

(19)



(11)

EP 3 889 345 B1

(12)

EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent:

01.02.2023 Bulletin 2023/05

(51) International Patent Classification (IPC):

D21F 3/02 ^(2006.01) **D21F 11/00** ^(2006.01)
D21H 11/02 ^(2006.01) **B65D 65/40** ^(2006.01)
D21H 27/10 ^(2006.01) **D21H 11/00** ^(2006.01)

(21) Application number: **21160869.0**

(52) Cooperative Patent Classification (CPC):

(22) Date of filing: **14.05.2020**

D21F 3/0218; D21F 11/00; D21H 11/00; D21H 27/10

(54) OPTIMIZED PRODUCTION OF A CONTAINERBOARD TO BE USED AS FLUTING

OPTIMIERTE HERSTELLUNG VON WELLPAPPE ZUR VERWENDUNG ALS RIFFELUNG

PRODUCTION OPTIMISÉE D'UN CARTON-CAISSE DESTINÉ À ÊTRE UTILISÉ EN TANT QUE CANNELURE

(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

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(30) Priority: **14.05.2019 EP 19174469**

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(43) Date of publication of application:

06.10.2021 Bulletin 2021/40

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(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:

20174696.3 / 3 739 115

(56) References cited:

EP-A1- 3 026 173 WO-A1-2018/054957

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Description**TECHNICAL FIELD**

5 **[0001]** The invention relates to a method of producing a containerboard to be used as fluting.

BACKGROUND

10 **[0002]** Neutral Sulfite Semi-Chemical (NSSC) pulping is an old process that it is well known in the field of paper pulping and in use in many pulp mills around the world. One of the reasons for using NSSC pulping is the high yield.

[0003] In NSSC pulping, the cooking liquor comprises sulfite, such as Na_2SO_3 or $(\text{NH}_4)_2\text{SO}_3$ and a base, such as NaOH or Na_2CO_3 . "Neutral" means that the pH of the NSSC cooking liquor is generally between 6 and 10. Normally, the cooking time is between 0.5 and 3 hours and the cooking temperature is 160-185 °C. However, the cooking time may be as short as 15 min, in particularly in case of a relatively high temperature, such as ≥ 180 °C. The NSSC pulp comprises comparatively high amounts of residual lignin, such as 15-20 %, which make the NSSC pulp fibers stiff. The NSSC pulping is "semi-chemical" in the sense that it comprises mechanical treatment/grinding (after the chemical (cooking) step).

[0004] The NSSC pulp is for example used to produce containerboard that is subsequently corrugated to form the fluting of corrugated board.

20 **[0005]** Examples of mills using the NSSC pulping method are: BillerudKorsnäs' mills in Gruvön (PM 6) and Skärblacka (PM4), Sweden; Mondi Swiecie S.A.'s mill in Swiecie (PM 4), Poland; Mondi's (Powerflute's) mill in Koupio, Finland; Stora Enso Oyj's mill in Heinola, Finland (Heinola Fluting Mill); S.C. Celrom S.A.'s mill in Drobeta, Romania; Packaging Corp. of America's mills in Filer City (PM1, PM2 & PM3), Tomahawk (PM2 & PM4) and Wallula (PM2), United States; Ilim Group's mills (PM1 and PM3) in Korjazma, Russia; Permsky Karton's mill (PM2) in Perm, Russia; WestRock's mills in Longview (PM10) and Stevenson (PM1 & PM2), United States; International Paper's mills in Mansfield (PM2) and Pine Hill (PM2), United States; Georgia-Pacific LLC's mills in Big Island (PM1 & PM3) and Cedar Springs, United States; Cascades Containerboard Packaging's mill in Trenton, Canada; Sappi's Tugela mill (PM2) in South Africa; Irving Lake Utopia Paper's mill in St. George, Canada; Graphic Packaging International's mill in West Monroe, United States; Greif Bros Corp's mill in Riverville, United States; Hood Container Corp's mill in New Johnsonville, United States; and Sonoco's mill in Hartsville (PM10), United States.

[0006] EP3026173 discloses a method of producing a containerboard (to be used as fluting) of increased SCT strength from pulp comprising NSSC pulp. According to the method, a web formed from the pulp comprising NSSC pulp is pressed in a shoe press, in which the line load is at least 1200 kN/m.

35 **[0007]** Further, it is generally acknowledged in the prior art that the SCT strength of NSSC-based containerboard to be used as fluting is increased when the NSSC pulp is subjected to more refining. As an example, the rebuild of PM4 in Swiecie in 2015 involved a rebuild of the refining system to allow for more refining of the NSSC pulp in order to increase SCT strength. For the same purpose, Billerud AB (now BillerudKorsnäs AB) increased the refining capacity in the NSSC mill (PM 6) in Gruvön, Sweden back in 2005. Powerflute's NSSC mill and Stora Enso's mill in Heinola improved their refining capacity in 2010 and 2011, respectively.

SUMMARY

[0008] The object of the present disclosure is to optimize the production of NSSC-based containerboard intended to be used as fluting.

45 **[0009]** To meet the above-mentioned object, there is provided a method of producing a containerboard for use as fluting, comprising the steps of:

- forming a web from a pulp having a Schopper-Riegler (SR) value of 16.0-19.0 when measured according to ISO 5267-1:1999, wherein at least 70% by dry weight of the pulp is NSSC pulp;
- 50 - pressing the web in a press section comprising a shoe press, wherein the line load in the shoe press is in the range of 1200-2000 kN/m; and
- drying the web from the press section in a drying section to obtain said containerboard.

55 **[0010]** The above range for the SR value of the pulp (16.0-19.0) reflects a very low degree of refining, which means low energy consumption in that stage of the papermaking process. The inventors have shown that a reduction of the refining energy results in a drastically reduced energy consumption (i.e. steam consumption) in the drying section. Still, the containerboard produced by the method of the present disclosure is surprisingly strong. The inventors have thus identified an optimum at which strong containerboard is produced at low energy consumption.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

5 Figure 1 shows the SCT index at 50% and 90% relative humidity (RH) of lab sheets formed from NSSC pulp that had been subjected to different degrees of LC refining.

Figure 2 shows the CCT index at 50% and 90% relative humidity (RH) of lab sheets formed from NSSC pulp that had been subjected to different degrees of LC refining.

10 Figure 3 shows the CMT index at 50% and 90% relative humidity (RH) of lab sheets formed from NSSC pulp that had been subjected to different degrees of LC refining.

Figure 4 shows the tensile stiffness index at 50% and 90% relative humidity (RH) of lab sheets formed from NSSC pulp that had been subjected to different degrees of LC refining.

15 Figure 5 shows the degree of refining of the NSSC pulp and the specific steam consumption in the drying section during a full-scale trial on the paper machine PM 6. As shown in the figure, the degree of refining was first maintained at 60 kWh/tonne, then gradually increased to 115 kWh/tonne and finally gradually decreased back to 60 kWh/tonne. The x-axis shows the time.

DETAILED DESCRIPTION

25 [0012] There is thus provided a method of producing a containerboard. The containerboard is intended for use as fluting (i.e. corrugated medium) in corrugated board. As understood by the skilled person, the method is intended to be used on a full-scale paper machine, i.e. a machine adapted to produce at least 50,000 tons of containerboard per year, normally at least 100,000 tons of containerboard per year. The grammage of the containerboard may be in the range of 100-240 g/m², such as 110-240 g/m², such as 120-240 g/m², such as 120-200 g/m² or 140-230 g/m², such as 150-230 g/m². Grammage is measured according to ISO 536:2012.

30 [0013] The present invention may have particular value when the grammage is relatively high, e.g. 140-230 g/m².

[0014] Preferably, the geometric SCT index (measured according to ISO 9895:2008) of the containerboard is 37.0-43.0 Nm/g, such as 37.0-42.0 Nm/g, such as 38.0-42.0 Nm/g, such as 38.0-41.0 Nm/g.

35 [0015] To obtain the geometric SCT index, the compressive strength in the machine direction (MD) and the cross direction (CD) of the containerboard is first measured using a short-span compressive tester (SCT) measured according to ISO 9895:2008. To calculate the compressive strength index, the compressive strength (N/m) is divided by the grammage. The unit of the SCT index is thus Nm/g. The geometric SCT index is calculated as the square root of the product of the SCT index in MD and CD:

$$40 \quad \text{geometric SCT index} = \sqrt{(\text{SCT index (MD)} * \text{SCT index (CD)})}.$$

[0016] The compressive strength is considered to be more important in CD than in MD. The SCT index in the CD of the containerboard may for example be above 28 Nm/g, such as at least 29 Nm/g. An upper limit for the SCT index in CD may for example be 32 Nm/g.

45 [0017] The method comprises the step of:

- forming a web from a pulp having a Schopper-Riegler (SR) value of 16.0-19.0 when measured according to ISO 5267-1:1999, wherein at least 70% by dry weight of the pulp is NSSC pulp, typically in a wire section (as conventional in paper making).

50 [0018] The SR value referred to above (and in the items) is the SR value that the pulp has in the head box (i.e. the chamber from which the pulp is caused to flow onto the wire of the wire section). To obtain this SR value, the pulp of the present disclosure is typically subjected to low consistency (LC) refining between the NSSC pulping process and the head box. The energy input of such LC refining may for example be 40-65 kWh/tonne, such as 40-60 kWh/tonne. The "energy input" having the unit kWh/tonne means, in the context of the present disclosure, the net energy input, which excludes the no-load power. The "tonne" of the unit means tonne of dry fiber.

55 [0019] In a preferred embodiment, the SR value is 16.0-18.5.

[0020] Preferably, at least 80% by dry weight of the pulp is NSSC pulp. In one example, at least 85% or 88% by dry

weight of the pulp is NSSC pulp.

[0021] The NSSC pulp may comprise hardwood NSSC pulp. Preferably, at least 70% by dry weight of the NSSC pulp is hardwood NSSC pulp, such as birch NSSC pulp. In one example, at least 80% by dry weight of the NSSC pulp is hardwood NSSC pulp, such as birch NSSC pulp.

[0022] It has been reported in the prior art that a relatively low yield of the NSSC pulp is needed to obtain a large increase in strength. The results presented in the Examples section are however obtained using a NSSC pulp of a relatively high yield, more precisely about 82 %. The yield of the NSSC pulp of the present disclosure may thus be 75%-85%, preferably 79%-85 %, such as 80-84%.

[0023] In addition to the NSSC pulp, the pulp may comprise recycled fibers, reject pulp and/or clippings (typically corrugated box plant clippings). The above-mentioned LC refining may be carried out before or after mixing with such other fibres.

[0024] "NSSC pulp" is obtained from "NSSC pulping", which in turn is defined in the background section. The NSSC pulp of the present disclosure may for example be sodium-based NSSC pulp, which means that the cooking liquor of the NSSC cook comprised Na_2SO_3 .

[0025] In the method, the head box consistency may for example be 0.50%-1.20%, such as 0.80%-1.20%, such as 0.90%-1.15%. The higher consistencies are particularly relevant when a large proportion (e.g. at least 80%) of the NSSC pulp is derived from hardwood.

[0026] In one embodiment, the head box consistency is 1.05%-1.20% and the grammage of the containerboard is 140-240 g/m², such as 140-200 g/m².

[0027] The method further comprises the step of:

- pressing the web in a press section comprising a shoe press.

[0028] The nip length in the shoe press may for example be 200-330 mm, such as 250-300 mm. The shoe press is typically a double felted shoe press.

[0029] The shoe press may comprise a shoe press belt having discontinuous grooves. Such a shoe press belt is commercially available. An example is the BlackBelt G DG marketed by Valmet. Another example is Valmet Black Belt H DG marketed by Valmet. The hardness of the elastomer in the shoe press belt may for example be 93-95 Shore A.

[0030] The line load in the shoe press is in the range of 1200-2000 kN/m, preferably 1300-2000 kN/m. A higher shoe press line load typically correlates with a higher geometric SCT index.

[0031] In the shoe press, the web maybe subjected to a press impulse of 105-280 kPa*s, such as 105-190 kPa*s, such as 105-135 kPa*s. The highest press impulses are obtained when the line load is relatively high and the web speed is relatively low (because of a high grammage of the produced containerboard).

[0032] The press section may comprise another press arranged upstream the shoe press. The other press is typically double felted and may for example be a jumbo press or a shoe press. The line load of the other press may be 100-300 kN/m, such as 150-250 kN/m, in particular in case of a jumbo press.

[0033] Finally, the method further comprises the step of:

- drying the web from the press section in a drying section to obtain said containerboard. The method of the present disclosure facilitates a reduced steam consumption in the drying section and/or production at a relatively high speed, such as 700-850 m/min or even 750-850 m/min. When the method of the present disclosure is carried out, the steam consumption in the drying section may be as low as 0.95-1.15 tonne steam per tonne paper. This steam is normally "medium pressure steam", which refers to steam having a pressure of 6-11 bar, such as 6-10 bar, typically about 8 bar.

EXAMPLES

Lab sheets

[0034] NSSC pulp was obtained from a full-scale process of producing NSSC containerboard (intended for fluting) in the Gruvön mill (PM 6), Sweden.

[0035] A first pulp sample was obtained from a position upstream the two LC refining steps of the process. Accordingly, this pulp had been subjected to 0 kWh/tonne of LC refining.

[0036] A second and a third pulp sample were obtained from a position between the two LC refining steps of the process. These pulp samples had been subjected to 20 and 40 kWh/tonne of LC refining, respectively.

[0037] Four more pulp samples were obtained from a position downstream the two LC refining steps of the process. These pulp samples had been subjected to a total of 60, 80, 100 and 115 kWh/tonne of LC refining, respectively.

[0038] The composition of all samples was 100% NSSC pulp from birch.

[0039] The Schopper-Riegler (SR) value (also referred to as the "SR number") of all samples was measured according

to the standard ISO 5267-1:1999. The results of the measurements are shown in table 1 below.

Table 1

Pulp sample #	Specific refining energy (kWh/ton)	SR number
1	0	13.00
2	20	15.05
3	40	16.25
4	60	18.50
5	80	23.10
6	100	30.30
7	115	39.75

[0040] Raphid Köhten lab sheets having grammages of about 100 g/m² were produced from the pulp samples according to ISO 5269-2:2004. The actual grammages were then measured. The following strength parameters of the lab sheets were measured at 50% and 90% relative humidity: SCT (ISO 9895:2008); CCT (SCAN P-42); CMT (SS-EN ISO 7263:2011); and tensile stiffness (SS-ISO 1924-3:2011). The measured strength parameters were indexed by the measured grammages (by dividing a value by the grammage, an indexed value is obtained).

[0041] The SCT is often considered to be the most important strength parameter.

[0042] Figure 1 shows the SCT index values, which increases with increased refining up to 60 kWh/tonne (corresponding to an SR value of 18.50). Between 60 and 80 kWh/tonne, no increase was observed.

[0043] Also when looking at the other strength parameters, the benefit of refining up to 80 kWh/tonne is questionable (see figures 2-4).

Steam consumption

[0044] The pulp from which samples 1-4 were obtained was subjected to a total of 60 kWh/tonne LC refining in the full-scale process. To obtain samples 5-7, the total LC refining was successively increased up to 115 kWh/tonne. Subsequent to the LC refining, the NSSC pulp was mixed with kraft pulp in a 90:10 dry weight ratio.

[0045] In the full-scale process, a web was formed in a forming section. The headbox consistency was about 0.94%. The web was then pressed in a press section and dried in a drying section.

[0046] The press section had two double felted nips; first a jumbo press (line load = 200 kN/m) and then a shoe press (line load = 1300 kN/m) with a shoe press belt having discontinuous grooves (Valmet Black Belt H DG, void volume = 477 g/m², open area = 42%).

[0047] In figure 5, the steam consumption in the drying section following the increased LC refining is plotted. It is shown that the increased refining resulted in a drastically increased specific steam consumption. At 115 kWh/ton, the steam consumption was about 70% higher than at 60 kWh/ton.

Testing of paper from the full-scale process

[0048] Paper produced by the full-scale process (further described above) was obtained at 18:26 (see figure 5), which means that the paper was formed from pulp subjected to a total of 60 kWh/tonne LC refining. Samples of the paper was tested. Despite the moderate level of refining, the SCT index at 50% RH (ISO 9895:2008) of the sampled paper was 56.0 Nm/g in MD and 29.4 Nm/g in CD, resulting in a geometric SCT index of 40.59 Nm/g. The grammage was 120 g/m².

Claims

1. A method of producing a containerboard for use as fluting, comprising the steps of:

- forming a web from a pulp having, in the head box, a Schopper-Riegler (SR) value of 16.0-19.0 when measured according to ISO 5267-1:1999, wherein at least 70% by dry weight of the pulp is NSSC pulp;
- pressing the web in a press section comprising a shoe press, wherein the line load in the shoe press is in the range of 1200-2000 kN/m; and
- drying the web from the press section in a drying section to obtain said containerboard.

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2. The method according to claim 1, wherein the web is subjected to a press impulse of 105-190 kPa*s in the shoe press.
3. The method according to claim 1 or 2, wherein the speed of the web is in the range of 700-850 m/min, such as 750-850 m/min.
- 5 4. The method according to any one of the preceding claims, wherein grammage of the containerboard is in the range of 100-240 g/m², such as 140-230 g/m², such as 150-230 g/m², when measured according to ISO 536:2012.
- 10 5. The method according to any one of the preceding claims, wherein line load in the shoe press is in the range of 1300-2000 kN/m.
6. The method according to any one of the preceding claims, wherein at least 80% by dry weight of the pulp is NSSC pulp.
7. The method according to any one of the preceding claims, wherein at least 88% by dry weight of the pulp is NSSC pulp.
- 15 8. The method according to any one of the preceding claims, wherein the yield of the NSSC pulp is 75-85 %, such as 79-85 %.
9. The method according to any one of the preceding claims, wherein the pulp from which the web is formed has a SR value of 16.0-18.5, such as 16.0-18.0, when measured according to ISO 5267-1:1999.
- 20 10. The method according to any one of the preceding claims, wherein at least 70% by dry weight of the NSSC pulp is hardwood NSSC pulp, such as birch NSSC pulp.
- 25 11. The method according to any one of the preceding claims, wherein at least 80% by dry weight of the NSSC pulp is hardwood NSSC pulp, such as birch NSSC pulp.
12. The method according to any one of the preceding claims, wherein the steam consumption in the drying section is below 1.20 tonne steam per tonne paper, such as 0.95-1.19 tonne steam per tonne paper, such as 1.00-1.19 tonne steam per tonne paper.
- 30 13. The method according to any one of the preceding claims, wherein the press section comprises another press, such as a jumbo press or a shoe press, arranged upstream the shoe press.
- 35 14. The method according to any one of the preceding claims, wherein the consistency of the pulp in a head box used for forming the web is 0.50%-1.20%.
- 40 15. The method according to claim 10 or 11, wherein the consistency of the pulp in a head box used for forming the web is 0.80%-1.20%, 0.90%-1.20%, such as 0.90%-1.15%.

Patentansprüche

- 45 1. Verfahren zur Herstellung von Wellpappe zur Verwendung als Riffelung, umfassend die Schritte:
- Bilden einer Bahn aus einem Zellstoff, der in dem Stoffauflauf einen Schopper-Riegler- (SR) Wert gemäß ISO 5267-1:1999 von 16,0-19,0 aufweist, wobei mindestens 70 % des Trockengewichts des Zellstoffs NSSC-Zellstoff ist;
 - Pressen der Bahn in einer Pressenpartie, die eine Schuhpresse umfasst, wobei die Linienlast in der Schuh-

50 presse im Bereich von 1200-2000 kN/m liegt; und

 - Trocknen der Bahn aus der Pressenpartie in einer Trockenpartie, um die Wellpappe zu erhalten.
- 55 2. Verfahren nach Anspruch 1, wobei die Bahn in der Schuhpresse einem Pressimpuls von 105-190 kPa*s ausgesetzt wird.
3. Verfahren nach Anspruch 1 oder 2, wobei die Geschwindigkeit der Bahn im Bereich von 700-850 m/min, beispielsweise 750-850 m/min, liegt.

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4. Verfahren nach einem der vorhergehenden Ansprüche, wobei das gemessene Flächengewicht gemäß ISO 536:2012 der Wellpappe im Bereich von 100-240 g/m², beispielsweise 140-230 g/m², beispielsweise 150-230 g/m², liegt.
5. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Linienlast in der Schuhpresse im Bereich von 1300-2000 kN/m liegt.
6. Verfahren nach einem der vorhergehenden Ansprüche, wobei mindestens 80 % des Trockengewichts des Zellstoffs NSSC-Zellstoff ist.
10. 7. Verfahren nach einem der vorhergehenden Ansprüche, wobei mindestens 88 % des Trockengewichts des Zellstoffs NSSC-Zellstoff ist.
8. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Ausbeute an NSSC-Zellstoff 75-85 %, beispielsweise 79-85 %, beträgt.
15. 9. Verfahren nach einem der vorangehenden Ansprüche, wobei der Zellstoff, aus dem die Bahn gebildet wird, einen SR-Wert gemäß ISO 5267-1:1999 von 16,0-18,5, beispielsweise 16,0-18,0, aufweist.
20. 10. Verfahren nach einem der vorangehenden Ansprüche, wobei mindestens 70 % des Trockengewichts des NSSC-Zellstoffs Hartholz-NSSC-Zellstoff, beispielsweise Birken-NSSC-Zellstoff, ist.
11. Verfahren nach einem der vorangehenden Ansprüche, wobei mindestens 80% des Trockengewichts des NSSC-Zellstoffs Hartholz-NSSC-Zellstoff, wie etwa Birken-NSSC-Zellstoff, ist.
25. 12. Verfahren nach einem der vorangehenden Ansprüche, wobei der Dampfverbrauch in der Trockenpartie unter 1,20 Tonnen Dampf pro Tonne Papier, beispielsweise 0,95-1,19 Tonnen Dampf pro Tonne Papier, beispielsweise 1,00-1,19 Tonnen Dampf pro Tonne Papier, liegt.
30. 13. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Pressenpartie eine andere Presse, wie eine Jumbopresse oder eine Schuhpresse, umfasst, die stromaufwärts der Schuhpresse angeordnet ist.
14. Verfahren nach einem der vorangehenden Ansprüche, wobei die Konsistenz des Zellstoffs in einem Stoffauflaufkasten, der zum Bilden der Bahn verwendet wird, 0,50 %-1,20 % beträgt.
35. 15. Verfahren nach Anspruch 10 oder 11, wobei die Konsistenz des Zellstoffs in einem Stoffauflaufkasten, der zum Bilden der Bahn verwendet wird, 0,80 %-1,20 %, 0,90 %-1,20 %, beispielsweise 0,90 %-1,15 %, beträgt.

Revendications

40. 1. Procédé de production d'un carton-caisse destiné à être utilisé en tant que cannelure, comprenant les étapes consistant à :
 45. - former une bande à partir d'une pâte à papier ayant, dans la boîte de tête, une valeur de Schopper-Riegler (SR) comprise entre 16,0 et 19,0 lorsqu'elle est mesurée conformément à la norme ISO 5267-1:1999, dans lequel au moins 70 % à l'état sec de la pâte à papier est une pâte de type NSSC ;
 - presser la bande dans une section de presse comprenant une presse à sabot, dans lequel la charge de ligne dans la presse à sabot se situe dans la plage allant de 1200 à 2000 kN/m ; et
 50. - sécher la bande provenant de la section de presse dans une section de séchage afin d'obtenir ledit carton-caisse.
2. Procédé selon la revendication 1, dans lequel la bande est soumise à une impulsion de presse comprise entre 105 et 190 kPa*s dans la presse à sabot.
55. 3. Procédé selon la revendication 1 ou la revendication 2, dans lequel la vitesse de la bande se situe dans la plage allant de 700 à 850 m/min, telle que comprise entre 750 et 850 m/min.
4. Procédé selon l'une quelconque des revendications précédentes, dans lequel le grammage du carton-caisse se

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situe dans la plage allant de 100 à 240 g/m², tel que compris entre 140 et 230 g/m², tel que compris entre 150 et 230 g/m², lorsqu'il est mesuré conformément à la norme ISO 536:2012.

- 5
5. Procédé selon l'une quelconque des revendications précédentes, dans lequel la charge de ligne dans la presse à sabot se situe dans la plage allant de 1300 à 2000 kN/m.
- 10
6. Procédé selon l'une quelconque des revendications précédentes, dans lequel au moins 80 % à l'état sec de la pâte à papier est une pâte à papier de type NSSC.
7. Procédé selon l'une quelconque des revendications précédentes, dans lequel au moins 88 % à l'état sec de la pâte à papier est une pâte à papier de type NSSC.
- 15
8. Procédé selon l'une quelconque des revendications précédentes, dans lequel le rendement de la pâte à papier de type NSSC est compris entre 75 et 85 %, tel que compris entre 79 et 85 %.
9. Procédé selon l'une quelconque des revendications précédentes, dans lequel la pâte à papier à partir de laquelle la bande est formée a une valeur SR comprise entre 16,0 et 18,5, telle que comprise entre 16,0 et 18,0, lorsqu'elle est mesurée conformément à la norme ISO 5267-1:1999.
- 20
10. Procédé selon l'une quelconque des revendications précédentes, dans lequel au moins 70 % à l'état sec de la pâte à papier de type NSSC est une pâte à papier de type NSSC de bois dur, telle qu'une pâte à papier de type NSSC de bouleau.
- 25
11. Procédé selon l'une quelconque des revendications précédentes, dans lequel au moins 80 % à l'état sec de la pâte à papier de type NSSC est une pâte à papier de type NSSC de bois dur, telle qu'une pâte à papier de type NSSC de bouleau.
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12. Procédé selon l'une quelconque des revendications précédentes, dans lequel la consommation de vapeur dans la section de séchage est inférieure à 1,20 tonne de vapeur par tonne de papier, telle que comprise entre 0,95 et 1,19 tonne de vapeur par tonne de papier, telle que comprise entre 1,0 et 1,19 tonne de vapeur par tonne de papier.
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13. Procédé selon l'une quelconque des revendications précédentes, dans lequel la section de presse comprend une autre presse, telle qu'une presse jumbo ou une presse à sabot, agencée en amont de la presse à sabot.
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14. Procédé selon l'une quelconque des revendications précédentes, dans lequel la consistance de la pâte à papier dans une boîte de tête utilisée pour la formation de la bande est comprise entre 0,50 % et 1,20 %.
15. Procédé selon la revendication 10 ou la revendication 11, dans lequel la consistance de la pâte à papier dans une boîte de tête utilisée pour la formation de la bande est comprise entre 0,80 % et 1,20 %, comprise entre 0,90 % et 1,20 %, telle que comprise entre 0,90 % et 1,15 %.

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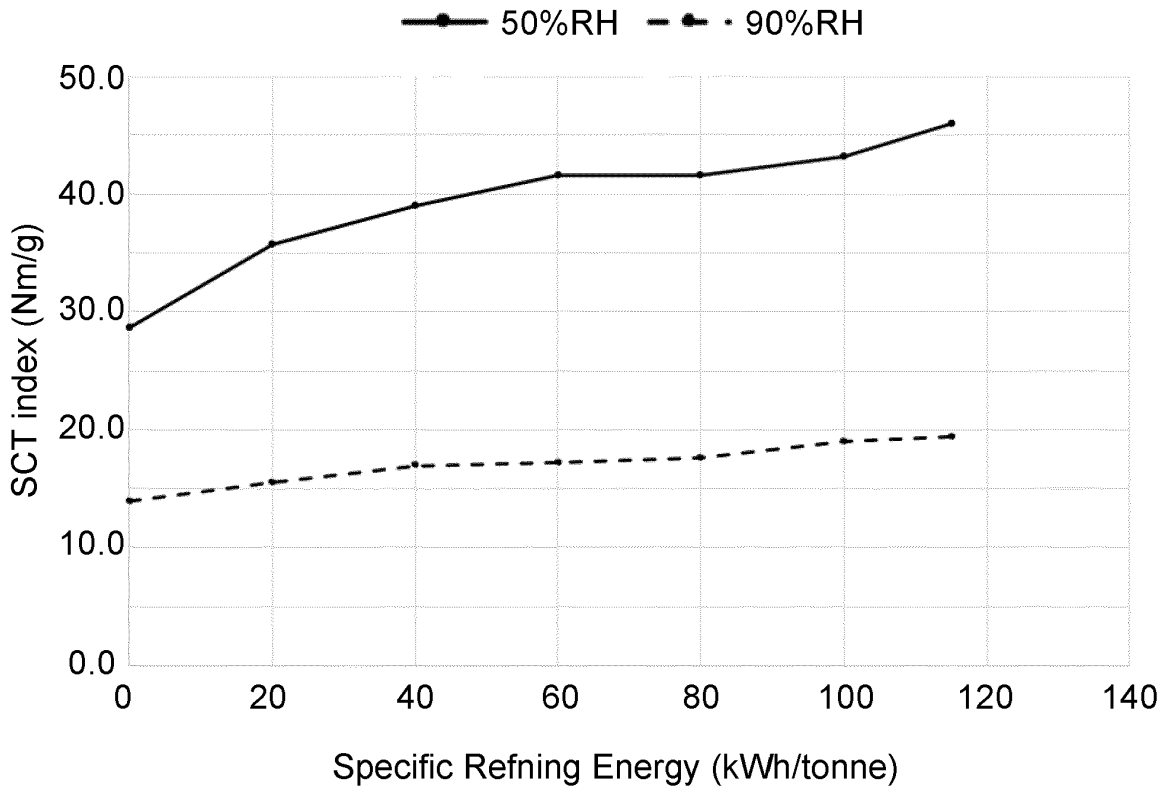


Fig. 1

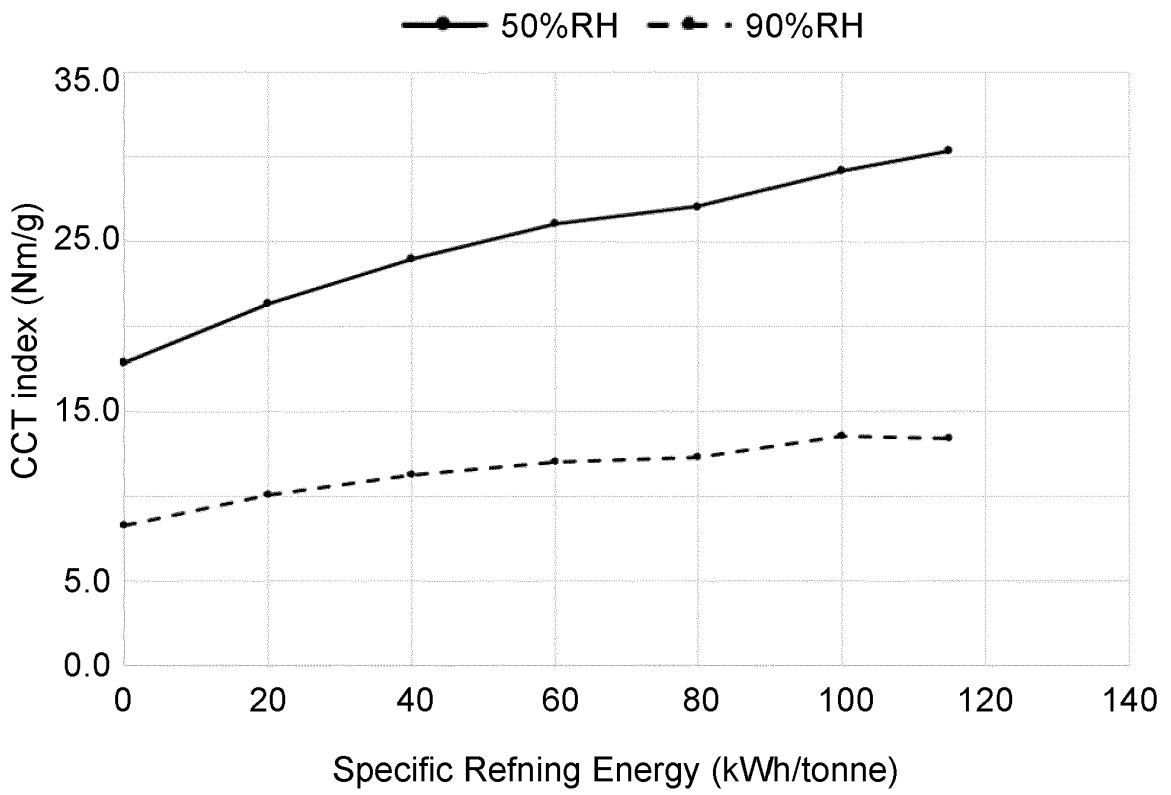


Fig. 2

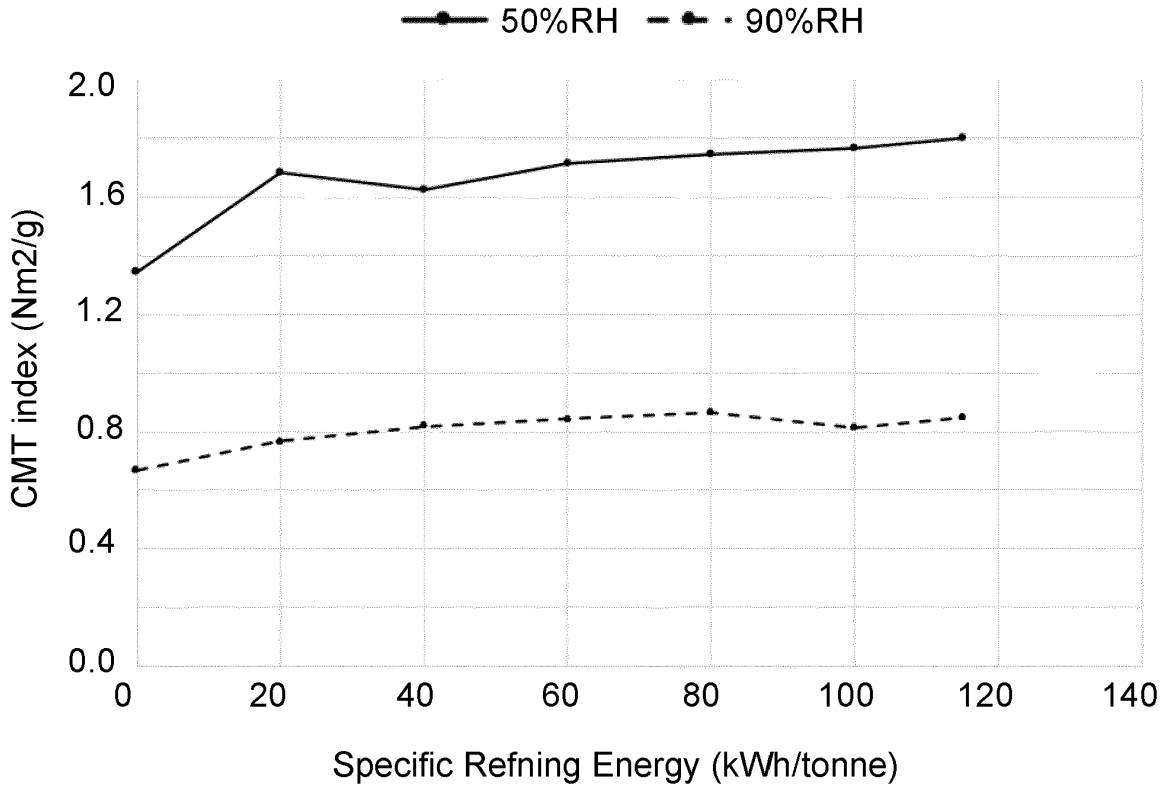


Fig. 3

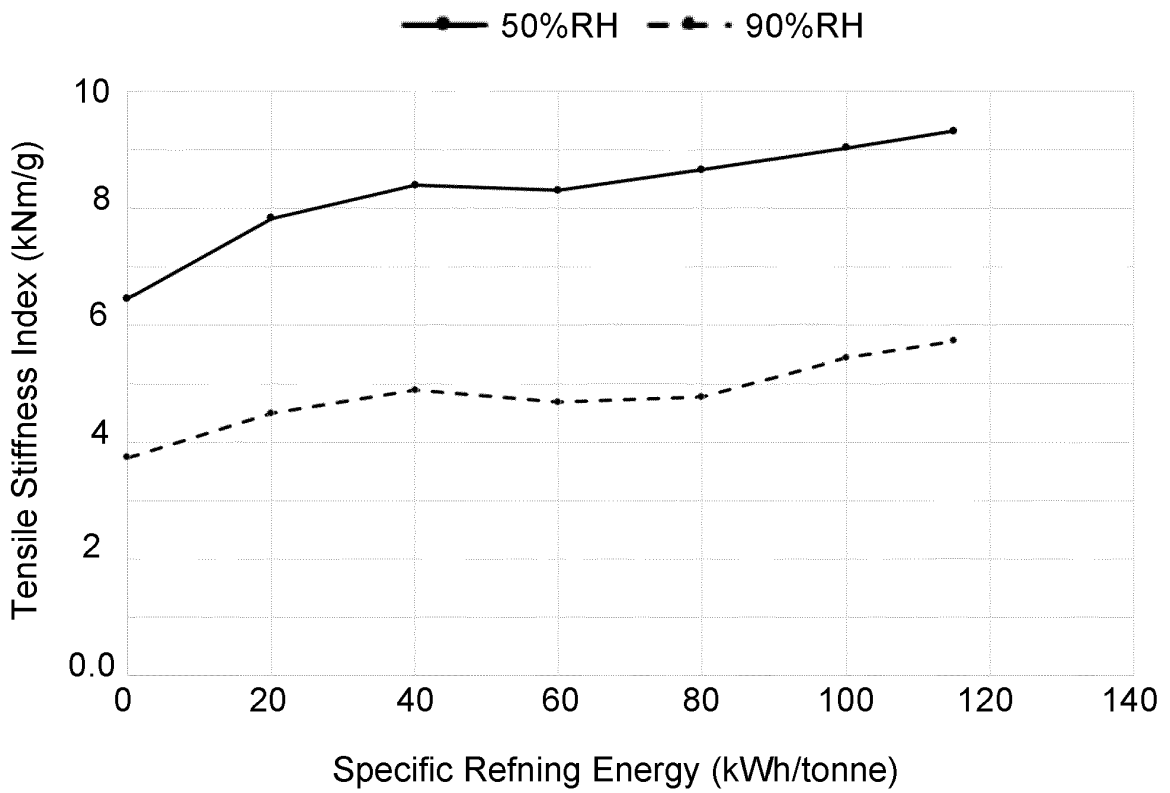


Fig. 4

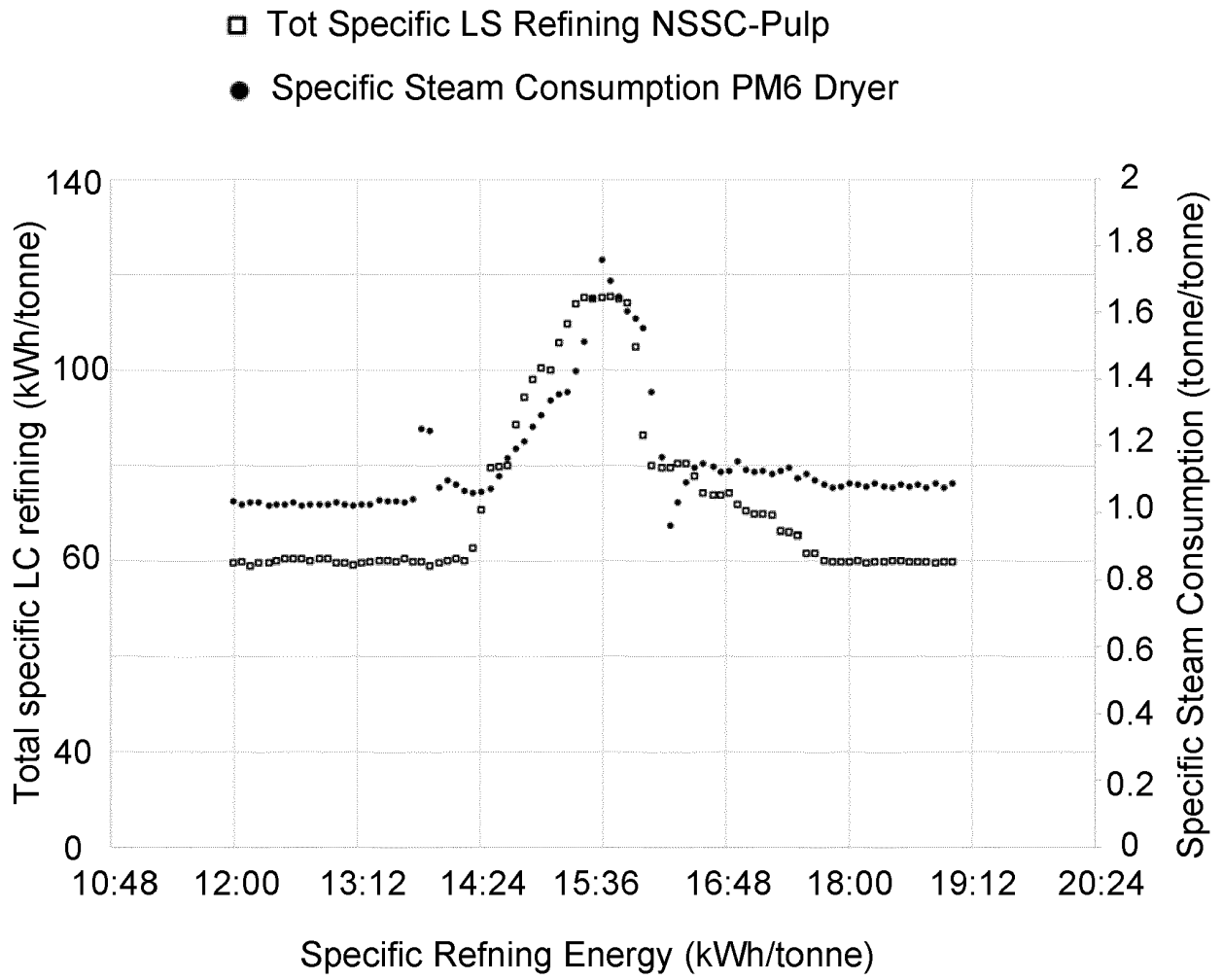


Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 3026173 A [0006]