermomechanical pulp made of hardwood comprises a large number of fine particles. The average fiber length distribution of bleached chemithermomechanical pulp also differs from bleached chemical pulp. The bleached chemithermomechanical pulp contains a higher proportion of particles having a small average fiber length. The number weighted average amount of fine particles in bleached chemithermomechanical pulp is 21%, and 14% in the bleached chemical pulp. The increase in the amount of fine particles in the bleached chemithermomechanical pulp compared to the bleached chemical pulp is 50%, which can have an impact in the retention level of fine particles in a paper manufacturing process comprising bleached chemithermomechanical pulp of hardwood.

55 [0070] The relatively high content of fine particles in bleached chemithermomechanical pulp made of a single hardwood species, compared to the content of fine particles in bleached chemical pulp, may lead to difficulties in the manufacturing

process of the paper. The chemical composition of the bleached chemithermomechanical pulp differing from bleached chemical pulp may also have an effect on the refining of a pulp mixture comprising both bleached chemical pulp and bleached chemithermomechanical pulp. One of the observed difficulties relates to a higher concentration of the fine particles in the short circulation of a paper machine on the wire section, where water is removed by drainage from the forming paper web. The bleached chemithermomechanical pulp made of hardwood such as aspen comprises a low retention capability, such that fine particles may migrate through the formed paper web and end up into the short circulation of the paper machine, thereby accumulating into the pulp suspension used for forming the paper web. This may destabilise the wet end chemistry of the paper machine. Difficulties, such as foaming tendency of the pulp suspension may lead to web breaks in the manufacturing process.

[0071] Working examples below describe some of the difficulties related to use of bleached chemithermomechanical pulp made of a single hardwood species, and novel solutions to overcome these difficulties.

Example 1

Glassine paper comprising BCTMP of hardwood

[0072] The use of bleached chemithermomechanical pulp made of hardwood in glassine paper was tested on a paper machine. The pulp mixture used to manufacture the paper comprised bleached chemical pulp of hardwood and softwood and 25 wt.-% of bleached chemithermomechanical pulp made of aspen. The paper grade manufactured had a grammage of 57g/m² and was calendared into a final thickness of 53 micrometers (μm). The paper was measured to have a density of 1087 kg/m³. Measurements were taken from the paper manufacturing process at consecutive time points up to a time point of 42 hours, in order to observe the development of parameter used in characterizing the quality of the manufactured paper and suitability for release liner support layer purpose. During the measurement period the content of bleached chemithermomechanical pulp added into the pulp mixture was maintained at 25 wt.-% of the pulp mixture.

[0073] Figures 3a, 3b and 3c are trend diagrams representing by way of examples the development of paper transparency (%), top side roughness (PPS) and back side water absorptiveness (CobbA60) as a function of time in a paper manufacturing process, wherein the pulp suspension comprises 25 wt.-% of bleached chemithermomechanical pulp made of aspen. From Figure 3a it can be observed, that the transparency of the paper decreased in the manufacturing process as a function of time, when the content of bleached chemithermomechanical pulp added into the pulp mixture was maintained at 25 wt.-% of the pulp mixture. The observed change in the transparency level was from 49.9% to 46.7%, which means over 6% change over the measurement period. From Figure 3b it can be observed, that the roughness of the paper increased in the manufacturing process as a function of time, when the content of bleached chemithermomechanical pulp added into the pulp mixture was maintained at 25 wt.-% of the pulp mixture. The observed change in the roughness (PPS) from top side of the paper changed from a value of 1.45 PPS to 1.69 PPS, which means over 16% change in the roughness level. The top side of paper refers to the side preferred for printing or coating purposes, which is against the felt rollers during manufacture. From Figure 3c it can be observed, that the water absorptiveness of the paper increased in the manufacturing process as a function of time, when the content of bleached chemithermomechanical pulp added into the pulp mixture was maintained at 25 wt.-% of the pulp mixture. The observed water absorption (CobbA60) from the back side of the paper changed from a value of 21.4 to 31.5, which means over 47% increase in water absorptiveness. The back side of the paper refers to the side against the wire during manufacture.

[0074] The example 1 above showed, that while advantageous in increasing bulk of the product, bleached chemithermomechanical pulp made of hardwood may introduce difficulties in the process control when continued longer, such as over one day or over two days. In particular, these bleached chemithermomechanical pulp threshold values have been discovered to be problematic with bleached chemithermomechanical pulp made of aspen. In addition to the noticed decrease in transparency, increase in roughness and water absorptiveness as a function of time, a pulp mixture comprising equal to or more than 10 wt.-% of bleached chemithermomechanical pulp made of aspen lead to reduced retention capability of fine particles on the forming section of the paper machine. When the fine particles were recycled back into the pulp suspension, foaming on the wet end of the paper machine was noticed, which increased the risk of web break due to excessive amounts of air trapped into the pulp suspension. Primer layer difficulties were observed with pulp mixture comprising equal to or more than 25 wt.-% of bleached chemithermomechanical pulp made of aspen, such that conventional surface sizing of the paper was no longer feasible. A reduction in the internal bond strength compared to glassine paper, which lead to brittleness of the paper, was observed with pulp mixture comprising equal to or more than 35 wt.-% of bleached chemithermomechanical pulp made of aspen.

[0075] The observed difficulties were noticed by measuring the manufacturing process for a longer time, such as over 24 hours or more. The difficulties in the manufacturing process runnability were reflected in the paper quality, and lead to poor paper quality, when the manufacturing process was continued. It was contemplated, that a drawback of aspen or other similar hardwood species is, that the chemical and physical characteristics of bleached chemithermomechanical pulp made of such wood species alone may not be suitable for the manufacturing process, at least when the manufacturing

process is continued for a longer time, such as over one day or two days.

Example 2

5 Glassine paper comprising BCTMP of hardwood and softwood

10 **[0076]** It was unexpectedly noticed, that softwood may be used to improve the compatibility of the bleached chemithermomechanical pulp to the paper manufacturing process. Different wood species have different chemical composition, and a different average fiber length in a pulpwood. In paper manufacturing, the wood material used to produce cellulose fibers is traditionally divided into two groups based on the average cellulose fiber length. Hardwood typically denotes wood wherein the average fiber length of cellulose fibers in a pulp is less than 2 millimetres, such as in the range of 0.7 to 1.8 millimetres, whereas softwood denotes species having a longer average fiber length of cellulose fibers in a pulp compared to the hardwood, such as in the range of 2 to 3 millimetres. By changing the composition and method of manufacturing the bleached chemithermomechanical pulp to comprise both hardwood and a suitable softwood, these drawbacks could be solved. A suitable softwood may be, for example a coniferous wood species, preferably spruce. Spruce has an average fiber length typically in the range of 2.2 to 2.5 millimetres in a pulpwood. The use of bleached chemithermomechanical pulp comprising both aspen and spruce in a pulp mixture can stabilize the wet end chemistry of the paper machine, such that the paper manufacturing process may be continued without interruptions for extended time periods, such as over two days or more, such as several days or even several weeks.

20 **[0077]** The use of bleached chemithermomechanical pulp made of hardwood and softwood in glassine paper was tested on a paper machine. The pulp mixture used to manufacture the paper comprised bleached chemical pulp of hardwood and softwood and 25 wt.-% of bleached chemithermomechanical pulp made of aspen and spruce. The paper grade manufactured had a grammage of 57g/m² and was calendared into a final thickness of 53 micrometers (μm). The paper was measured to have a density of 1082 kg/m³. Measurements were taken from the paper manufacturing process over several days, up to a time period of 62 hours, during which the content of bleached chemithermomechanical pulp added into the pulp mixture was maintained at 25 wt.-% of the pulp mixture.

25 **[0078]** Figures 4a, 4b and 4c are trend diagrams representing by way of examples the development of paper transparency (%), top side roughness (PPS) and back side water absorptiveness (CobbA60) as a function of time in a paper manufacturing process, wherein the pulp suspension comprises 25 wt.-% of bleached chemithermomechanical pulp made of aspen and spruce. From Figure 4a it can be observed, that the transparency of the paper has a relatively small decrease in the manufacturing process as a function of time, when the content of bleached chemithermomechanical pulp added into the pulp mixture was maintained at 25 wt.-% of the pulp mixture. The observed change in the transparency level was from 48.6% to 46.5 %, which means less than 4.4% change over the measurement period of several days. From Figure 4b it can be observed, that the roughness of the paper decreased to some extent in the manufacturing process as a function of time, when the content of bleached chemithermomechanical pulp added into the pulp mixture was maintained at 25 wt.-% of the pulp mixture. The observed change in the roughness (PPS) from top side of the paper started from a value of 1.33 and ended in a value of 1.39. The standard deviation of the values measured over several days was 6%. From Figure 4c it can be observed, that the water absorptiveness of the paper decreased in the manufacturing process as a function of time, when the content of bleached chemithermomechanical pulp added into the pulp mixture was maintained at 25 wt.-% of the pulp mixture. The observed water absorption (CobbA60) from the back side of the paper started from a value of 19.0 and ended in a value of 19.6. The average value was 22.5, and standard deviation of the values measured over several days was 1.71%.

30 **[0079]** The example 2 indicated, that the presence of softwood in the bleached chemithermomechanical pulp improves the runnability of the manufacturing process. The results also indicate, that the presence of softwood in the bleached chemithermomechanical pulp improves the fiber length distribution of the bleached chemithermomechanical pulp such that the retention of fine particles in the paper web is higher. The results also indicate, that the presence of softwood in the bleached chemithermomechanical pulp improves the fiber length distribution of the bleached chemithermomechanical pulp such that the average fiber length is longer.

50 Example 3

Effect of BCTMP to paper density

55 **[0080]** Table 1 below is an example of two papers, wherein the first paper p1 has been manufactured using an amount of 25% of bleached chemithermomechanical pulp (BCTMP) comprising both aspen and spruce, and the second paper p2 has been manufactured using only bleached chemical pulp.

EP 3 059 344 A1

Table 1. Comparative quality data of yellow paper p1 comprising 25 wt.-% of bleached chemithermomechanical pulp comprising both aspen and spruce and of yellow paper p2 comprising only bleached chemical pulp.

Paper	1	2	3	4	5	6	7	8
	BCTMP %	transp. %	μm	g/m ²	kg/m ³	sec/min	PPS	Cobb A60
p1	25	47.2	53	57	1080	129	1.5	21.5
p2	0	48.6	53	60	1140	167	1.4	22.4

[0081] Table 1 discloses comparative quality data of papers p1 and p2. The columns are numbered from 1 to 8 and refer to following parameters:

- 1: Transparency (%)
- 2: BCTMP content (wt.%)
- 3: Paper thickness (micrometers)
- 4: Paper grammage (g/m²)
- 5: Paper density (kg/m³)
- 6: Paper Bekk porosity (sec/min)
- 7: Paper top side roughness (PPS)
- 8: Paper back side water absorptiveness (Cobb A60)

[0082] The difference between the papers p1 and p2 is in the content of bleached chemithermomechanical pulp added into the pulp mixture. Paper p1 comprises 75 wt.-% of bleached chemical pulp and 25 wt.-% of bleached chemithermomechanical pulp comprising both aspen and spruce. Paper p2 comprises only bleached chemical pulp. Both papers p1 and p2 were calendared to the same thickness of 53 micrometers. As can be determined from the table 1, the density of the paper p1 is only ca. 94% of the density of paper p2. The bulk of paper p1 is 0.925 cm³/g, and the bulk of paper p2 is 0.877 cm³/g, the bulk denoting the inverse of density, and expressed in cubic centimeters per gram (cm³/g). The ratio of bulk to the grammage (g/m²) in paper p1 is 1.016, whereas the ratio of bulk to the grammage (g/m²) in paper p2 is 1.014. Therefore, the ratio of bulk to the grammage in paper p1 comprising bleached chemithermomechanical pulp is more than 11% higher than the ratio of bulk to the grammage in paper p2, comprising only bleached chemical pulp. The ratio of grammage (g/m²) to thickness in micrometers in both papers p1 and p2 is above 1.0. In paper p1, the ratio of grammage to thickness in micrometers is 1.07. In paper p2, the ratio of grammage to thickness in micrometers is 1.13. Therefore, the paper p1 comprising 25 wt.-% of bleached chemithermomechanical pulp has a lighter grammage in the same thickness. Furthermore, the water absorptiveness level of the paper p1 comprising 25 wt.-% of bleached chemithermomechanical pulp is only 96% of the water absorptiveness level of paper p2, which reflects a moderate refining of the fibers, and is an indication of sufficient surface density of for release coating purposes. The transparency of both papers p1 and p2 is above 45%. Considering that the papers have been manufactured to comprise a yellow colour, which typically reduces the transparency value, the measured transparency of the papers p1 and p2 is very good.

Example 4

Effect of BCTMP content to paper

[0083] Table 2 below is an example of papers p3 and p4, wherein paper p3 has been manufactured using an amount of 10% of bleached chemithermomechanical pulp (BCTMP) comprising both aspen and spruce, and paper p4 has been manufactured using an amount of 25% of bleached chemithermomechanical pulp (BCTMP) comprising both aspen and spruce. The paper colour type in papers p3 and p4 was "Brilliant", denoting non-coloured, white paper with high transparency level. The paper type in both papers p3 and p4 is glassine paper.

Table 2. Comparative quality data of non-coloured, white paper p3 comprising 10 wt.-% of bleached chemithermomechanical pulp comprising both aspen and spruce and of non-coloured, white paper p4 comprising 25 wt.-% of bleached chemithermomechanical pulp comprising both aspen and spruce.

Paper	1	2	3	4	5	6	7	8
	BCTMP %	transp. %	μm	g/m ²	kg/m ³	sec/min	PPS	Cobb A60
p3	10 %	42.9 %	61.1	68.8	1127	141.4	1.5	25.1

(continued)

Paper	1	2	3	4	5	6	7	8
	BCTMP %	transp. %	μm	g/m ²	kg/m ³	sec/min	PPS	Cobb A60
p4	25 %	43.1 %	61.0	66.5	1092	104.9	1.7	23.1

[0084] The columns are numbered from 1 to 8, referring to same parameters as in table 1 above.

[0085] The difference between the papers p3 and p4 is in the content of bleached chemithermomechanical pulp added into the pulp mixture. Both papers p3 and p4 were calendared to the same thickness of 61 micrometers. As can be determined from the table 2, the transparency of both papers is similar. In fact, paper p4 having a higher content of bleached chemithermomechanical pulp has a slightly higher transparency level. The density of the paper p4 is ca. 95% of the density of paper p3. Therefore, the bulk of the paper has been increased by increasing the content of the bleached chemithermomechanical pulp added into the pulp mixture. The bulk of paper p3 is 0.887 cm³/g, and the bulk of paper p2 is 0.916 cm³/g, the bulk denoting the inverse of density, and expressed in cubic centimeters per gram (cm³/g). The ratio of bulk to the grammage in paper p3 is 1.012, whereas the ratio of bulk to the grammage in paper p4 is 1.013. This indicates, that the ratio of bulk to the grammage may be increased by providing a higher amount of bleached chemithermomechanical pulp. An increase from 10 wt.-% to 25 wt.-% of bleached chemithermomechanical pulp added into the pulp mixture provided higher than 6% increase in the ratio of bulk to the grammage. The ratio of grammage to thickness in micrometers in both papers p3 and p4 is above 1.0. In paper p3, the ratio of grammage to thickness in micrometers is 1.12. In paper p4, the ratio of grammage to thickness in micrometers is 1.09. Therefore, the paper p4 comprising 25 wt.-% of bleached chemithermomechanical pulp has a lighter grammage in the same thickness, when compared to the paper p3 comprising 10 wt.-% of bleached chemithermomechanical pulp. The ratio of grammage to thickness in micrometers may therefore also be reduced, by means of increasing the content of the bleached chemithermomechanical pulp added into the pulp mixture. Furthermore, the water absorptiveness level of the paper p4 comprising 25 wt.-% of bleached chemithermomechanical pulp is only 96% of the water absorptiveness level of paper p3. It is likely, therefore, that the increase in the content of bleached chemithermomechanical pulp has improved the process of pulp mixture refining, such that the fibers have reduced swelling characteristics. This is a positive indication of the bleached chemithermomechanical pulp promoting the formation of sufficient surface density of the paper. The transparency of both papers p3 and p4 is above 40 %. Considering that the papers have been manufactured to a thickness of 61 micrometers, the measured transparency of the papers p3 and p4 is very good.

Example 5

Effects of BCTMP content to paper quality and manufacturing process

[0086] Table 3 below represents by way of an example of papers p5, p6, p7 and p8, wherein paper p5 has been manufactured using only bleached chemical pulp, paper p6 has been manufactured using bleached chemical pulp and an amount of 10% of bleached chemithermomechanical pulp comprising both aspen and spruce, paper p7 has been manufactured using bleached chemical pulp and an amount of 25% of bleached chemithermomechanical pulp comprising both aspen and spruce and paper p8 has been manufactured using bleached chemical pulp and an amount of 35% of bleached chemithermomechanical pulp comprising both aspen and spruce. The data values of papers p5, p6, p7 and p8 are average values of multiple measurements in each paper p5, p6, p7 and p8. The average values in the columns 2 to 8 are based on the measurement results of multiple rolls of papers produced on a paper machine, to enhance the representativeness of the value. Each average value represents the mean value of paper from a manufacturing process over several kilometers of produced paper.

Table 3. Comparative quality data of papers p5 to p8 having thickness in the range of 51 to 53 micrometers, and manufactured using either only bleached chemical pulp as in p5 or an amount of bleached chemithermomechanical pulp comprising both aspen and spruce in the range of 10 to 35 wt.% as in p6 to p8.

Paper	1	2	3	4	5	6	7	8
	BCTMP %	transp. %	μm	g/m ²	kg/m ³	sec/min	PPS	Cobb A60
p5	0 %	49.9 %	53.0	60.3	1139.5	177.2	1.4	21.0
p6	10 %	51.1 %	51.7	58.0	1121.0	141.8	1.5	21.0

(continued)

Paper	1	2	3	4	5	6	7	8
	BCTMP %	transp. %	μm	g/m^2	kg/m^3	sec/min	PPS	Cobb A60
p7	25 %	47.9 %	53.0	57.3	1082.8	103.5	1.7	25.0
p8	35 %	48.7 %	51.5	54.7	1063.0	101.3	1.8	25.0

[0087] The columns are numbered from 1 to 8, referring to same parameters as in table 1 above.

[0088] From table 3 it can be observed, that the transparency level is maintained high despite the addition of bleached chemithermomechanical pulp. All papers p5 to p8 were calendared close to the same thickness in the range of 51 to 53 micrometers. As can be determined from the table 3, the transparency of all papers p5 to p8 is similar. The measured decrease in the transparency level between paper p5 manufactured using only bleached chemical pulp compared and papers p6 to p8 manufactured using bleached chemithermomechanical pulp was equal to or less than 2 percentage units. In fact, paper p6 having a content of 10 wt.-% of bleached chemithermomechanical pulp has a slightly higher transparency level, despite the addition of bleached chemithermomechanical pulp.

[0089] From table 3 it can be further observed, that the density of the paper decreases as a function of the bleached chemithermomechanical pulp content, wherein a higher bleached chemithermomechanical pulp content corresponds to a lower density in paper. A paper comprising bleached chemithermomechanical pulp in the range of 10 to 35 wt.-% has a density in the range of $1139.5 \text{ kg}/\text{m}^3$ to $1063 \text{ kg}/\text{m}^3$, respectively. The density of paper p6 having a content of 10 wt.-% of bleached chemithermomechanical pulp is about 98% of the density of paper p5 comprising only bleached chemical pulp. The density of paper p7 having a content of 25 wt.-% of bleached chemithermomechanical pulp is about 95% of the density of paper p5 comprising only bleached chemical pulp. The density of paper p8 having a content of 35 wt.-% of bleached chemithermomechanical pulp is about 93% of the density of paper p5 comprising only bleached chemical pulp. Similarly, the specific volume or bulk, which is inverse of the density of the paper, increases as a function of the bleached chemithermomechanical pulp content, wherein a higher bleached chemithermomechanical pulp content corresponds to a higher specific volume. The results indicate, that the specific volume of the paper may be configured to increase as a function of the bleached chemithermomechanical pulp content.

[0090] From table 3 it can be further observed, that the Bekk porosity (sec/min) of the paper decreases as a function of the bleached chemithermomechanical pulp content, wherein a higher bleached chemithermomechanical pulp content corresponds to a lower Bekk porosity. A paper comprising bleached chemithermomechanical pulp in the range of 10 to 35 wt.-% has a Bekk porosity in the range of 177 to 101 sec/min , respectively. This indicates, that the surface integrity is very good in paper comprising bleached chemithermomechanical pulp, and that the surface fibers are sufficiently bonded to fibers beneath the surface towards the interior of the paper, which provides a good support for a primer layer coating.

[0091] From table 3 it can be further observed, that the top side roughness of the paper (PPS) of the paper increases as a function of the bleached chemithermomechanical pulp content, wherein a higher bleached chemithermomechanical pulp content corresponds to a higher top side roughness of the paper. A paper comprising bleached chemithermomechanical pulp in the range of 10 to 35 wt.-% has a top side roughness in the range of 1.4 to 1.8 PPS, respectively. This indicates, that the surface roughness in paper comprising bleached chemithermomechanical pulp increases as a function of the bleached chemithermomechanical pulp content. Of notice is, that the top side roughness is also an indication of paper retention level, wherein a higher top side roughness may correspond to a higher amount of fine particles flowing through the formed paper web and through the wire into the short circulation, which may lead to accumulation of the particles in the pulp suspension. When comparing the table 3 roughness data to the roughness data indicated in Figure 3b, it becomes apparent that bleached chemithermomechanical pulp comprising both aspen and spruce is beneficial in preventing the rate of increase of the top side roughness. In Figure 3b, paper comprising 25 wt.-% of bleached chemithermomechanical pulp made of aspen has a top side roughness, which increases linearly as a function of time in a manufacturing process. With softwood such as spruce also present in the bleached chemithermomechanical pulp, the top side roughness in the manufacturing process may be controlled. Figure 4b shows the effect of a softwood fraction as a function of time in a manufacturing process in a paper web comprising 25 wt.-% of bleached chemithermomechanical pulp made of aspen and spruce.

[0092] From table 3 it can be further observed, that the back side water absorptiveness of the paper (Cobb A60) of the paper increases as a function of the bleached chemithermomechanical pulp content, wherein a higher bleached chemithermomechanical pulp content corresponds to a higher back side water absorptiveness of the paper. A paper comprising bleached chemithermomechanical pulp in the range of 10 to 35 wt.-% has a back side water absorptiveness in the range of 21 to 25 PPS, respectively. This indicates, that the back side water absorptiveness in paper comprising

bleached chemithermomechanical pulp increases as a function of the bleached chemithermomechanical pulp content. Of notice is, that back side water absorptiveness is also an indication of paper refining level, wherein a higher back side water absorptiveness may correspond to a higher amount of fine particles, which may flow through the formed paper web and through the wire into the short circulation, which may further lead to accumulation of the particles in the pulp suspension. When comparing the table 3 water absorptiveness data to the water absorptiveness data indicated in Figure 3c, it becomes apparent that, bleached chemithermomechanical pulp comprising both aspen and spruce is beneficial in moderating the rate of increase of the top side roughness. In Figure 3c, paper comprising 25 wt.-% of bleached chemithermomechanical pulp made of aspen has a water absorptiveness, which increases rapidly as a function of time in a manufacturing process. With softwood such as spruce also present in the bleached chemithermomechanical pulp, the water absorptiveness in the manufacturing process may be controlled. Figure 4c shows the effect of a softwood fraction as a function of time in a manufacturing process in a paper web comprising 25 wt.-% of bleached chemithermomechanical pulp made of aspen and spruce.

[0093] From table 3 it can be further observed, that the grammage of the paper decreases as a function of the bleached chemithermomechanical pulp content, such that a higher bleached chemithermomechanical pulp content corresponds to a lower grammage of the paper. In addition, the grammage of the paper decreases as a function of the paper density, such that a lower paper density corresponds to a lower grammage of the paper. The grammage of paper p6 having a content of 10 wt.-% of bleached chemithermomechanical pulp is about 96% of the grammage of paper p5 comprising only bleached chemical pulp. The grammage of paper p7 having a content of 25 wt.-% of bleached chemithermomechanical pulp is about 95% of the grammage of paper p5 comprising only bleached chemical pulp. The grammage of paper p8 having a content of 35 wt.-% of bleached chemithermomechanical pulp is about 91% of the grammage of paper p5 comprising only bleached chemical pulp.

[0094] From table 3 it can be further observed, that a paper comprising bleached chemithermomechanical pulp in the range of 10 to 35 wt.-% may be configured to have a high transparency equal to higher than 40%, such as in the range of 45 to 52%, and a reduction in the grammage equal to or higher than 10%, such as from ca. 60 g/m² to ca. 54 g/m², while maintaining the thickness of the paper. Bleached chemithermomechanical pulp may therefore be used to reduce the grammage of the paper, while maintaining the thickness of the paper, such that the surface density and transparency of the paper remain suitable for release coating purposes. When using bleached chemithermomechanical pulp made of aspen and spruce, the top side roughness has increased less than 23% and water absorptiveness of the paper has increased less than 17%. Compared to the water absorptiveness data indicated in Figure 3c of bleached chemithermomechanical pulp made of aspen, it may be hypothesized that in a paper comprising bleached chemithermomechanical pulp in the range of 10 to 35 wt.-% made of aspen and spruce, a higher amount of the cellulose fibers of short average fiber length present in the bleached chemithermomechanical pulp has therefore been retained in the formed paper web during dewatering, such that the amount of cellulose fibers in a specific volume of the paper is increased. The higher amount of fine particles, i.e. cellulose fibers of short average fiber length present in the bleached chemithermomechanical pulp, may be one reason for the high surface density of the paper. The presence of the softwood fraction in the bleached chemithermomechanical pulp may enable a higher retention level of the fine particles on the paper web surface, such that the surface density of the paper may be improved, when bleached chemithermomechanical pulp made of aspen and spruce is used.

[0095] The effects of bleached chemithermomechanical pulp in the range of 10 to 35 wt.-% to the relationship of paper specific density, grammage and thickness have been further described in Table 4, by way of an example, using the quality data of papers p5, p6, p7 and p8 .

Table 4. The effect of bleached chemithermomechanical pulp in the range of 10 to 35 wt.-% to the relationship of paper specific density, grammage and thickness in papers p5 to p8.

Paper	1. BCTMP content	2. bulk	3. bulk/ grammage	4. grammage/ thickness	5. difference of bulk / grammage	6. difference of grammage/ thickness
	BCTMP %	cm ³ /g	ratio	ratio	%	%
p5	0 %	0.878	0.0146	1.138		
p6	10 %	0.892	0.0154	1.122	5.7%	-1.4%
p7	25 %	0.924	0.0161	1.081	10.7%	-5.0 %
p8	35 %	0.941	0.0172	1.062	18.2 %	-6.6 %

[0096] The columns in Table 4 are numbered from 1 to 6 and refer to following parameters:

- 1: BCTMP content (wt.%)
- 2: Paper bulk (cm^3/g), i.e. specific density
- 3: Ratio of bulk (cm^3/g) to grammage (g/m^2)
- 4: Ratio of grammage (g/m^2) to thickness (micrometers)
- 5: Percentage change of the bulk to grammage ratio to paper p5
- 6: Percentage change of the grammage to thickness ratio to paper p5

[0097] From table 4 it may be observed, that when using bleached chemithermomechanical pulp in the range of 10 to 35 wt.-% to manufacture a paper having a thickness in the range of 51 to 53 micrometers, the specific density of the paper has been increased. The specific density increased from $0.878 \text{ cm}^3/\text{g}$ in a paper comprising only bleached chemical pulp to $0.878 \text{ cm}^3/\text{g}$ in a paper comprising 35 wt.-% of bleached chemithermomechanical pulp. The ratio of bulk to grammage has been increased from 0.0146 in a paper comprising only bleached chemical pulp to 0.0172 in a paper comprising 35 wt.-% of bleached chemithermomechanical pulp. The ratio of grammage to thickness has been decreased from 1.138 in a paper comprising only bleached chemical pulp to 1.062 in a paper comprising 35 wt.-% of bleached chemithermomechanical pulp. The ratio of bulk to grammage has increased more than 5% in a paper comprising 10 wt.-% of bleached chemithermomechanical pulp, more than 10% in a paper comprising 25 wt.-% of bleached chemithermomechanical pulp, and more than 18% in a paper comprising 35 wt.-% of bleached chemithermomechanical pulp, when compared to the ratio of bulk to grammage in a paper comprising only bleached chemical pulp. The ratio of grammage to thickness has decreased less than 1.5% in a paper comprising 10 wt.-% of bleached chemithermomechanical pulp, equal to or less than 5% in a paper comprising 25 wt.-% of bleached chemithermomechanical pulp, and less than 7% in a paper comprising 35 wt.-% of bleached chemithermomechanical pulp, when compared to the ratio of grammage to thickness in a paper comprising only bleached chemical pulp.

Manufacturing process for bleached chemithermomechanical pulp made of aspen and spruce

[0098] As shown in Figures 3a-3c, Figures 4a-4c and tables 1-4 above, bleached chemithermomechanical pulp may be arranged to have a composition configured to optimize the process conditions of a paper manufacturing process, where said bleached chemithermomechanical pulp is used. Typical characteristics of bleached chemithermomechanical pulp are bulk, absorbency, internal bond and stiffness. In release paper manufacturing, the bulk may be used to reduce grammage. In release paper manufacturing, the high amount of short fibers in bleached chemithermomechanical pulp may also be used to improve the density of the paper surface, while increasing the bulk. However, increased absorbency is not desired, as this increases the need for paper web pressing and drying, as well as reduces dimensional stability of the paper web.

[0099] Bleached chemithermomechanical pulp used in paper manufacturing can be made of hardwood, such as aspen. Aspen wood has a relatively low lignin content compared to other pulped hardwoods which makes the pulp easier to bleach. Typical properties of aspen fiber in a chemical pulp are a fiber length in the range of 1.0 to 1.3 mm, fiber width in the range of 18 to 19 μm and fiber wall thickness in the range of 2.0 to 3.0 μm . By producing bleached chemithermomechanical pulp made of aspen, the characteristic of aspen may be used to improve release liner support layer papers. Bleached chemithermomechanical pulp made of aspen is quick to refine, such that the average fiber length is reduced, and a dense, smooth paper, may be produced. However, the strength compared to pulp made of longer fibers, such as birch pulp, is less. The easy reduction of the cellulose fiber length by refining may also lead to difficulties in the paper manufacturing, as described above. Due to the fiber behavior in refining, the cellulose fiber length distribution of bleached chemithermomechanical pulp made of aspen comprises a large amount of fine particles, such as cellulose fibers having a fiber length less than the original fiber length of aspen. The increase of fine particles has been noticed to reduce the retention capability of fine particles on the forming section of the paper machine, such that the paper manufacturing process is difficult to control. Furthermore, the manufactured paper has reduced quality.

[0100] Tables 5 and 6 below are examples of characteristic values of bleached chemithermomechanical pulp made of aspen and spruce, refined to different freeness levels. The parameters in the tables refer to values obtained by Metso Fiber Image Analyzer (Metso FS5), using defined standards. The average length $L_c(l)$ (mm) refers to length weighted average length in millimeters of cellulose fibers in a sample. The fiber mass per length (mg/m) refers to mass of fiber per length unit in a sample in milligrams per meter. The kink of the sample is given as an inverse of length (1/m). The fiber content refers to the percentage of fibers in a given length range in a sample; for example "fiber content 0-0.2 mm" refers to number weighted average amount of fibers having a measured length less than 0.2 millimeters in a sample, and "fiber content 0.2-0.6 mm" refers to number weighted average amount of fibers having a measured length equal to or higher than 0.2 millimeters and less than 0.6 millimeters in a sample. The fiber content 0-0.2 mm" is equal to the amount of fine particles in a sample. The series of samples S10, S11, S12 and S13 represent bleached chemithermo-

EP 3 059 344 A1

mechanical pulp made of aspen and spruce, refined to Canadian standard freeness (CSF) 330 ml, 270 ml, 240 ml and 189 ml, respectively. The series of samples S20, S21, S22 and S23 represent bleached chemithermomechanical pulp made of aspen and spruce, refined to Canadian standard freeness 140 ml, 127 ml, 108 ml and 91 ml, respectively. The Canadian Standard Freeness value of 90 ml is approximately equal to a Schopper-Riegler value of 70.

5

Table 5. Characterization of bleached chemithermomechanical pulp sample series S10-S13 comprising samples S10, S11, S12 and S13 made of aspen and spruce, refined to a Canadian standard freeness in the range of 330-189ml.

10

15

20

25

30

35

Parameter	Unit	S10	S11	S12	S13
CSF	ml	330	270	240	189
Lc(l)	mm	0.88	0.87	0.84	0.82
Fiber mass/length	mg/m	0.133	0.134	0.132	0.132
Kink	1/m	413	392	403	407
Fiber content 0-0.2 mm	%	14.6	15.3	15.8	16.4
Fiber content 0.2-0.6 mm	%	22.0	22.0	24.1	24.7
Fiber content 0.6-1.2 mm	%	48.7	49.4	47.9	48.7
Fiber content 1.2-2.0 mm	%	12.6	11.8	10.8	9.3
Fiber content 2.0-3.2 mm	%	2.0	1.6	1.4	0.9
Fiber content 3.2-7.6 mm	%	0.2	0.0	0.0	0.0
Fibrillation	%	1.74	1.82	1.89	1.98
Dry weight	mg	2.26	2.31	2.10	2.19
Particle amount	pcs	230880	257652	255838	285862
Fiber amount	pcs	28339	30768	29102	32047
Flakes	%	27.9	29.0	30.4	31.2
Fibrils	%	18.6	17.8	18.7	18.8

40

Table 6. Characterization of bleached chemithermomechanical pulp sample series S20-S23 comprising samples S20, S21, S22 and S23 made of aspen and spruce, refined to a Canadian standard freeness in the range of 140-91 ml.

45

50

55

Parameter	Unit	S20	S21	S22	S23
CSF	ml	140	127	108	91
Lc(l)	mm	0.84	0.82	0.80	0.78
Fiber mass/length	mg/m	0.115	0.119	0.117	0.119
Kink	1/m	419	443	444	452
Fiber content 0-0.2 mm	%	17.9	18.7	19.1	18.5
Fiber content 0.2-0.6 mm	%	24.6	25.8	27.5	27.7
Fiber content 0.6-1.2 mm	%	45.5	44.3	44.0	43.8

(continued)

Parameter	Unit	S20	S21	S22	S23
Fiber content 1.2-2.0 mm	%	10.1	9.6	8.6	9.6
Fiber content 2.0-3.2 mm	%	1.7	1.5	0.8	0.5
Fiber content 3.2-7.6 mm	%	0.2	0.1	0.1	0.0
Fibrillation	%	2.24	2.29	2.34	2.40
Dry weight	mg	1.77	1.82	1.59	1.76
Particle amount	pcs	346736	361769	340946	371720
Fiber amount	pcs	32695	33893	31023	33868
Flakes	%	35.5	36.4	37.3	36.6
Fibrils	%	31.7	30.7	31.7	31.6

[0101] In Figure 2a, the number weighted average amount of fine particles, i.e. the cellulose fiber content in the range of 0 to 0.2 mm fiber length, in bleached chemithermomechanical pulp made of aspen was 21%. From Tables 5 and 6 it may be observed, that in the sample series S10-S13 and S20-S23 made of aspen and spruce, the number weighted average amount of fine particles in bleached chemithermomechanical pulp is less than 20 %, in the range of 14.6 to 19.1 %. Therefore, the number weighted average amount of fine particles in bleached chemithermomechanical pulp made of hardwood and softwood is less than the number weighted average amount of fine particles in bleached chemithermomechanical pulp made of hardwood only. Similarly, in the sample series S10-S13 and S20-S23 made of aspen and spruce, the number weighted average amount of fine particles in bleached chemithermomechanical pulp is higher than 14 %. Therefore, the number weighted average amount of fine particles in bleached chemithermomechanical pulp made of hardwood and softwood is less than the number weighted average amount of fine particles in bleached chemical pulp made of hardwood only. In Figure 2b, the number weighted average amount of fine particles in bleached chemical pulp made of aspen was 14%. Therefore, by varying the amount of softwood in the bleached chemithermomechanical pulp, the composition may be used to optimize the process conditions of a paper manufacturing process, where said bleached chemithermomechanical pulp is used. In particular, the amount of cellulose fibers in a specific volume of the paper may be increased by the composition of the bleached chemithermomechanical pulp. As can be observed from the results of the sample series S10-S13 and S20-S23, the amount of fine particles and particle amounts is proportional to the extent of refining. By refining more, the amount of amount of fine particles increases.

[0102] The manufacturing method has a role in determining the properties of the bleached chemithermomechanical pulp. The characteristics and compatibility of the bleached chemithermomechanical pulp for use in a paper for a release liner may be, at least to some extent, be determined by the way of manufacturing the bleached chemithermomechanical pulp. To provide advantageous effects, the bleached chemithermomechanical pulp preferably is chemically compatible with the paper manufacturing process. In addition to cellulose fibers having a short average fiber length, the fine particles may comprise other compounds, which originate from the wood species used in manufacturing the bleached chemithermomechanical pulp. The wood material of aspen, for example, may comprise compounds which promote foaming in amounts, which when accumulating in the short circulation of the paper machine, may lead to foaming of the pulp suspension.

[0103] By modifying the composition of the bleached chemithermomechanical pulp used in paper manufacturing to comprise both hardwood and softwood, the drawbacks noticed in the paper manufacturing process when using bleached chemithermomechanical pulp made of aspen could be overcome. It is contemplated, that the composition of spruce pulp comprises compounds, such as coniferous resins, which appear to facilitate the manufacturing process of chemithermomechanical pulp, in particular the washing of the chemithermomechanical pulp. Measured pH of aqueous extracts from bleached chemithermomechanical pulp have indicated that chemithermomechanical pulp comprising both aspen and spruce may have a higher pH value than chemithermomechanical pulp comprising only aspen. Furthermore, the presence of spruce has been noticed to act as a protective component in the refining. Therefore, a softwood component may be arranged to protect the hardwood component of chemithermomechanical pulp or bleached chemithermomechanical pulp during mechanical refining. When refined bleached chemithermomechanical pulp comprising both aspen and spruce was compared to similarly refined bleached chemithermomechanical pulp comprising only aspen, the mixture

of both aspen and spruce was noticed to refine less. The manufacturing process of bleached chemithermomechanical pulp may also be improved by adjusting the pH and extent of refining, such that bleached chemithermomechanical pulp having a desired water absorptiveness and fiber length distribution is obtained. After refining the bleached chemithermomechanical pulp may have for example,

- a Canadian Standard Freeness value of equal to or more than of 90 ml, such as in the range of 90 to 500 ml and the pH of aqueous extracts equal to or above pH 7.0, or
- a Canadian Standard Freeness value equal to or more than 130 ml, such as in the range of 130 to 425 ml and the pH of aqueous extracts equal to or above pH 7.1, or
- a Canadian Standard Freeness value equal to or more than 325 ml, such as in the range of 325 to 435 ml and the pH of aqueous extracts equal to or above pH 7.3.

[0104] Chemithermomechanical pulp may be manufactured by a hybrid process wherein wood chips are first pretreated with chemicals, heated for a short period and subsequently refined by mechanical means. When the wood chips are pretreated in a higher pH, preferably by impregnating the wood chips with chemicals, the internal bonding of the cellulose fibers may be reduced, such that the specific volume of the formed chemithermomechanical pulp may be increased. The pH during the chemical impregnation treatment is typically an alkaline treatment, wherein the chemical solution raises the pH environment experienced by the wood chips to above pH level 7. The pH environment experienced by the wood chips may be, for example in the range of pH 7 to 11, advantageously in the range of pH 7 to 9. By increasing the pH of the chemical impregnation treatment, the duration of the chemical impregnation treatment and the duration of the subsequent heating, preferably by steam, the bulkiness of the formed chemithermomechanical pulp may be increased such that less amount of refining may be required for providing the desired water absorptiveness and fiber length distribution. When less amount of refining is used in producing bleached chemithermomechanical pulp, the amount of short fibers, such as fine particles, in the bleached chemithermomechanical pulp may be increased, which in a pulp suspension are suitable for increasing the specific volume of a paper web formed from the pulp suspension, while providing means to reduce the grammage of a paper formed from the paper web. By increasing the pH of the chemical impregnation treatment, the foaming tendency of the formed bleached chemithermomechanical pulp may also be reduced, such that the runnability of a further manufacturing process of paper comprising bleached chemithermomechanical pulp may be improved.

[0105] The effect of manufacturing method of the bleached chemithermomechanical pulp to the average fiber length and water absorptiveness may be observed, for example, by comparing samples S10, S12 and S20 from tables 5 and 6. Samples S10 and S20 are bleached chemithermomechanical pulp manufactured according to an embodiment of the invention and refined to initial Canadian standard freeness levels of 330 ml and 140 ml, respectively. Sample S12 has been obtained by further refining sample S10 from Canadian standard freeness level of 330 ml to Canadian standard freeness level of 240 ml. Sample S12 and sample S20 both have the same average fiber length of 0.84mm. The fiber content in the range of 0-0.2mm denoting the amount of fine particles in sample S20 is 17.9%, whereas the fiber content in the range of 0-0.2mm denoting the amount of fine particles in sample S12 is 15.8%. Therefore, by adjusting the manufacturing process conditions, bleached chemithermomechanical pulp having a desired water absorptiveness and fiber length distribution may be obtained.

[0106] When manufacturing low weight high quality paper suitable for use as a support layer of a release liner, bleached chemithermomechanical pulp made of aspen and spruce has been unexpectedly noticed to be particularly advantageous for the manufacturing process and the paper quality. Spruce is a coniferous wood, of which a typical example is *Picea abies*. Coniferous woods from genus *Picea*, *Abies*, *Larix* or *Pinus* are softwoods, which have a long cellulose fiber length compared to aspen. The cellulose fibers of spruce are thin walled and collapse to thin bands upon drying. The chemical composition of pulp made of spruce is easy to bleach. Typical fiber length of spruce in a chemical pulp is in the range of 2.2 to 2.5 mm. The chemical characteristics of spruce is well suited for manufacturing glassine paper and other papers for release liner. In particular, it has been observed, that when bleached chemithermomechanical pulp comprising both aspen and spruce has been refined to a Canadian Standard Freeness value equal to or above 130, and the measured pH level of aqueous extracts from the bleached chemithermomechanical pulp has been equal to or higher than pH 7.0, such as equal to or higher than pH 7.1, the bleached chemithermomechanical pulp has been particularly suitable for the manufacturing process to overcome problems related to roughness, water absorptiveness and retention levels. Furthermore, it has been observed, that when bleached chemithermomechanical pulp comprising both aspen and spruce has been refined to a Canadian Standard Freeness value equal to or above 325, and the measured pH level of aqueous extracts from the bleached chemithermomechanical pulp has been equal to or higher than pH 7.3, such as equal to or higher than pH 7.5, the bleached chemithermomechanical pulp has been particularly suitable for the manufacturing process to overcome problems related to roughness, water absorptiveness and retention levels. The pH level of aqueous extracts from the bleached chemithermomechanical pulp has been measured after washing and bleaching of the chemithermomechanical pulp. A bleached chemithermomechanical pulp is typically manufactured into a dry product, such as

into a sheet or bale. The pH of aqueous extracts may be measured from a manufactured bleached chemithermomechanical pulp product according to the standard DIN 53124 (ISO 6588-1 or ISO 6588-2), as described above.

[0107] When measuring the pH of aqueous extracts from a dry bleached chemithermomechanical pulp, a modified version of the standard ISO 6588-2 may be used. An amount of 2 grams of pulp sample is cut into pieces, such that each piece has a maximum dimension of 1 centimeter. The cut pieces of pulp sample are mixed with 100 millilitres of deionised water to disperse the pulp with the water such that a dispersed pulp sample having a pulp concentration of 2 wt.-% of water is obtained. The dispersed pulp sample is heated to a boiling point and boiled for 60 minutes. After boiling, the dispersed pulp sample is cooled down, such that the temperature of the pulp sample is in the range of 20 to 25°C, and the pulp sample is filtrated through a filter having a 200 mesh grid, for example by means of a Buchner-funnel, thereby obtaining a filtrate separated from the bleached chemithermomechanical pulp. The pH is measured from the filtrate thus obtained. The pH may be measured from the filtrate by means of a pH meter, using two buffer solutions having pH4 and pH7, respectively. Suitable pH meters are, for example, pH-meter CG 840 with electrode N 1042A, Knick pH-meter 766 Calimatic with electrode SE 103 or Mettler-Toledo MP 120, used according to the manufacturer's instructions.

[0108] When measuring the pH of aqueous extracts from bleached chemithermomechanical pulp suspension sample having a pulp concentration less than 5 wt.-%, a modified version of the standard ISO 6588-1 may be used, wherein the pH of aqueous extracts is measured directly from such sample having a volume of at least 25 ml. When measuring the pH of aqueous extracts from bleached chemithermomechanical pulp suspension sample having a pulp concentration equal to or higher than 5 wt.-%, a modified version of the standard ISO 6588-1 may be used, wherein a sample having a volume of at least 25 ml is filtrated through a filter having a 200 mesh grid, for example by means of a Büchner-funnel, and the pH of aqueous extracts is measured from the thus obtained filtrate. Advantageously, in both methods for pulp suspension samples, the pH of aqueous extracts from a bleached chemithermomechanical pulp suspension sample is measured after disintegrating the sample by heating to a boiling point and boiling the sample for 60 minutes, and cooling the sample down to a temperature in the range of 20 to 25°C, before performing the pH measurement.

[0109] Below, are given variations by way of examples for manufacturing bleached chemithermomechanical pulp BCTMP11, BCTMP12, BCTMP13, BCTMP14 having a desired water absorptiveness and fiber length distribution. The bleached chemithermomechanical pulp BCTMP11, BCTMP12, BCTMP13, BCTMP14 may be further used in manufacturing of a release liner support layer PAP1 comprising bleached chemithermomechanical pulp BCTMP, as shown in Figure 1 b. The bleached chemithermomechanical pulp BCTMP refers to bleached chemithermomechanical pulp manufactured according to any of the variations presented in Figures 5, 6, 7 or 8 below. The bleached chemithermomechanical pulp BCTMP11, BCTMP12, BCTMP13, BCTMP14 may be used, for example, in manufacturing of a glassine paper or a baking paper, such that the glassine paper or the baking paper comprises bleached chemithermomechanical pulp BCTMP. The bleached chemithermomechanical pulp BCTMP11, BCTMP12, BCTMP13, BCTMP14 may be used for example, in manufacturing of a release liner support layer.

[0110] In the figures 5 to 8, variations are presented of a method for manufacturing bleached chemithermomechanical pulp BCTMP11, BCTMP12, BCTMP13, BCTMP14 comprising cellulose fibres from hardwood HW1 and softwood SW1. The method may comprise:

- producing wood chips by debarking and chipping,
- impregnating the wood chips with a chemical solution CH1, thereby producing impregnated wood chips,
- heating the impregnated wood chips by steam, thereby producing heated and impregnated wood chips,
- refining the heated and impregnated wood chips, thereby forming chemithermomechanical pulp CTMP11, CTMP12, CTMP1, CTMP2,
- washing the chemithermomechanical pulp, and
- bleaching the chemithermomechanical pulp to form bleached chemithermomechanical pulp BCTMP11, BCTMP12, BCTMP13, BCTMP14,

wherein the amount of softwood SW1 in the bleached chemithermomechanical pulp is equal to or less than 50 wt.-% of the weight of the bleached chemithermomechanical pulp, such that the formed bleached chemithermomechanical pulp BCTMP11, BCTMP12, BCTMP13, BCTMP14 has a Canadian Standard Freeness value in the range of 90 to 500 ml, and a pH of aqueous extracts measured from the formed bleached chemithermomechanical pulp above pH 7.

[0111] The variations differ from each other in the order of the step, where the mixing of the hardwood component and the softwood component is performed. The method above may further comprise

- mixing the wood chips prior to impregnating the wood chips, thereby forming a wood chip mixture MIX11 comprising hardwood HW1 and softwood SW1, as presented in Figure 5, or
- mixing the impregnated wood chips prior to heating the impregnated wood chips, thereby forming an impregnated wood chip mixture MIX12 comprising hardwood HW1 and softwood SW1, as presented in Figure 6, or

- mixing chemithermomechanical pulp CTMP1 comprising hardwood HW1 and chemithermomechanical pulp CTMP2 comprising softwood SW1, thereby forming a chemithermomechanical pulp mixture MIX13 comprising hardwood HW1 and softwood SW1, as presented in Figure 7, or
- mixing bleached chemithermomechanical pulp BCTMP1 comprising hardwood HW1 and bleached chemithermomechanical pulp BCTMP2 comprising softwood SW1, thereby forming bleached chemithermomechanical pulp BCTMP14 comprising hardwood HW1 and softwood SW1, as presented in Figure 8.

[0112] Figure 5 shows, by way of an example a method for manufacturing bleached chemithermomechanical pulp comprising hardwood and softwood. The amount of softwood SW1 in the bleached chemithermomechanical pulp may be equal to or less than 50 wt.-%, such as in the range of 1 to 50 wt.-%. Preferably, the amount of softwood SW1 in the bleached chemithermomechanical pulp BCTMP11 may be equal to or more than 5 wt.-%, such as equal to or more than 10 wt.-%, preferably equal to or more than 25 wt.-%, most preferably equal to or more than 35 wt.-%. The amount of softwood SW1 in the bleached chemithermomechanical pulp may be, for example in the range of 5 to 45 wt.-%, or in the range of 10 to 35 wt.-%. In the method, wood chips from hardwood HW1 and softwood SW1 may be produced by debarking and chipping wood. The debarked and chipped hardwood HW1 and softwood SW1 may be mixed 21 in a mixer, thereby forming a wood chip mixture MIX11 comprising the debarked and chipped hardwood HW1 and softwood SW1. The mixing of the wood chips may be done prior to adding a chemical solution CH1 on the wood chips. A chemical solution CH1 may be applied 20 on the wood chips, for example in the mixer. Preferably, impregnation of the chemical solution CH1 is used to improve the absorption of the chemicals into the wood chips, such that a more homogenous absorption profile of the chemicals inside the wood chips may be obtained. The even distribution of the chemicals into the wood chips reduces the amount of non-fibrillated material in the chemithermomechanical pulp, such as small splinters of wood chips. An example of chemical used in the chemical solution is sodium sulphite. The chemical solution CH1 may comprise sodium sulphite for example in the range of 2% to 5% by weight. The impregnation of the wood chips may be used to control the extent of the defibrillation of the cellulose fibers, such that the ratio of bulk to tensile strength may be adjusted. The chemical solution may have an alkaline pH value, such as a pH equal to or higher than pH 7, preferably equal to or higher than pH 7.5. When the amount of softwood SW1 in the wood chip mixture MIX11 is increased, a chemical solution CH1 having a higher pH value may be used. The impregnated wood chips are subsequently treated 23 by thermomechanical means. The treatment 23 comprises heating of the impregnated wood chips by steam. The temperature and duration of the heating step may be varied. For example, the impregnated wood chips may be heated for at least 2 minutes at a temperature in the range of 120 to 130°C, or even higher such as up to 150°C. The heating time may be longer, for example in the range of 2 to 5 minutes, or longer, in order to allow the chemical solution to soften the wood chips such that the defibrillation of the cellulose fibers by refining is improved. After heating, the softened fibers are separated from each other by mechanical means. The separation process may comprise, for example refiners, wherein the average fiber length of the material is also reduced. After refining, the formed chemithermomechanical pulp CTMP11 may be washed. Washing of the chemithermomechanical pulp with water, removes aqueous extracts from the material. Washing also helps to remove the compounds of the chemical solution CH1 used in impregnating the wood chips. The formed chemithermomechanical pulp CTMP11 may be bleached 24, for example by using hydrogen peroxide and sodium hydroxide, to form bleached chemithermomechanical pulp. The formed bleached chemithermomechanical pulp BCTMP11 advantageously has a Canadian Standard Freeness value in the range of 90 to 350 ml, preferably in the range of 130 to 330 ml, and a pH of aqueous extracts measured from the formed bleached chemithermomechanical pulp BCTMP11 above pH 7.0, preferably above pH 7.2 such as in the range of pH 7.0 to 9.0, preferably in the range of pH 7.4 to 8.0. Therefore, for the purpose of release liner manufacturing it is advantageous, that the temperature and duration of the thermomechanical treatment 23 are configured such that the amount of refining needed after the thermomechanical treatment 23 is as small as possible, such that the formed bleached chemithermomechanical pulp BCTMP11 has a Canadian Standard Freeness value equal to or more than 90 ml, preferably equal to or more than 180 ml, such as in the range of 90 to 500 ml and the pH of aqueous extracts equal to or above pH 7.0, such as in the range of pH 7.0 to 9.0. Preferably the formed bleached chemithermomechanical pulp BCTMP11 has a Canadian Standard Freeness value equal to or more than 130 ml, such as in the range of 130 to 425 ml and the pH of aqueous extracts equal to or above pH 7.1, such as in the range of pH 7.1 to 8.9. Most preferably the formed bleached chemithermomechanical pulp BCTMP11 has a Canadian Standard Freeness value equal to or more than 325 ml, such as in the range of 325 to 435 ml and the pH of aqueous extracts equal to or above pH 7.3, in the range of pH 7.3 to 8.8.

[0113] Figure 6 shows, by way of an example a variation of the method described above, for manufacturing bleached chemithermomechanical pulp comprising hardwood and softwood. In the method, bleached chemithermomechanical pulp BCTMP12 comprising cellulose fibers from hardwood HW1 and softwood SW1 may be manufactured such that the wood chips are impregnated 30a, 30b with the chemical solution CH1 prior to forming an impregnated wood chip mixture MIX12, such that the composition and amount of the chemical solution CH1 may be separately applied to the cellulose fibers from hardwood HW1 and softwood SW1. This enables a different chemical treatment to be applied to each wood type, which may be used in optimizing the composition of the bleached chemithermomechanical pulp BCTMP12. After

applying the chemical solution CH1, the wood chips are mixed 31, and subjected to a thermomechanical treatment 32 as described above, such that chemithermomechanical pulp CTMP12 is obtained. By bleaching 33 the chemithermomechanical pulp CTMP12, bleached chemithermomechanical pulp BCTMP12 may be obtained, which has a Canadian Standard Freeness value equal to or more than 90 ml, preferably equal to or more than 180 ml, such as in the range of 90 to 500 ml and the pH of aqueous extracts equal to or above pH 7.0, such as in the range of pH 7.0 to 9.0. Preferably the formed bleached chemithermomechanical pulp BCTMP12 has a Canadian Standard Freeness value equal to or more than 130 ml, such as in the range of 130 to 425 ml and the pH of aqueous extracts equal to or above pH 7.1, such as in the range of pH 7.1 to 8.9. Most preferably the formed bleached chemithermomechanical pulp BCTMP12 has a Canadian Standard Freeness value equal to or more than 325 ml, such as in the range of 325 to 435 ml and the pH of aqueous extracts equal to or above pH 7.3, in the range of pH 7.3 to 8.8.

[0114] Figure 7 shows, by way of an example a variation of the method described above, for manufacturing bleached chemithermomechanical pulp comprising hardwood and softwood. In the method, bleached chemithermomechanical pulp BCTMP12 comprising cellulose fibers from hardwood HW1 and softwood SW1 may be manufactured such that the wood chips are impregnated 40a, 40b with the chemical solution CH1 separately, as in Figure 6. After applying the chemical solution CH1, the wood chips are subjected to separate thermomechanical treatments 41 a, 41 b, such that chemithermomechanical pulp CTMP1 made of hardwood HW1 and chemithermomechanical pulp CTMP2 made of softwood SW1 is obtained, wherein the different chemical 40a, 40b and thermomechanical 41a, 41b treatments may be used in optimizing the composition of the bleached chemithermomechanical pulp BCTMP12. By mixing 42 chemithermomechanical pulp CTMP1 comprising hardwood HW1 and chemithermomechanical pulp CTMP2 comprising softwood SW1, a chemithermomechanical pulp mixture MIX13 comprising hardwood HW1 and softwood SW1 may be formed. By bleaching 43 the chemithermomechanical pulp mixture MIX13, bleached chemithermomechanical pulp BCTMP13 may be obtained, which has a Canadian Standard Freeness value equal to or more than 90 ml, preferably equal to or more than 180 ml, such as in the range of 90 to 500 ml and the pH of aqueous extracts equal to or above pH 7.0, such as in the range of pH 7.0 to 9.0. Preferably the formed bleached chemithermomechanical pulp BCTMP13 has a Canadian Standard Freeness value equal to or more than 130 ml, such as in the range of 130 to 425 ml and the pH of aqueous extracts equal to or above pH 7.1, such as in the range of pH 7.1 to 8.9. Most preferably the formed bleached chemithermomechanical pulp BCTMP13 has a Canadian Standard Freeness value equal to or more than 325 ml, such as in the range of 325 to 435 ml and the pH of aqueous extracts equal to or above pH 7.3, in the range of pH 7.3 to 8.8.

[0115] Figure 8 shows, by way of an example a variation of the method described above, for manufacturing bleached chemithermomechanical pulp comprising hardwood and softwood. In the method, bleached chemithermomechanical pulp BCTMP14 comprising cellulose fibers from hardwood HW1 and softwood SW1 may be manufactured such that the wood chips are impregnated 50a, 50b with the chemical solution CH1 separately, as in Figure 6. After applying the chemical solution CH1, the wood chips are subjected to separate thermomechanical treatments 51 a, 51 b, such that chemithermomechanical pulp CTMP1 made of hardwood HW1 and chemithermomechanical pulp CTMP2 made of softwood SW1 is obtained. By bleaching 52a, 52b the chemithermomechanical pulp CTMP1 made of hardwood HW1 and chemithermomechanical pulp CTMP2 made of softwood SW1 separately, bleached chemithermomechanical pulp comprising hardwood BCTMP1 and bleached chemithermomechanical pulp comprising softwood BCTMP2 may be obtained separately, wherein the different chemical 50a, 50b, thermomechanical 51 a, 51 b and bleaching 52a, 52b treatments may be used in optimizing the composition of the bleached chemithermomechanical pulps BCTMP1, BCTMP2. The bleached chemithermomechanical pulps may further be mixed 53, thereby forming bleached chemithermomechanical pulp BCTMP14 comprising hardwood HW1 and softwood SW1, and which bleached chemithermomechanical pulp BCTMP14 has a Canadian Standard Freeness value equal to or more than 90 ml, preferably equal to or more than 180 ml, such as in the range of 90 to 500 ml and the pH of aqueous extracts equal to or above pH 7.0, such as in the range of pH 7.0 to 9.0. Preferably the formed bleached chemithermomechanical pulp BCTMP14 has a Canadian Standard Freeness value equal to or more than 130 ml, such as in the range of 130 to 425 ml and the pH of aqueous extracts equal to or above pH 7.1, such as in the range of pH 7.1 to 8.9. Most preferably the formed bleached chemithermomechanical pulp BCTMP14 has a Canadian Standard Freeness value equal to or more than 325 ml, such as in the range of 325 to 435 ml and the pH of aqueous extracts equal to or above pH 7.3, in the range of pH 7.3 to 8.8.

[0116] For the purpose of release liner manufacturing it is advantageous, that the temperature and duration of the thermomechanical treatment 23, 32, 41 a, 41 b, 51 a, 51 b is configured such that the amount of refining needed after the thermomechanical treatment is reduced, such that the formed bleached chemithermomechanical pulp BCTMP11, BCTMP12, BCTMP13, BCTMP14 has a Canadian Standard Freeness value equal to or higher than 90, preferably equal to or higher than 130 ml, most preferably equal to or higher than 325 ml and pH value of aqueous extracts equal to or higher than 7.0, preferably equal to or higher than 7.2, most preferably equal to or higher than 7.3. The methods described above enable forming bleached chemithermomechanical pulp BCTMP11, BCTMP12, BCTMP13, BCTMP14, wherein the bulk of the bleached chemithermomechanical pulp is advantageously equal to or higher than 1.8 cm³/g, preferably at least 2.0 cm³/g, such as in the range of 1.8 to 3.2 cm³/g. The methods described above further enable forming bleached chemithermomechanical pulp BCTMP11, BCTMP12, BCTMP13, BCTMP14, wherein the brightness of the bleached

chemithermomechanical pulp may be equal to or higher than 60%, preferably equal to or higher than 80%, most preferably equal to or higher than 85%, such as in the range of 60 to 85% .

[0117] The invention has been described with the aid of illustrations and examples. The methods or any product obtained by the methods are not limited solely to the above presented embodiments, but may be modified within the scope of the appended claims.

[0118] Numbered examples 1.1 to 1.22:

1.1. A paper (PAP1) suitable for use as a layer of a release liner (REL1), the paper having a grammage equal to or higher than 30 grams per square meter and a transparency level of equal to or higher than 28%, the paper comprising cellulose fibers from

- bleached chemical pulp and
- bleached chemithermomechanical pulp (BCTMP) made of hardwood (HW1) and softwood (SW1),

wherein the amount of cellulose fibers in a specific volume of the paper is increased by the bleached chemithermo-mechanical pulp such that the density of the paper is equal to or less than 1200 kg/m³ and the ratio of grammage to thickness of the paper in micrometres is equal to or higher than 1.0.

1.2. A method for manufacturing paper (PAP1) suitable for use as a layer of a release liner (REL1), the method comprising:

- forming a pulp mixture (MIX1) comprising cellulose fibers by mixing
 - bleached chemical pulp and
 - bleached chemithermomechanical pulp (BCTMP) made of hardwood (HW1) and softwood (SW1),
- forming a paper web (WEB1) from the pulp mixture (MIX1),
- reducing moisture content of the paper web in a press section, and drying the paper web in a drying section, thereby forming paper (PAP1) having a grammage equal to or higher than 30 grams per square meter and a transparency level of equal to or higher than 28%, wherein the amount of cellulose fibers in a specific volume of the paper is increased by the bleached chemithermomechanical pulp such that the bulk of the paper is equal to or less than 1200 kg/m³ and the ratio of grammage to thickness of the paper in micrometres is equal to or higher than 1.0.

1.3. The method according to numbered example 1.2, further comprising refining the pulp mixture (MIX1), such that after refining the pulp mixture (MIX1) has

- a Schopper-Riegler value equal to or less than 70, preferably equal to or less than 50, such as in the range of 25 to 55, preferably in the range of 30 to 50, or
- a Canadian Standard Freeness value of equal to or more than 90 ml, preferably equal to or more than 180 ml, such as in the range of 180 to 500 ml, preferably in the range of 215 to 425 ml.

1.4. The method according to numbered example 1.2 or 1.3, further comprising refining the bleached chemical pulp and/or the bleached chemithermomechanical pulp (BCTMP) prior to forming the pulp mixture (MIX1) such that after refining the bleached chemical pulp and/or the bleached chemithermomechanical pulp (BCTMP) has

- a Canadian Standard Freeness value of equal to or more than of 90 ml, such as in the range of 90 to 500 ml and the pH of aqueous extracts equal to or above pH 7.0, or
- a Canadian Standard Freeness value equal to or more than 130 ml, such as in the range of 130 to 425 ml and the pH of aqueous extracts equal to or above pH 7.1, or
- a Canadian Standard Freeness value equal to or more than 325 ml, such as in the range of 325 to 435 ml and the pH of aqueous extracts equal to or above pH 7.3.

1.5. The method according to numbered example 1.2, 1.3 or 1.4, further comprising calendering the paper after drying, thereby forming the paper (PAP1).

1.6. The paper (PAP1) according to numbered example 1.1 or the method according to any of the numbered examples 1.2 to 1.5, wherein the layer is a support layer or a substrate layer of the release liner.

1.7. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein the bleached chemical pulp comprises hardwood pulp (PULP1), such as bleached pulp from a Kraft process.

5 1.8. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein the bleached chemical pulp comprises both hardwood pulp (PULP1) and softwood pulp (PULP2), such as bleached pulp from a Kraft process.

10 1.9. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein the amount of cellulose fibers from bleached chemithermomechanical pulp in the paper is equal to or less than 50 wt.-% of the weight of the paper, such as in the range of 1 to 50 wt.-%, preferably in the range of 5 to 45 wt.-%, most preferably in the range of 10 to 35 wt.-%.

15 1.10. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein the grammage of the paper is equal to or less than 120 g/m², preferably equal to or less than 80 g/m², most preferably equal to or less than 70 g/m², such as in the range of 30 to 120 g/m², preferably in the range of 35 to 80 g/m², most preferably in the range of 50 to 70 g/m².

20 1.11. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein the density of the paper is less than 1200 kg/m³, preferably in the range of 1000 to 1200 kg/m³, most preferably in the range of 1050 to 1150 kg/m³.

25 1.12. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein the thickness of the paper is equal to or less than 100 micrometres, such as in the range of 35 to 95 micrometres, preferably in the range of 40 to 68 micrometres, most preferably in the range of 45 to 60 micrometres.

1.13. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein

- 30
- the paper has a transparency level of equal to or higher than 28%, preferably equal to or higher than 33%, such as in the range of 28% to 85%, when the grammage of the paper is equal to or higher than 70 grams per square meter, or
 - the paper has a transparency level equal to or higher than 40%, preferably equal to or higher than 60%, such as in the range of 40% to 85%, when the grammage of the paper is less than 70 grams per square meter.

35 1.14. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein the amount of softwood (SW1) in the bleached chemithermomechanical pulp (BCTMP) is in the range of 1 to 50 wt.-%, preferably in the range of 5 to 45 wt.-%, most preferably in the range of 10 to 35 wt.-% of the weight of the bleached chemithermomechanical pulp.

40 1.15. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein the cellulose fibers from softwood (SW1) in the bleached chemithermomechanical pulp are from a coniferous tree, preferably from the genus Picea, Abies, Larix or Pinus.

45 1.16. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein the cellulose fibers from softwood (SW1) in the bleached chemithermomechanical pulp are from spruce, such as Picea abies.

1.17. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein the cellulose fibers from hardwood (HW1) in the bleached chemithermomechanical pulp are from aspen or eucalyptus, preferably from the genus Populus or Eucalyptus, such as Populus tremuloides, Populus tremula or Eucalyptus globulus.

50 1.18. The paper (PAP1) or the method according to any of the preceding numbered examples, wherein the paper (PAP1) is glassine paper.

55 1.19. A release liner substrate layer comprising a primer layer applied to a support layer, wherein the support layer is paper according to any of the numbered examples 1.1 or 1.6-1.18.

1.20. A release liner comprising a release coating and a primer layer applied to a support layer, wherein the support layer is paper according to any of the numbered examples 1.1 or 1.6-18.

1.21. Use of a paper (PAP1) according to any of the numbered examples 1.1 or 1.6-1.18 as a release liner support layer.

1.22. Use of a paper (PAP1) according to any of the numbered examples 1.1 or 1.6-1.18 in combination with a release coating.

[0119] Numbered examples 2.1 to 2.18:

2.1. A method for manufacturing bleached chemithermomechanical pulp (BCTMP11, BCTMP12, BCTMP13, BCTMP14) comprising cellulose fibres from hardwood (HW1) and softwood (SW1), the method comprising:

- producing wood chips by debarking and chipping,
- impregnating the wood chips with a chemical solution (CH1), thereby producing impregnated wood chips,
- heating the impregnated wood chips by steam, thereby producing heated and impregnated wood chips,
- refining the heated and impregnated wood chips, thereby forming chemithermomechanical pulp (CTMP11, CTMP12, CTMP1, CTMP2),
- washing the chemithermomechanical pulp, and
- bleaching the chemithermomechanical pulp to form bleached chemithermomechanical pulp (BCTMP11, BCTMP12, BCTMP13, BCTMP14),

wherein the amount of softwood (SW1) in the bleached chemithermomechanical pulp is equal to or less than 50 wt.-% of the weight of the bleached chemithermomechanical pulp, such that the formed bleached chemithermomechanical pulp (BCTMP11, BCTMP12, BCTMP13, BCTMP14) has a Canadian Standard Freeness value in the range of 90 to 500 ml, and a pH of aqueous extracts measured from the formed bleached chemithermomechanical pulp above pH 7.0.

2.2. The method according to numbered example 2.1, further comprising

- mixing the wood chips prior to impregnating the wood chips, thereby forming a wood chip mixture (MIX11) comprising hardwood (HW1) and softwood (SW1), or
- mixing the impregnated wood chips prior to heating the impregnated wood chips, thereby forming an impregnated wood chip mixture (MIX12) comprising hardwood (HW1) and softwood (SW1), or
- mixing chemithermomechanical pulp (CTMP1) comprising hardwood (HW1) and chemithermomechanical pulp (CTMP2) comprising softwood (SW1), thereby forming a chemithermomechanical pulp mixture (MIX13) comprising hardwood (HW1) and softwood (SW1), or
- mixing bleached chemithermomechanical pulp (BCTMP1) comprising hardwood (HW1) and bleached chemithermomechanical pulp (BCTMP2) comprising softwood (SW1), thereby forming bleached chemithermomechanical pulp (BCTMP14) comprising hardwood (HW1) and softwood (SW1).

2.3. The method according to numbered example 2.1 or 2.2, wherein the amount of softwood in the bleached chemithermomechanical pulp (BCTMP11, BCTMP12, BCTMP13, BCTMP14) is in the range of 1 to 50 wt.-% of the weight of the bleached chemithermomechanical pulp, such as in the range of 5 to 45 wt.-%, preferably in the range of 10 to 35 wt.-%.

2.4. The method according to any of the previous numbered examples, the chemical solution (CH1) comprising sodium sulphite in the range of 2% to 5%

2.5. The method according to any of the previous numbered examples, the chemical solution having a pH equal to or higher than pH 7.

2.6. The method according to any of the previous numbered examples, comprising heating the impregnated wood chips by steam for at least 2 minutes at a temperature equal to or less than 150°C.

2.7. The method according to any of the previous numbered examples, wherein the chemithermomechanical pulp is bleached with a solution comprising hydrogen peroxide and sodium hydroxide.

2.8. The method according to any of the previous numbered examples, wherein pH of aqueous extracts measured from the formed bleached chemithermomechanical pulp (BCTMP11, BCTMP12, BCTMP13, BCTMP14) is in the

range of pH 7.0 to 9.0.

2.9. The method according to any of the previous numbered examples, wherein the chemithermomechanical pulp has

- a Canadian Standard Freeness value of equal to or more than of 90 to 500 ml and the pH of aqueous extracts equal to or above pH 7.0, preferably
- a Canadian Standard Freeness value equal to or more than 130 ml, such as in the range of 130 to 425 ml and the pH of aqueous extracts equal to or above pH 7.1, most preferably
- a Canadian Standard Freeness value equal to or more than 325 ml, such as in the range of 325 to 435 ml and the pH of aqueous extracts equal to or above pH 7.3.

2.10. The method according to any of the previous numbered examples, wherein the bulk of the bleached chemithermomechanical pulp (BCTMP11, BCTMP12, BCTMP13, BCTMP14) is equal to or higher than 1.8 cm³/g, preferably at least 2.0 cm³/g, such as in the range of 1.8 to 3.2 cm³/g.

2.11. The method according to any of the previous numbered examples, wherein the brightness of the bleached chemithermomechanical pulp (BCTMP11, BCTMP12, BCTMP13, BCTMP14) is equal to or higher than 60%, such as in the range of 60 to 80%.

2.12. The method according to any of the previous numbered examples, wherein the softwood belongs to the genus *Picea*, such as *Picea abies*.

2.13. The method according to any of the previous numbered examples, wherein the hardwood is from the genus *Populus*, such as *Populus tremuloides* or *Populus tremula*.

2.14. The method according to any of the previous numbered examples, wherein the hardwood is aspen and the softwood is spruce.

2.15. Use of bleached chemithermomechanical pulp (BCTMP11, BCTMP12, BCTMP13, BCTMP14) according to any of the numbered examples 2.1 to 2.14 in manufacturing of a release liner support layer.

2.16. Use of bleached chemithermomechanical pulp (BCTMP11, BCTMP12, BCTMP13, BCTMP14) according to any of the numbered examples B1 to B14 in manufacturing of a glassine paper or a baking paper.

2.17. Use of bleached chemithermomechanical pulp (BCTMP11, BCTMP12, BCTMP13, BCTMP14) according to any of the numbered examples 2.1 to 2.14 in a release liner support layer.

2.18. Use of bleached chemithermomechanical pulp (BCTMP11, BCTMP12, BCTMP13, BCTMP14) according to any of the numbered examples 2.1 to 2.14 in a glassine paper or a baking paper.

Claims

1. A paper (PAP1) suitable for use as a layer of a release liner, the paper having density equal to or less than 1200 kg/m³, the paper having a ratio of grammage to thickness of the paper in micrometres equal to or higher than 1.0, wherein the grammage refers to the weight of the paper (PAP1) in grams per square meter, the paper (PAP1) comprising cellulose fibres from

- bleached chemical pulp and
- bleached chemithermomechanical pulp (BCTMP),

wherein the bleached chemithermomechanical pulp comprises cellulose fibres from hardwood (HW1) and softwood (SW1).

2. A method for manufacturing paper (PAP1) suitable for use as a layer of a release liner, the method comprising:

- mixing

EP 3 059 344 A1

o bleached chemical pulp and
o bleached chemithermomechanical pulp (BCTMP) from hardwood (HW1) and softwood (SW1), thereby forming a pulp mixture (MIX1),

5 - forming a paper web (WEB1) from the pulp mixture (MIX1),
- reducing moisture content of the paper web (WEB1) in a press section, and
- drying the paper web (WEB1) in a drying section, thereby forming paper (PAP1) having a density equal to or less than 1200 kg/m³, a ratio of grammage to thickness of the paper in micrometres equal to or higher than 1.0, wherein the grammage refers to the weight of the paper (PAP1) in grams per square meter.

10 **3.** The method according to claim 2, further comprising refining the pulp mixture (MIX1), such that after refining, the pulp mixture (MIX1) has

15 - a Schopper-Riegler value equal to or less than 70, preferably equal to or less than 50, such as in the range of 25 to 55, preferably in the range of 30 to 50, or
- a Canadian Standard Freeness value of equal to or more than 90 ml, preferably equal to or more than 180 ml, such as in the range of 180 to 500 ml, preferably in the range of 215 to 425 ml.

20 **4.** The method according to claim 2 or 3, further comprising refining the bleached chemical pulp and/or the bleached chemithermomechanical pulp prior to forming the pulp mixture (MIX1) such that after refining, the bleached chemical pulp and/or the bleached chemithermomechanical pulp has

25 - a Canadian Standard Freeness value of equal to or more than of 90 ml, such as in the range of 90 to 500 ml, and the pH of aqueous extracts equal to or above pH 7.0, or
- a Canadian Standard Freeness value equal to or more than 130 ml, such as in the range of 130 to 425 ml, and the pH of aqueous extracts equal to or above pH 7.1, or
- a Canadian Standard Freeness value equal to or more than 325 ml, such as in the range of 325 to 435 ml, and the pH of aqueous extracts equal to or above pH 7.3.

30 **5.** The method according to claim 2, 3 or 4, further comprising calendering the paper (PAP1) after drying.

6. The paper (PAP1) according to claim 1 or the method according to any of the claims 2 to 5, wherein the layer is a support layer or a substrate layer of the release liner.

35 **7.** The paper (PAP1) or the method according to any of the preceding claims, wherein the bleached chemical pulp comprises hardwood pulp (PULP1), such as bleached pulp from a Kraft process.

8. The paper (PAP1) or the method according to any of the preceding claims, wherein the bleached chemical pulp comprises both hardwood pulp (PULP1) and softwood pulp (PULP2), such as bleached pulp from a Kraft process.

40 **9.** The paper (PAP1) or the method according to any of the preceding claims, wherein the amount of cellulose fibers from bleached chemithermomechanical pulp in the paper is equal to or less than 50 wt.-% of the weight of the paper, such as in the range of 1 to 50 wt.-%, preferably in the range of 5 to 45 wt.-%, most preferably in the range of 10 to 35 wt.-%.

45 **10.** The paper (PAP1) or the method according to any of the preceding claims, wherein the grammage of the paper is equal to or less than 120 g/m² preferably equal to or less than 80 g/m², most preferably equal to or less than 70 g/m², such as in the range of 30 to 120 g/m², preferably in the range of 35 to 80 g/m², most preferably in the range of 50 to 70 g/m².

50 **11.** The paper (PAP1) or the method according to any of the preceding claims, wherein the density of the paper is less than 1200 kg/m³, preferably in the range of 1000 to 1200 kg/m³, most preferably in the range of 1050 to 1150 kg/m³.

55 **12.** The paper (PAP1) or the method according to any of the preceding claims, wherein the thickness of the paper is equal to or less than 100 micrometres, such as in the range of 35 to 95 micrometres, preferably in the range of 40 to 68 micrometres, most preferably in the range of 45 to 60 micrometres.

13. The paper (PAP1) or the method according to any of the preceding claims, wherein

EP 3 059 344 A1

- the paper has a transparency level of equal to or higher than 28%, preferably equal to or higher than 33%, such as in the range of 28% to 85%, when the grammage of the paper is equal to or higher than 70 grams per square meter, or

- the paper has a transparency level equal to or higher than 40%, preferably equal to or higher than 60%, such as in the range of 40% to 85%, when the grammage of the paper is less than 70 grams per square meter.

5
10
14. The paper (PAP1) or the method according to any of the preceding claims, wherein the amount of softwood (SW1) in the bleached chemithermomechanical pulp (BCTMP) is in the range of 1 to 50 wt.-%, preferably in the range of 5 to 45 wt.-%, most preferably in the range of 10 to 35 wt.-% of the weight of the bleached chemithermomechanical pulp.

15
15. The paper (PAP1) or the method according to any of the preceding claims, wherein the cellulose fibers from softwood (SW1) in the bleached chemithermomechanical pulp are from a coniferous tree, preferably from the genus *Picea*, *Abies*, *Larix* or *Pinus*, most preferably from spruce, such as *Picea abies*.

16. The paper (PAP1) or the method according to any of the preceding claims, wherein the cellulose fibers from hardwood (HW1) in the bleached chemithermomechanical pulp are from aspen or eucalyptus, preferably from the genus *Populus* or *Eucalyptus*, such as *Populus tremuloides*, *Populus tremula* or *Eucalyptus globulus*.

20
17. The paper (PAP1) or the method according to any of the preceding claims, wherein the paper (PAP1) is glassine paper.

25
18. A release liner substrate layer comprising a primer layer applied to a support layer, wherein the support layer is paper (PAP1) according to any of the claims 1 or 6-17.

19. A release liner comprising a release coating and a primer layer applied to a support layer, wherein the support layer is paper (PAP1) according to any of the claims 1 or 6-17.

30
20. Use of a paper (PAP1) according to any of the claims 1 or 6-17 as a release liner support layer.

35
40
45
50
55
21. Use of a paper (PAP1) according to any of the claims 1 or 6-17 in combination with a release coating.

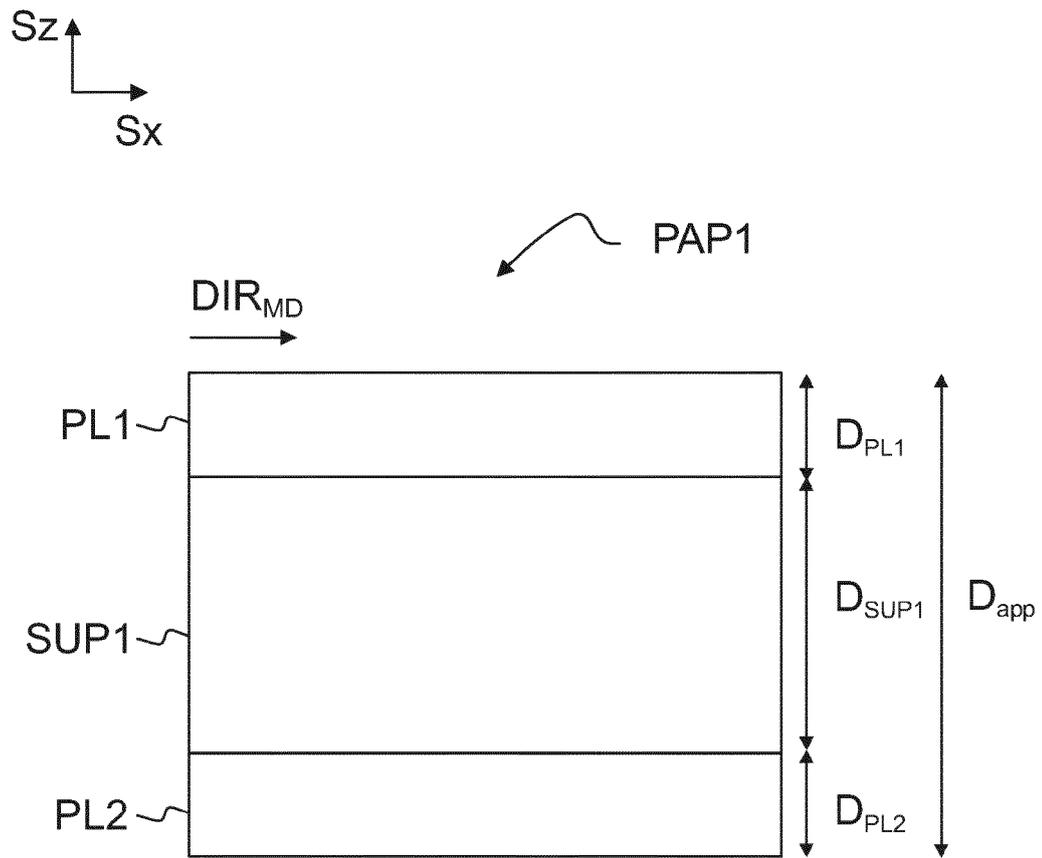


Fig. 1a

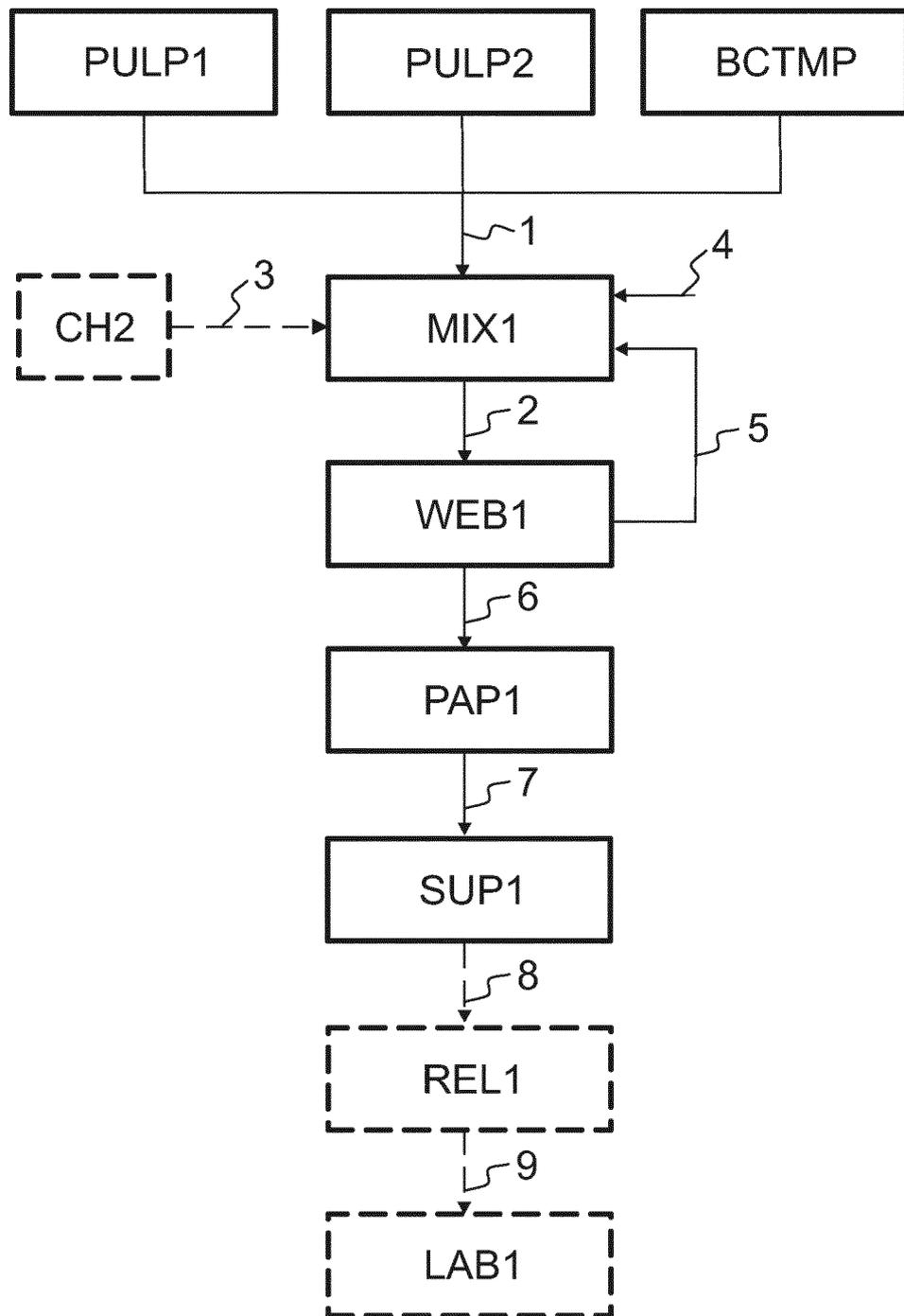


Fig. 1b

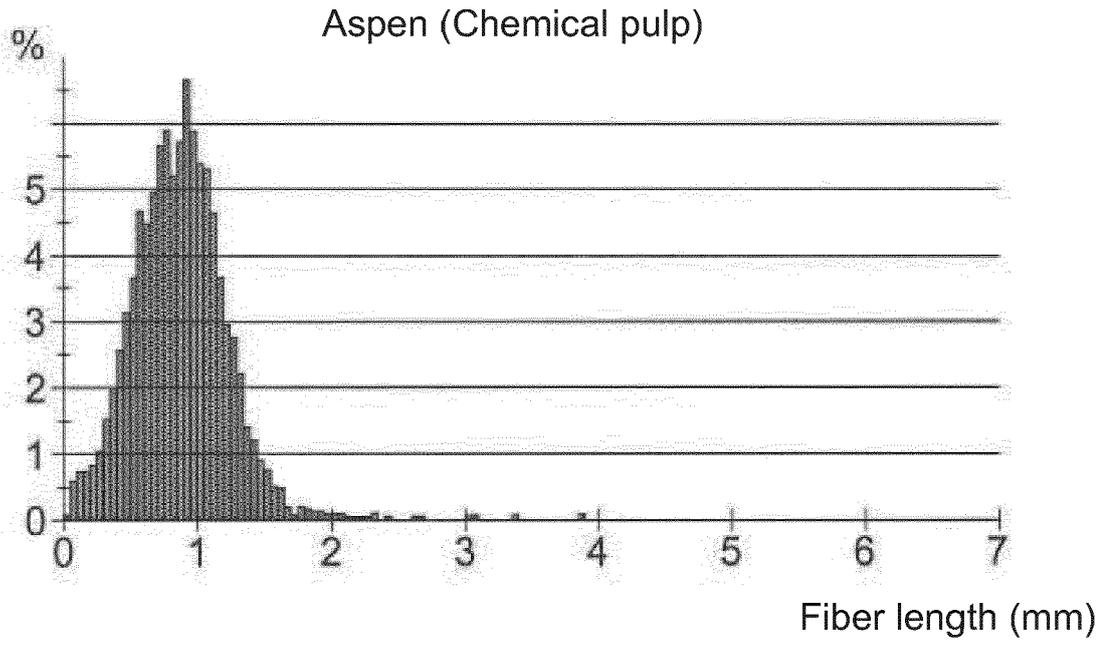


Fig.2a

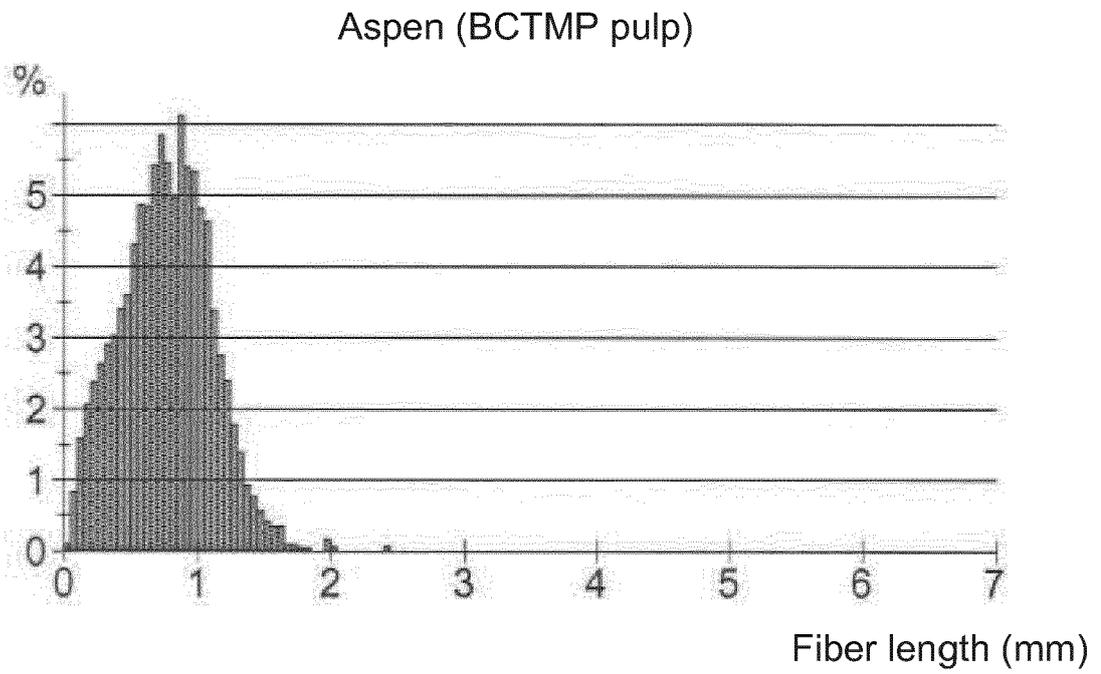


Fig.2b

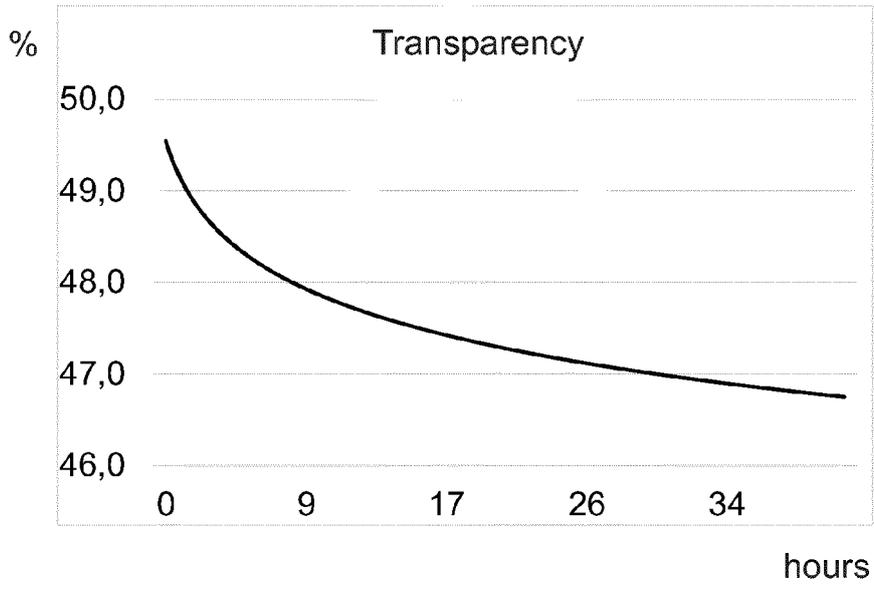


Fig.3a



Fig.3b

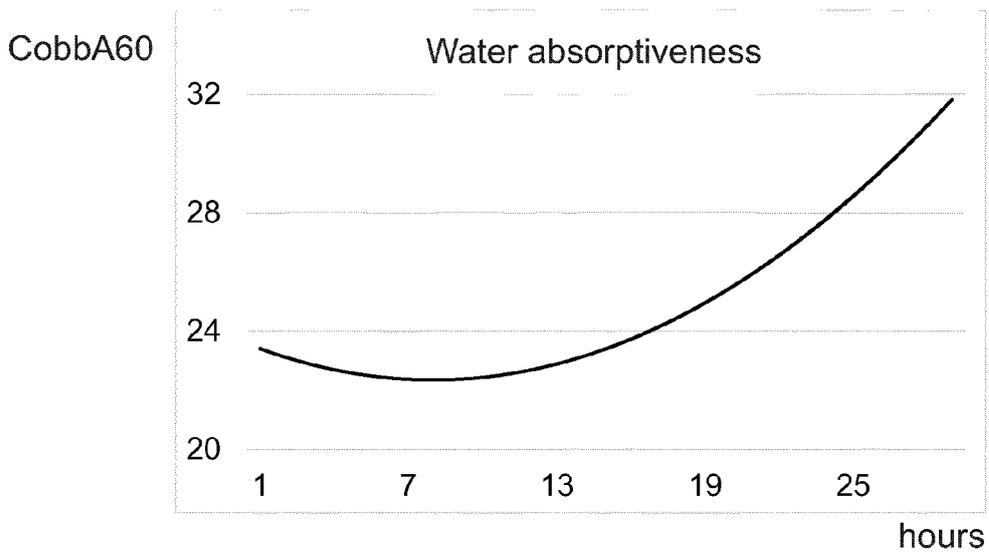


Fig.3c

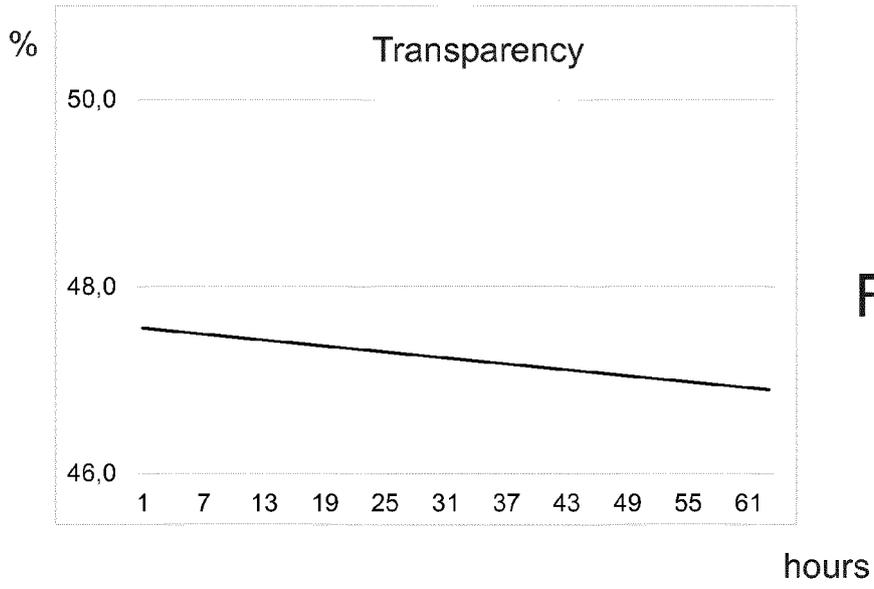


Fig.4a

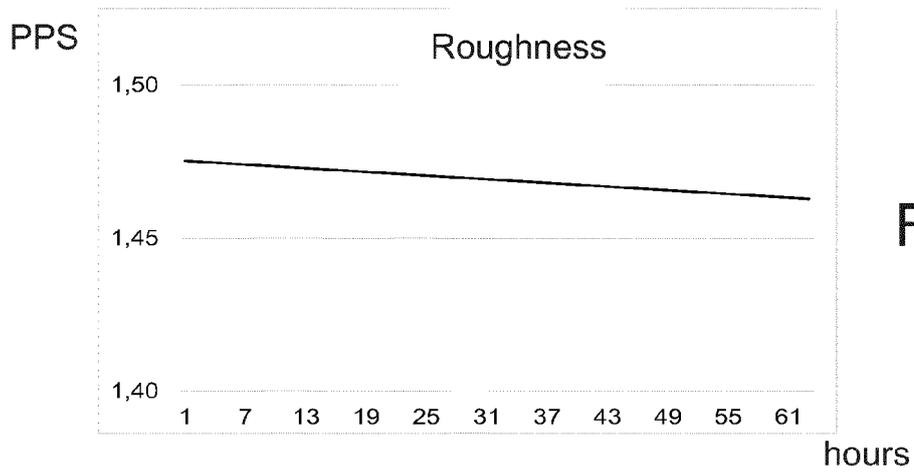


Fig.4b

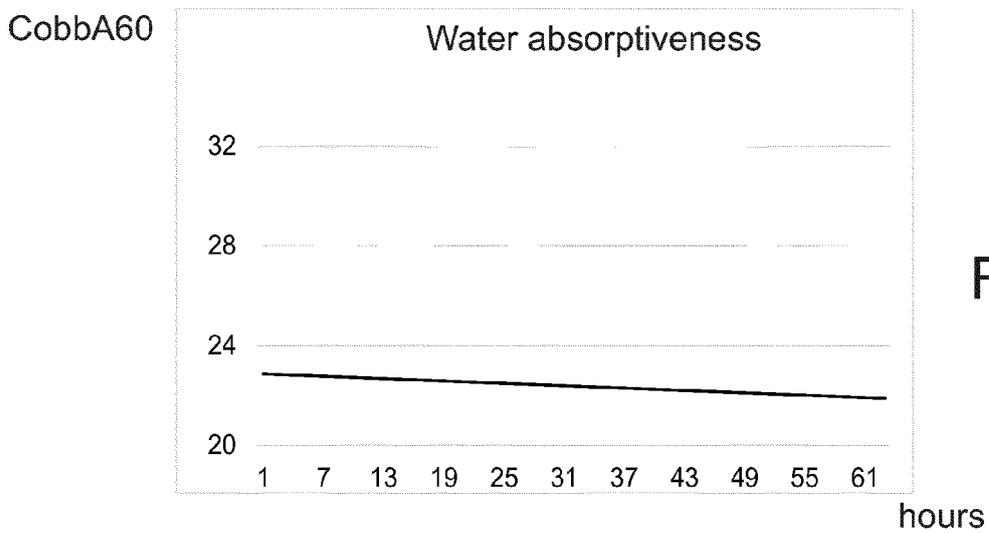


Fig.4c

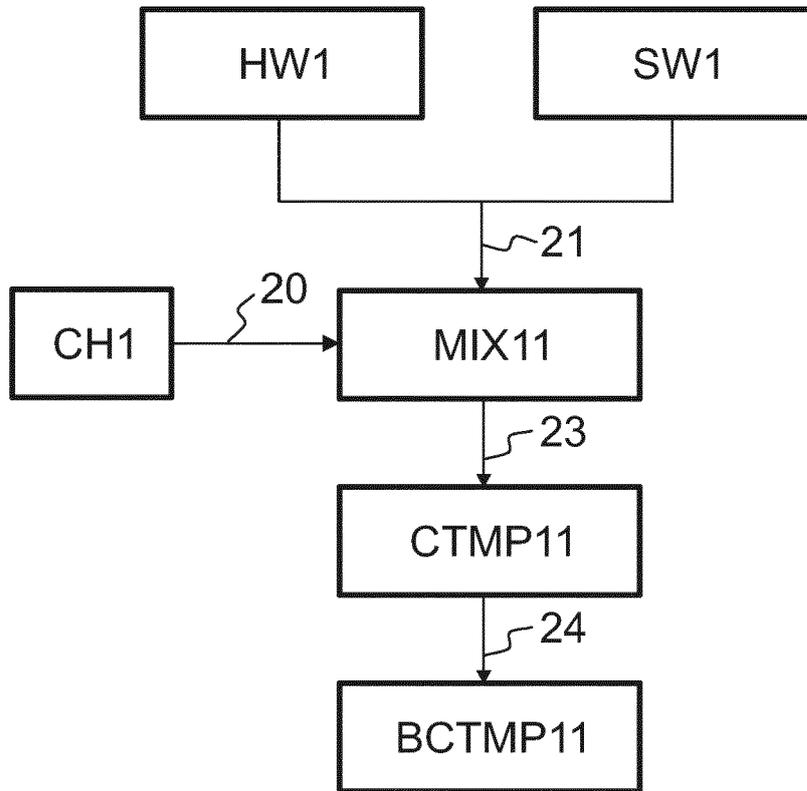


Fig. 5

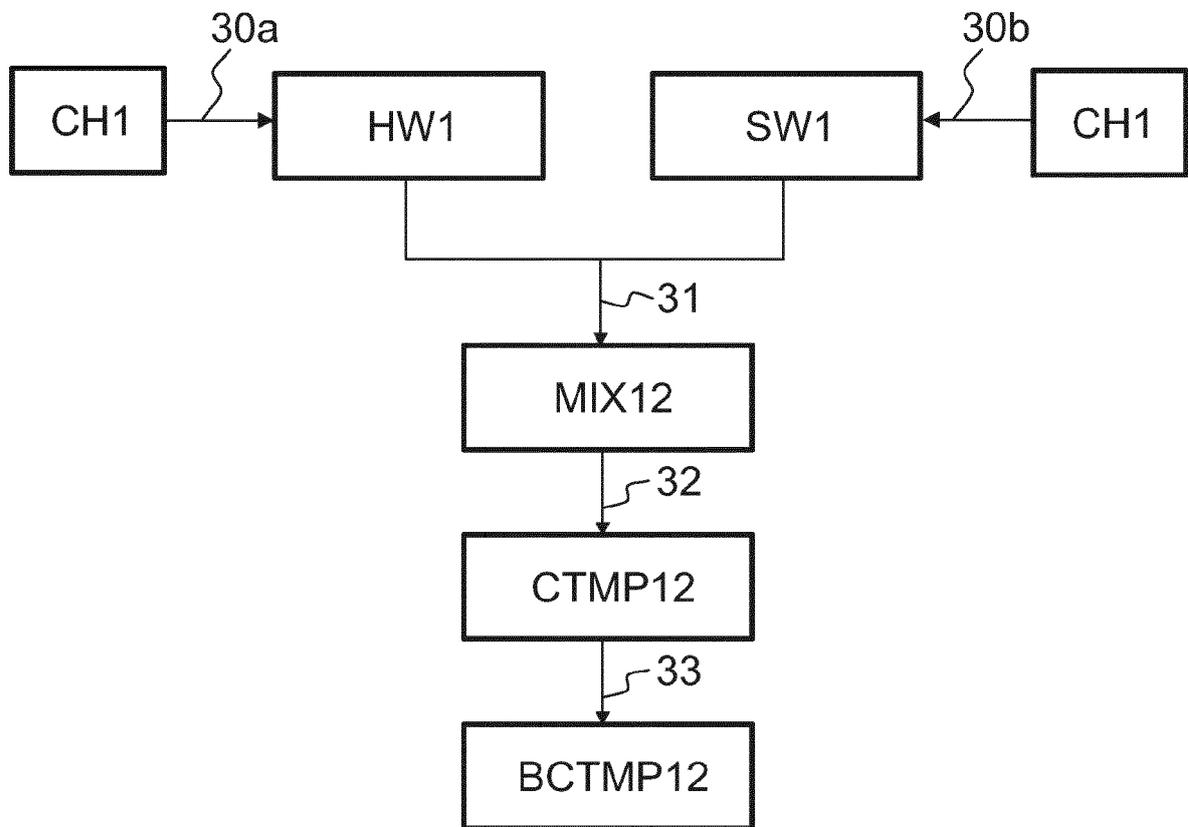


Fig. 6

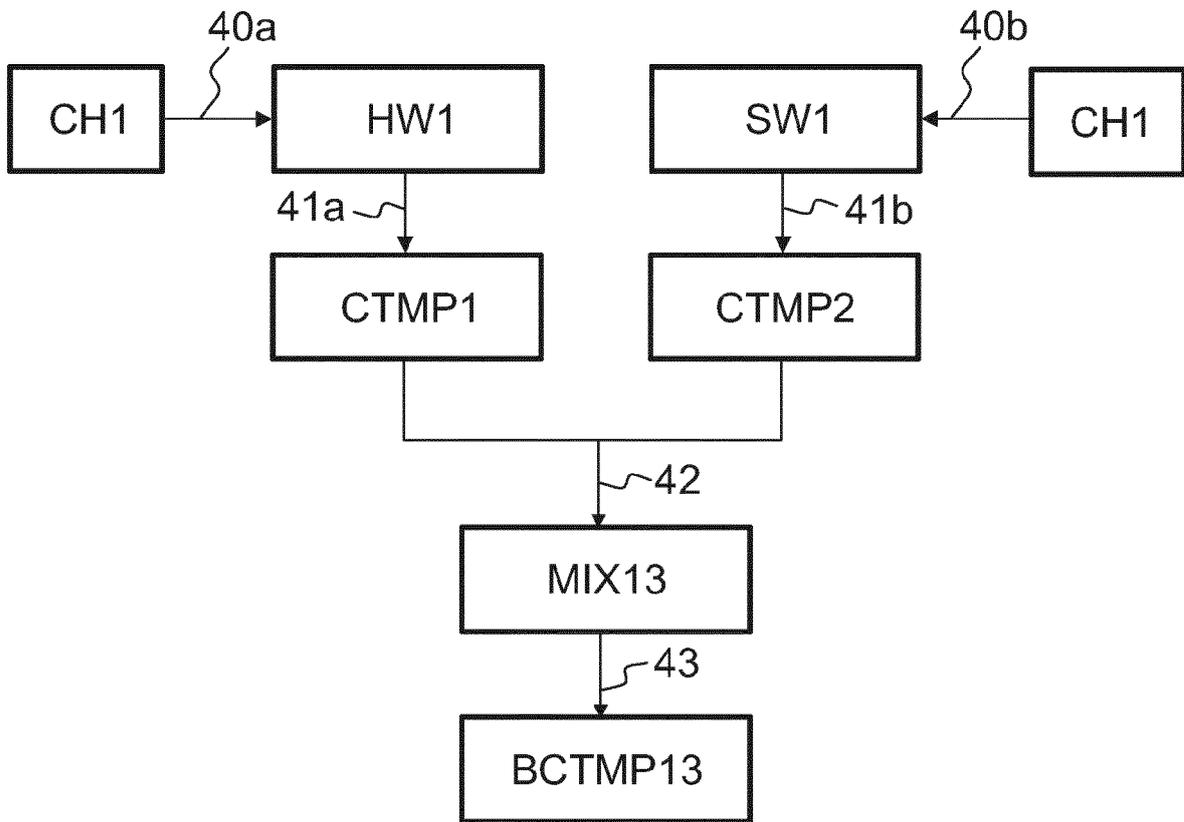


Fig. 7

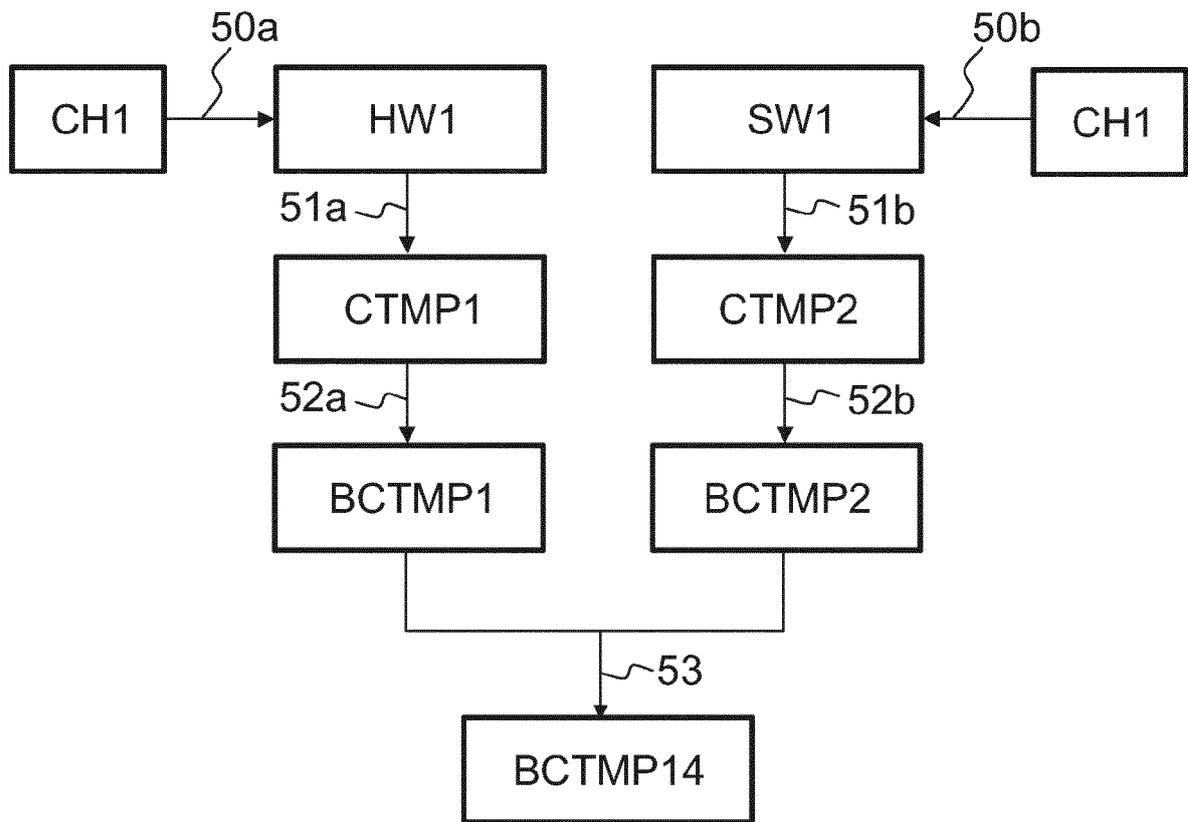


Fig. 8



EUROPEAN SEARCH REPORT

Application Number
EP 16 39 7503

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 00/03089 A1 (UPM KYMMENE CORP [FI]; AASMUS LARS [FI]; SKAATAR RUNE [FI]) 20 January 2000 (2000-01-20) * the whole document * -----	1-21	INV. D21H27/00 D21H19/82
A	WO 2009/059299 A1 (WAUSAU PAPER SPECIALTY PRODUCT [US]; WOZNIAK JOHN C [US]; MORTON DANA) 7 May 2009 (2009-05-07) * the whole document * -----	1-21	
A	WO 2004/009346 A1 (LOPAREX OY [FI]; PAHL TIMO [FI]; KAASALAINEN HANNU [FI]; PULKKINEN ANS) 29 January 2004 (2004-01-29) * the whole document * -----	1-21	
			TECHNICAL FIELDS SEARCHED (IPC)
			D21H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 11 July 2016	Examiner Naeslund, Per
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	

1
EPO FORM 1503 03/02 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 16 39 7503

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

11-07-2016

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 0003089 A1	20-01-2000	FI 981576 A WO 0003089 A1	09-01-2000 20-01-2000
WO 2009059299 A1	07-05-2009	US 2009133827 A1 WO 2009059299 A1	28-05-2009 07-05-2009
WO 2004009346 A1	29-01-2004	AU 2002321342 A1 DE 10297728 T5 GB 2401807 A US 2005214494 A1 US 2008233325 A1 WO 2004009346 A1	09-02-2004 18-08-2005 24-11-2004 29-09-2005 25-09-2008 29-01-2004

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82