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(72) Inventors:

- **LINDSTEDT, Thomas**
653 45 Karlstad (SE)
- **ENGSTRAND, Per**
616 33 Åby (SE)

(74) Representative: **Kransell & Wennborg KB**

P.O. Box 27834

115 93 Stockholm (SE)

(71) Applicant: **Billerud Aktiebolag (publ)**
169 27 Solna (SE)

(54) **A METHOD FOR PRODUCING CTMP HAVING A LOW EXTRACTIVES CONTENT**

(57) The present disclosure relates to a method for producing chemithermomechanical pulp, CTMP, comprising:

- providing wood chips comprising hardwood, softwood or a mixture thereof;
- impregnating the wood chips with an impregnation liquid to obtain impregnated chips;

c) heating the impregnated chips with steam to obtain pre-treated chips;

d) defibrating the pre-treated chips to obtain a pulp;

e) diluting the pulp in a pulper, wherein the residence time in the pulper is less than 15 min; and

f) dewatering the diluted pulp.

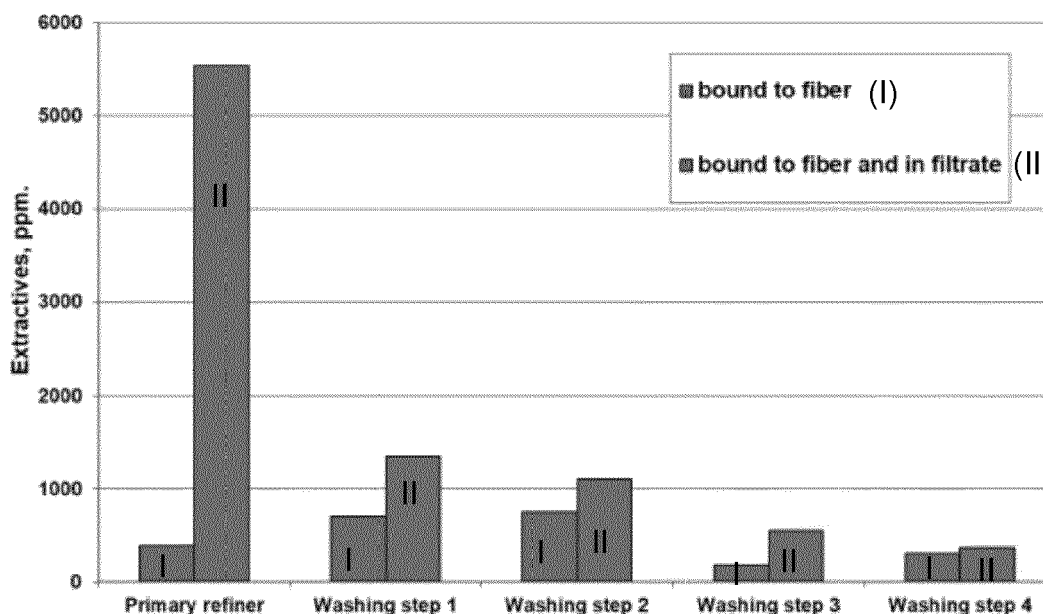


Fig. 4

Description

TECHNICAL FIELD

[0001] The present disclosure relates to the production of chemitheromechanical pulp (CTMP) having low extractives content.

BACKGROUND

[0002] Chemithermomechanical pulp, CTMP, is a high yield pulp which can provide a high bulk and has been used since 1960s. CTMP is produced by mild chemical impregnation of wood chips, followed by a heat treatment to soften the wood. The treated wood chips are then subjected to defibration/refining and optionally bleaching. The obtained CTMP typically has comparatively high bulk, preferably in combination with low shives content. The process can be further improved by using higher temperatures during the heat treatment.

[0003] Pulp, such as CTMP, comprise wood extractives such as triglycerides and fatty acids. These wood extractives may cause problems in final applications due to taste and odour issues. This is especially a problem when using pulp in food packaging applications such as in liquid packaging board (LPB). There is, thus, a desire to minimize the amount of extractives in the final pulp in order to minimize problems with taste and odour in the final applications.

SUMMARY

[0004] The present inventors have realized that by decreasing the residence time between the chip refining stage and the following first dewatering/washing stage, a CTMP having a low extractives content can be obtained.

[0005] The present disclosure, thus, relates to a method for producing CTMP comprising:

- a) providing wood chips comprising hardwood, softwood or a mixture thereof;
- b) impregnating the wood chips with an impregnation liquid to obtain impregnated chips;
- c) heating the impregnated chips with steam to obtain pre-treated chips;
- d) defibrating of the pre-treated chips to obtain a pulp;
- e) diluting the pulp in a pulper to obtain a diluted pulp, wherein the residence time in the pulper is less than 15 min; and
- f) dewatering the diluted pulp.

[0006] By diluting the pulp in a pulper, the pulp may be

homogeneously diluted within less than 15 min. The fast dilution enables a better removal of extractives in the subsequent dewatering step. During the CTMP manufacturing process, impregnation, heat treatment and chip refining enables the extractives to migrate from the cell walls of the wood into the water phase. Diluting the pulp after refining may further help to disperse the extractives in the water phase and thereby facilitate their removal in a subsequent dewatering step. The diluted pulp from step e) may have a consistency of 2-8 wt.96, such as 3-5 wt.96.

[0007] It is advantageous to obtain a good homogeneous dispersion of the pulp in order to obtain an effective dewatering step and hence removal of extractives. This usually takes a long time, typically >15 min, during which time some of the dispersed extractives may re-adsorb to the fibers. Extractives that are bound, re-adsorbed, to the fibers are harder to remove. Using a pulper for the dilution stage according to the present disclosure enables a fast dilution and thereby less time for the extractives to re-adsorb to the fibers. This in turn enables an improved removal of extractives. Hence, the present disclosure enables the production of a CTMP having a low content of extractives.

[0008] The residence time in the pulper may be 10 min or less, such as 2-5 min. The short time for dilution is enabled due the effective homogenising of the pulp in a pulper.

[0009] The steam present during the refining of the pre-treated chips may be removed from the pulp after the refining to obtain a pulp having a solid content of 30-50 wt.96 such as 40-50 wt.96. The steam maybe removed using a steam separator.

[0010] The pre-treated chips may be refined to a Canadian Standard Freeness of 650-750 ml, such as 690-750 ml as determined according to ISO 5267-2:2001 after disintegrating according to ISO 5263-3:2004. Having a pulp with a high freeness such as 650-750 ml facilitates the dewatering of the pulp and thereby also the removal of extractives.

[0011] The dewatering of the pulp may comprise pressing the pulp and removing the obtained pressate which comprise the extractives. Pressing of the pulp at this stage may be an effective way to remove the extractives.

[0012] The method of the present disclosure may be used to prepare high temperature CTMP (HT-CTMP). In order to produce the HT-CTMP, the steam used to heat the impregnated chips may have a temperature of at least 140 °C, such as at least 150 °C, such as at least 160 °C. HT-CTMP may have a lower shives content compared to CTMP and a more efficient refining of the pre-treated chips due to more effective impregnation and heating.

[0013] The impregnation liquid may comprise NaOH and/or Na₂SO₃.

[0014] The wood chips may be stored prior to being impregnated at a temperature of 45-75 °C, such as 50-70 °C, such as 55-65 °C for at least 24 h, such as 48-96 h in an aerobic environment. The storing may induce deg-

radation of the triglycerides and hence facilitate the removal of extractives.

[0015] The method of the present disclosure may further comprise a bleaching step after step f) in order to improve the brightness of the CTMP. The bleaching may be a two-step process wherein the first bleaching step occurs at a medium consistency of 10-12 wt. 96 and the second bleaching step occurs at a high consistency of 30-35 wt. 96.

[0016] The method may further comprise a second refining step after step f). The second refining step occurs at a consistency of 3-8 wt. 96, such as 3-7 wt. 96, such as 4-6 wt. 96. Performing a second refining step may enable the production of a CTMP having a higher tensile strength. The second refining step occurs after the bleaching step or prior to the bleaching step. The second refining step is advantageously preformed after to the bleaching step as bleaching may facilitate the refining.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Aspects and embodiments are now described, by way of example, with reference to the accompanying drawings, in which:

Fig 1 schematically illustrates a system for producing bleached HT-CTMP.

Fig 2 schematically illustrates a continuation of the system in Fig 1 designed for producing market HT-CTMP.

Fig 3 schematically illustrates a continuation of the system in Fig 1 designed to produce market HT-CTMP and supply an adjacent board-making machine with HT-CTMP.

Fig 4 shows the amount of extractives present in the pulp at different stages during a CTMP production.

Fig 5 shows the amount of triglycerides present in the pulp at different stages during a CTMP production.

DETAILED DESCRIPTION

[0018] The present disclosure relates to a method for preparing a CTMP having a low amount of extractives in order to improve the use of the pulp in applications such as food packaging.

[0019] Wood comprises different extractives which are typically embedded in the cell wall. The main components are waxes, fatty acids, resin acids and terpenes and the amounts present in the wood depends on the wood type. The extractives protect the wood from biotic attacks such as insects and fungi and aid in the metabolism of trees. However, the extractives may pose a problem during application of the pulp in e.g. food packaging applications

as the extractives cause taste and odour issues. The taste and odour issues may be especially pronounced for hardwood pulp as it generally contains more extractives.

[0020] The production of CTMP comprises impregnation of wood chips, heating the impregnated chips with steam and then defibrating the impregnated and heated chips. During this process a lot of extractives are released into the water phase which may later be washed out. However, some of the extractives that are released into the water phase may re-adsorb onto the fibers, making them difficult to wash out.

[0021] The present inventors have realized that in order to avoid the re-adsorption of the released extractives, the washing step should occur in close connection to the chip refining. This is enabled by arranging a pulper between the chip refiner and the washing step. The pulper effectively dilutes and homogenizes the refined pulp, e.g. to a low consistency of 2-8 wt. 96, such as 3-5 wt. 96. Due to the effectiveness of the pulper, short residence times (>15 min) maybe obtained. The shorter residence times, reduces the risk of re-adsorption of the extractives to the fibers and improves the removal of the extractives during the washing. The turbulent environment in the pulper may also reduce the risk of re-adsorption.

[0022] In addition to extractives, heavy metals that may be present in wood, may be more effectively removed using the method of the present disclosure.

[0023] Hardwood such as birch, maple and aspen as well as softwood such as spruce and pine may be used to produce a CTMP of the present disclosure. It may further be possible to modify the final properties of the CTMP by using mixtures of hardwood and softwood e.g. to obtain an optimal relationship between long and short fibers. An effective removal of extractives may be particularly important when using hardwood as raw material as they are known to have more pronounced issues concerning taste and odour when used in e.g. food packaging applications.

[0024] The aspects of the present disclosure will now be described more fully hereinafter with reference to the accompanying drawings, in which certain embodiments of the invention are shown.

[0025] Figures 1-3 illustrate exemplary embodiments of a system for producing bleached HT-CTMP.

[0026] The system may comprise a chipper 101 used to prepare chips from wood. In case of hardwood, in particular maple, it is preferable to prepare chips that are relatively short, such as < 20 mm, to aid impregnation. Softwood chips are generally easier to impregnate and can hence be longer, such as 22-24 mm. The settings of a conventional wood chipper can be adjusted to achieve such lengths. The thickness of the chips is proportional to its length, i.e. the shorter the chips are, the thinner they will be.

[0027] The chips from the chipper 101 are typically stored in at least one silo 102. When different types of wood are mixed in the system, there is typically one silo

for each type of wood, such as one hardwood chips silo 102a and one softwood chips silo 102b. When there is more than one type of wood chips, a chips mixing system 103 is preferably arranged downstream of the silos 102a, 102b.

[0028] The chips from the chips mixing system 103 are optionally stored in a maturation silo 104 for a period of at least 24 h such as 48 h. A typical temperature in the maturation silo 104 is 45-75 °C such as 60 °C, which can be achieved by feeding low-pressure steam into the maturation silo 104. The treatment of the chips in the maturation silo 104 degrades triglycerides. The degradation products can then be more easily extracted in downstream washing steps.

[0029] Another option is to design the chip silos 102a, 102b as maturation silos. A benefit of this option is that the maturation time and temperature can be individually adapted to the respective wood types.

[0030] Yet another option is to place the maturation silo 104 between the chip washing arrangement 106 and the pre-steaming bin 107 described below. It is also possible to omit the maturation step.

[0031] Before being impregnated, the chips may be washed in a chip washing arrangement 106. Upstream the chip washing arrangement 106, a conditioning device 105 may be arranged. The conditioning device 105 is typically a chip steaming bin. The purpose of the conditioning device 105 is to provide chips of fairly constant temperature. The conditioning device 105 may also, to some extent, reduce variations in the moisture content of the chips. During cold winter months, the conditioning device 105 may be used to melt the ice on the chips, which facilitates the downstream washing and processing. Hence, the conditioning device 105 may be particularly advantageous when there is no upstream maturation silo.

[0032] In the chip washing arrangement 106, the chips are typically soaked and agitated in water and then dewatered. Dirt and gravel are removed in the chip washing arrangement 106. The washed and dewatered chips are then steamed in a pre-steaming bin 107. The residence time of the chips in the pre-steaming bin 107 is typically at least 10 min such as 15-20 min. The pre-steaming of the chips removes air from the chips and replaces it with steam which may improve impregnation downstream.

[0033] The steamed chips from the pre-steaming bin 107 are subjected to impregnation in one or two steps.

[0034] In case of one-step impregnation, a plug screw 108 may feed the steamed chips into a reactor 109. The steamed chips, which were compressed in the plug screw 108, expand in a bath of aqueous impregnation liquid 110 in the reactor 109. During the expansion, the chips absorb impregnation liquid. The temperature of the impregnation liquid is preferably 80°C-99°C. The expanded and impregnated chips are lifted from the bath of impregnation liquid 110 by means of a transport screw 111 and are then allowed to fall over an edge 112 and into a heating zone 113 of the reactor 109, in which they are heated

by steam. The steam may have a temperature of above 140°C if HT-CTMP is produced. The transferring of the impregnated chips from the bath of impregnation liquid 110 to the heating zone 113 may occur without any compression of the chips. The impregnation liquid is thereby not pressed out of the chips prior to reaching the heating zone 113. The chips treated in the reactor 109 are transferred to a chips defibrator 114 without flashing off any steam on the way.

[0035] In case of two-step impregnation, a plug screw 115 may feed the steamed chips into a pre-impregnation chamber 116. The steamed chips, which were compressed in the plug screw 115, expands in a bath of pre-impregnation liquid 117 in the pre-impregnation chamber 116. During the expansion, the chips absorb pre-impregnation liquid. The temperature of the pre-impregnation liquid is preferably 80°C-99°C. The pre-impregnation liquid is water that may comprise NaOH and optionally Na₂SO₃. The expanded and impregnated chips are lifted from the bath of pre-impregnation liquid 117 by means of a transport screw 118. A plug screw 119 may then feed the pre-impregnated chips into a reactor 120. The pre-impregnated chips, which were compressed in the plug screw 119, expand in a bath of impregnation liquid 121 in the reactor 120. During the expansion, the chips absorb impregnation liquid, which preferably has a temperature of 80°C-99°C. The expanded and impregnated chips are lifted from the bath of impregnation liquid 121 by means of a transport screw 122 and are then allowed to fall over an edge 123 and into a heating zone 124 of the reactor 120, in which they are heated by steam having a temperature above 140°C. The transferring of the impregnated chips from the bath of impregnation liquid 121 to the heating zone 124 occurs without any compression of the chips. The impregnation liquid is thereby not pressed out of the chips prior to reaching the heating zone 124. The chips treated in the reactor 120 are transferred to the chips defibrator 114 without flashing off any steam on the way.

[0036] The impregnation liquid, in both the one-step and the two-step impregnation, may comprise NaOH and/or Na₂SO₃. The NaOH softens the wood chips by modifying carbohydrates such as hemicellulose and is typically used more for hardwood. The Na₂SO₃ softens the wood by modifying lignin by sulphonation making it more hydrophilic and is typically used more for softwood. The impregnation liquid may be adjusted as to optimize the softening of the chips which may occur differently depending on the wood composition.

[0037] In the chips defibrator 114, the dry matter content is 40-50 wt. % such as 45-50 wt. % (in case there is no plug screw between the heating zone 124 and the chips defibrator 114, the dry matter content may however be as low as 30 wt. %). It is advantageous for the solid content to be high in order to use as much of the refining energy for defibration of the chips rather than vaporizing the water in the impregnated chips. However, too high solid content, >50 wt. %, may lead to burnt fibers. The

pressure during refining may be ≥ 2 bar. If HT-CTMP is produced, the pressure may be ≥ 5 bar.

[0038] The pulp obtained from the chip defibrator 114 may be subjected to flashing in a steam separator 125 and then pulped in a first pulper 126. The pulp is diluted in the pulper 126 to a consistency of 3-5 wt.96 and homogenized for 10 min or less, typically for ≥ 5 min, in order to amongst other reduce the fiber latency. Using a pulper 126 in this position enables a short residence time which in turn limits the time available for re-adsorption of the extractives to the fibers. The water phase at this stage in the process (after refining) comprises a high amount of extractives which is why it is advantageous to reduce the time between the refining step and removal of the water phase. The pulp from the first pulper 126 is thereby treated in a first dewatering press 127. The pressate from the dewatering press 127 which contains the extractives (and dissolved wood substances and residual chemicals), is removed from the process. Separation of extractives by pressing in this position is even more advantageous since the pulp still has a high freeness (typically >650 ml or even >700 ml) and is thus easily dewatered.

[0039] The pulp from the dewatering press 127 is subjected to middle consistency (MC) bleaching in a MC bleach tower 128 using residual peroxide from a downstream high consistency (HC) bleaching. Fresh alkali such as NaOH may be added to the MC bleaching if necessary. MC means 10-12 wt.96. The MC-bleached pulp may be dewatered in a second dewatering press 129 also producing a pressate. The pulp from the second dewatering press is subjected to HC bleaching in a HC bleach tower 130 using fresh peroxide and alkali. It is advantageous that the peroxide is present in excess compared to the alkali during the entire bleaching process in order to obtain a high brightness. The HC-bleached fibers from the HC bleach tower 130 may be pulped in a second pulper 131 (residence time is preferably <10 min, such as about 3 min) to produce a pulp having a consistency of about 3-8 wt.96. This pulp is then subjected to low consistency (LC) refining in LC refiners 132. The LC refining may be performed in multiple stages, typically three LC refiners 132 are used. A third dewatering press 133 may then separate a third pressate from the LC-refined pulp. The fibers from the third dewatering press 133 may be pulped in a third pulper 134 (residence time is preferably <10 min, such as about 3 min) to produce a pulp having a consistency of 2-4 wt.96. Screens 135 may then be used to separate a reject from the pulp from the third pulper 134. The separated reject is collected in a reject tank 136.

[0040] The design of the remaining parts of the system depends on if only market pulp is produced (i.e. all (HT-)CTMP is subjected to flash drying and baling) or if there is also an adjacent board-making machine to which at least part of the (HT-)CTMP is supplied without drying.

[0041] In the former case, which is illustrated in figure 2, the pulp from the screens 135 are cleaned in cleaners 137 to provide cleaned pulp and a second reject that is

collected in a second reject tank 138. The cleaned pulp is then filtered in a disc filter 139 and collected in a MC tower 140. From the pulp from the MC tower 140, a fourth dewatering press 141 produces dewatered fibers and a fourth pressate. The dewatered fibers are led to an arrangement for fiber treatment and shredding 142 and then to a flash drying arrangement 143. Finally, bales of the dried fibers from the flash drying arrangement 143 are formed in a baling arrangement 144.

[0042] In the latter case, which is illustrated in figure 3, the pulp from the screens 135 is filtered in a disc filter 145 and treated in a fourth dewatering press 146 such that a fourth pressate and an MC pulp are obtained. The MC pulp is collected in a MC tower 147.

[0043] To produce (dried) market pulp, a fifth dewatering press 148 produces dewatered fibers and a fifth pressate from the MC pulp from the MC tower 147. The dewatered fibers are led to an arrangement for fiber treatment and shredding 149 and then to a flash drying arrangement 150. Finally, bales of the dried fibers from the flash drying arrangement 150 are formed in a baling arrangement 151.

[0044] To use the produced (HT-)CTMP directly in the production of paperboard, MC pulp from the MC tower 147 is led to a board-making machine.

EXAMPLES

Example 1

[0045] In order to determine where in the CTMP process a potential improvement in the removal of extractives may be obtained, pulp samples were removed from a conventional CTMP process at different stages and the amount of extractives present in the pulp samples were determined. Spruce was used as the raw material.

[0046] The first pulp sample (sample 1) was withdrawn after the wood chips had been impregnated, heated and defibrated. After chip defibration, the pulp was subjected to flashing followed by dilution to a consistency of ~ 5 wt.96 in a latency bin where the residence time was 15 min. Following the dilution, the pulp was washed/dewatered, and a sample was withdrawn (sample 2).

[0047] Sample 3 was taken after a MC-bleaching step, LC refining and a second dewatering/washing step. Sample 4 was taken after a third dewatering/washing step which followed the second dewatering/washing step. Sample 5 was taken after HC-bleaching step and a fourth dewatering/washing step.

[0048] The total amount of extractives and the amount of extractives bound to fibers were measured. Total amount of extractives include free extractives and extractives bound to the fibers. Free extractives are present in the water phase and can be removed during a dewatering step while the extractives bound to the fibers will stay in the pulp even after dewatering.

[0049] Figure 4 shows that after the primary refining step (sample 1) the amount of free extractives is very

high and the amount of extractives bound to fibers is low. After the first dewatering step (sample 2), the amount of free extractives decreased which was expected as the free extractives are more easily removed from the pulp. Interestingly, the amount of extractives bound to the fibers increased significantly.

[0050] Figure 5 shows the total amount of triglycerides and the amount of triglycerides that are bound to the fibers in the pulp samples. The same trend can be observed for the triglycerides as for the total amount of extractives. The total amount of triglycerides is highest after chip defibration (sample 1) and decreases significantly after the first dewatering step. The amount of bound triglycerides, however, increases after the first dewatering step (sample 2) compared to after chip defibration (sample 1).

[0051] These observations, made from figures 4 and 5, indicate that some of the free extractives re-adsorb onto the fibers between chip defibration and the first dewatering step. The present inventors concluded, from these observations, that the time between the chip defibration and the removal of the water phase had to be reduced. The present inventors further realized that the reduction in time between the chip defibration and the removal of the water phase may be obtained by placing a pulper after the chip refiner instead of a latency bin. The pulper enables a faster dilution under more turbulent conditions and hence a reduction in time. Due to the obtained reduction in time, the extractive will not have enough time to reabsorb to the fibers and more extractives can be removed during the first dewatering step.

Claims

1. A method for producing chemithermomechanical pulp, CTMP, comprising:

- a) providing wood chips comprising hardwood, softwood or a mixture thereof;
- b) impregnating the wood chips with an impregnation liquid to obtain impregnated chips;
- c) heating the impregnated chips with steam to obtain pre-treated chips;
- d) defibrating the pre-treated chips to obtain a pulp;
- e) diluting the pulp in a pulper to obtain a diluted pulp, wherein the residence time in the pulper is less than 15 min; and
- f) dewatering the diluted pulp.

2. The method of claim 1, wherein the residence time in the pulper is 10 min or less, such as 2-5 min.

3. The method of claim 1 or 2, further comprising removing steam from the pulp obtained after defibration of the pre-treated chips to obtain a pulp having a solid content of 30-50 wt.96 such as 40-50 wt.96.

4. The method of any one of the preceding claims, wherein the pulp obtained after defibration of the pre-treated chips has a Canadian Standard Freeness of 650-750 ml, such as 690-750 ml as determined according to ISO 5267-2:2001 after disintegrating according to ISO 5263-3:2004.

5. The method of any one of the preceding claims, wherein the CTMP is a high temperature CTMP, H⁺T-CTMP.

6. The method of claim 5, wherein the steam used for heating the impregnated chips has a temperature of above 140 °C, such as at least 150 °C, such as at least 160 °C.

7. The method of any one of the preceding claims, wherein the impregnation liquid comprises NaOH and/or Na₂SO₃.

8. The method of any one of the preceding claims, wherein the dewatering of the pulp comprises pressing the pulp and removing the obtained pressate.

9. The method of any one of the preceding claims, further comprising storing the wood chips prior to impregnation at a temperature of 45-80 °C for at least 24 h in an aerobic environment.

10. The method of any one of the preceding claims, further comprising a bleaching step after step f).

11. The method of claim 10, wherein the bleaching is a two-step process, the first step occurring at a medium consistency of 10-12 wt. 96 and the second step occurring at a high consistency of 30-35 wt.96.

12. The method of any one of the preceding claims, further comprising a second refining step after step f) the pulp wherein the refining occurs at a consistency of 3-8 wt. %, such as 3-7 wt. 96, such as 4-6 wt.96.

13. The method of anyone of claim 12, wherein the second refining step occurs after the bleaching step.

14. The method of anyone of claims 12, wherein the second refining step occurs prior to the bleaching step.

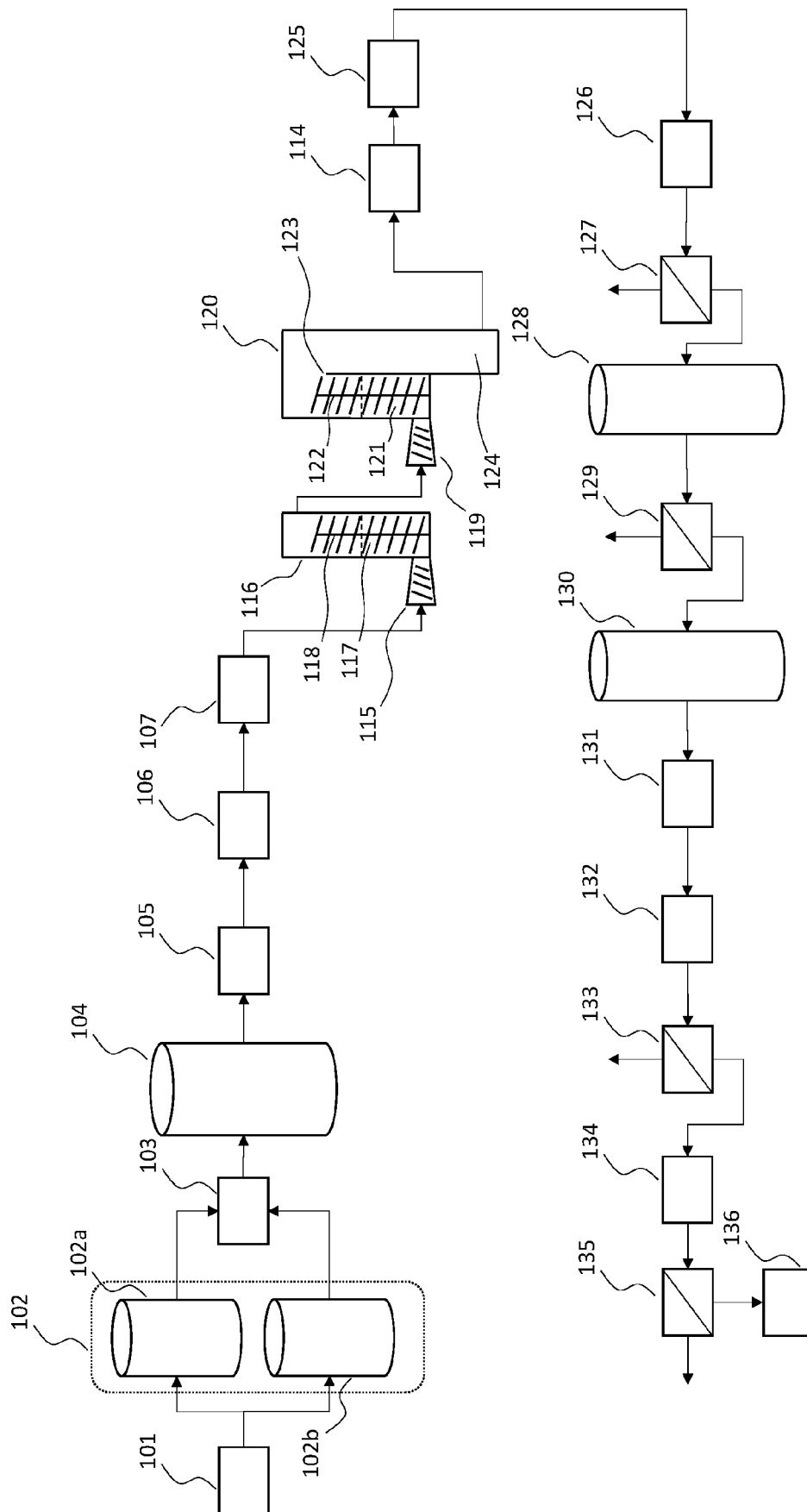


Fig. 1

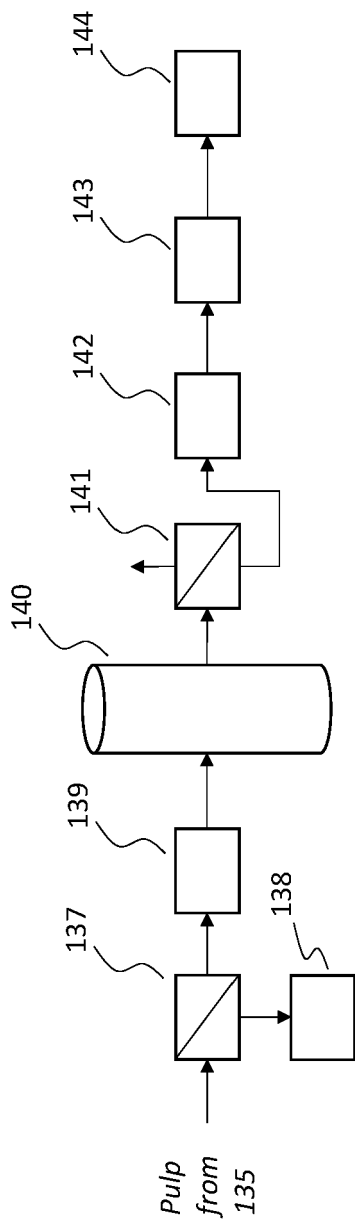


Fig. 2

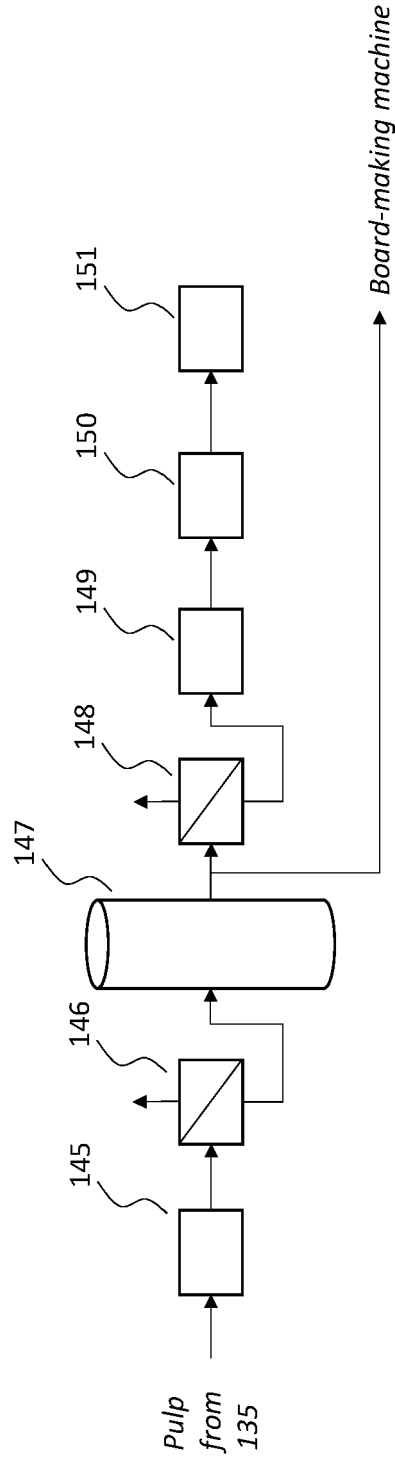


Fig. 3

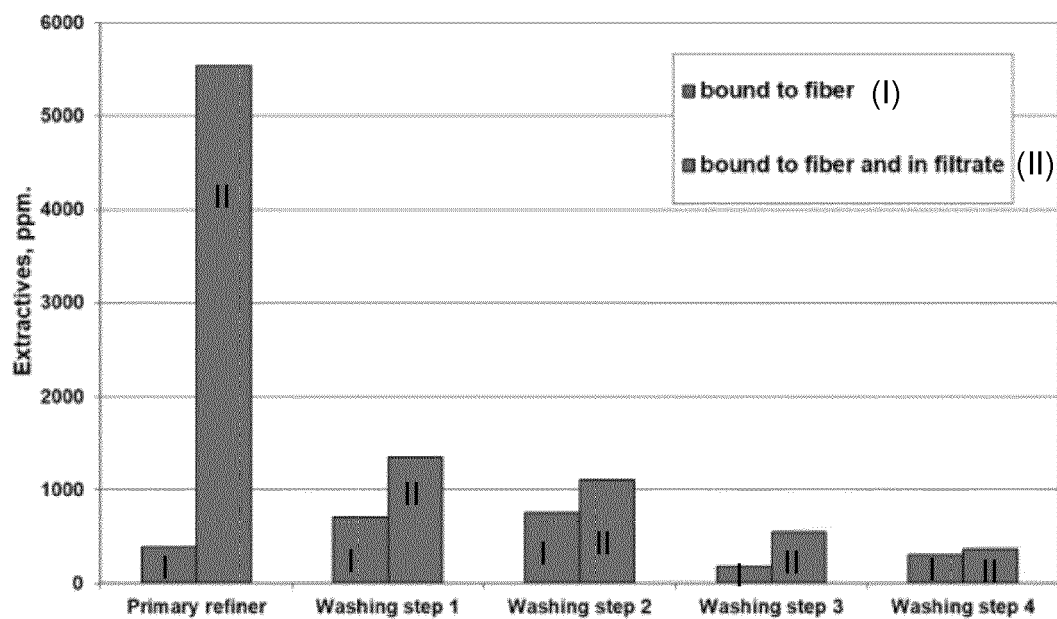


Fig. 4

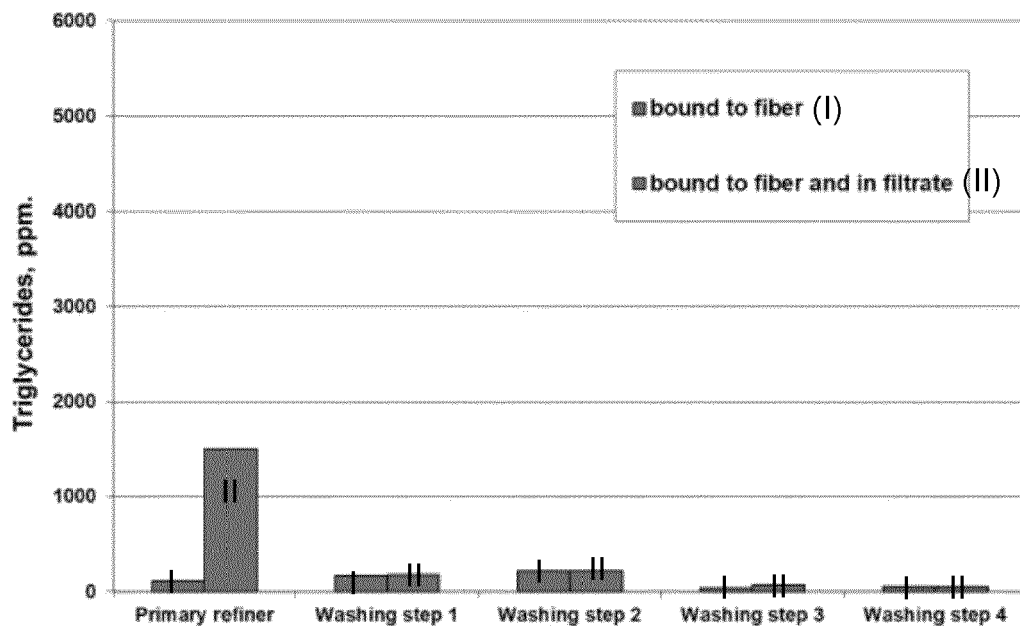


Fig. 5



EUROPEAN SEARCH REPORT

Application Number

EP 22 21 5621

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			D21C D21H
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 15 May 2023	Examiner Ponsaud, Philippe
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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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.

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