(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 682 520 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
08.01.2014 Bulletin 2014/02

(51) Int Cl.:
D21G 1/00 *(2006.01)*

(21) Application number: **12174715.8**

(22) Date of filing: **03.07.2012**

(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

(71) Applicant: **Metso Paper Inc.**
00130 Helsinki (FI)

(72) Inventors:
- **Vaittinen, Henri**
  04400 JÄRVENPÄÄ (FI)
- **Linnonmaa, Pekka**
  00370 Helsinki (FI)
- **Ilomäki, Jari**
  00920 Helsinki (FI)
- **Viljanmaa, Mika**
  00760 HELSINKI (FI)
- **Pietikäinen, Reijo**
  04420 JÄRVENPÄÄ (FI)
- **Hakola, Jani**
  04460 NUMMENKYLÄ (FI)

(74) Representative: **Berggren Oy Ab**
P.O. Box 16
Antinkatu 3 C
00101 Helsinki (FI)

(54) Method for producing fiber webs and production line for producing fiber webs

(57) The invention relates to a method for producing a fiber web (W), in which method the fiber web (W) is calendered in at least one calendering nip (NA; NB) of at least one calender (20A; 20B) and reeled up in a reel-up (40). The fiber web (W) is cooled by cooling means (10A; 10B) before calendering to temperatures of not higher than 40 °C, preferably to temperature in the range of 10 - 30 °C. The invention also relates to a production line for producing fiber webs (W), which comprises at least one calender (20A; 20B) with at least one calendering nip (NA; NB) and a reel-up (40) after the calender (20A; 20B). The production line comprises at least one cooling means (10A; 10B) before the at least one calender (20A; 20B) for cooling the fiber web to temperatures of not higher than 40 °C, preferably to temperature in the range of 10-30 °C.

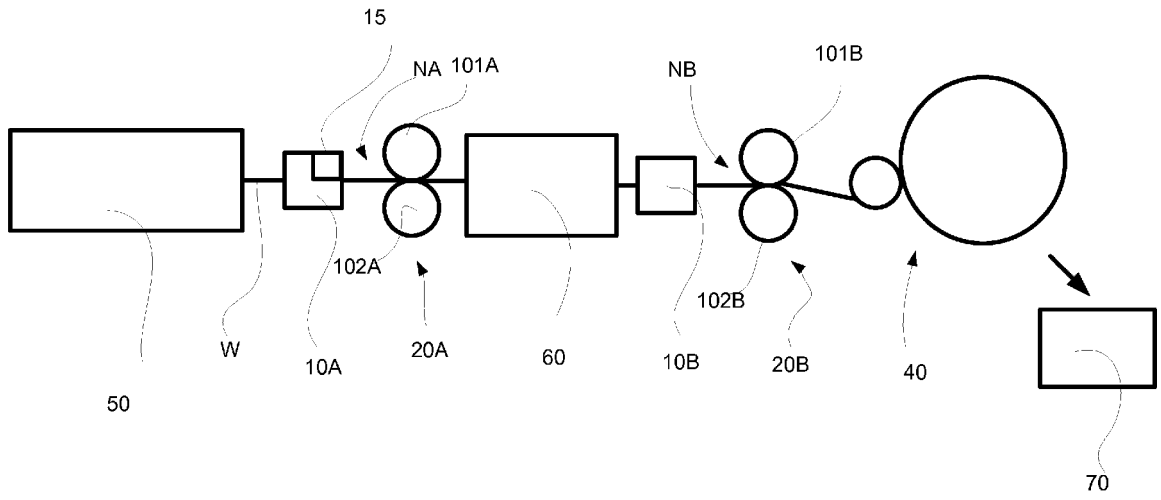

Fig. 1

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Description

[0001] In general present invention relates to producing fiber webs in a fiber web production line. More especially the present invention relates to a method according to preamble part of claim 1 and to a production line according to preamble part of claim 8.

[0002] As known from the prior art in fiber web producing processes typically comprise an assembly formed by a number of apparatuses arranged consecutively in the process line. A typical production and treatment line comprises a head box, a wire section and a press section as well as a subsequent drying section and a reel-up. The production and treatment line can further comprise other devices and/or sections for finishing the fiber web, for example, a pre-calender, a sizer, a final-calender, a coating section. The production and treatment line also comprises at least one slitter-winder for forming customer rolls as well as a roll packaging apparatus. In this description and the following claims by fiber webs are meant for example a paper and board webs.

[0003] Pre-calendering is typically used for creating required surface properties for further treatment for example for coating and final-calendering is generally carried out in order to improve the properties, like smoothness and gloss, of a web-like material such as a paper or board web. In calendering the web is passed into a nip, i.e. calendering nip, formed between rolls that are pressed against each other, in which nip the web becomes deformed as by the action of temperature, moisture and nip pressure. In the calender the nips are formed between a smooth-surfaced press roll such as a metal roll and a roll coated with resilient material such as a polymer roll or between two smooth-surfaced rolls. The resilient-surfaced roll adjusts itself to the forms of the web surface and presses the opposite side of the web evenly against the smooth-surfaced press roll. The nips can be formed also by using instead one of roll a belt or a shoe as known from prior art. Many different kinds of calenders to be used as a pre-calender and/or as an final-calender are known, for example hard nip calenders, soft nip calenders, supercalenders, metal belt calenders, shoe calenders, long nip calenders, multinip calenders etc.

[0004] Paper and board are available in a wide variety of grades and can be divided according to basis weight in two categories: papers with a single ply and a basis weight of 25 - 300 g/ m^2 and boards manufactured in multi-ply technology and having a basis weight of 150 - 600 g/ m^2. It should be noted that the borderline between paper and board is flexible since board grades with lightest basis weights are lighter than the heaviest paper grades. Generally speaking, paper is used for printing and board for packaging.

[0005] The subsequent descriptions are examples of some values presently applied for fibrous webs, and there may be considerable variations from the disclosed values. The descriptions are mainly based on the source publication Papermaking Science and Technology, section Papermaking Part 3, edited by Jokio, M., published by Fapet Oy, Jyväskylä 1999, 362 pages.

[0006] Mechanical-pulp based, i.e. wood-containing printing papers include newsprint, uncoated magazine and coated magazine paper.

[0007] Newsprint is composed either completely of mechanical pulp or may contain some bleached softwood pulp (0 - 15 %) and/or recycled fiber to replace some of the mechanical pulp. General values for newsprint can be regarded as follows: basis weight 40 - 48,8 g/m^2, ash content (SCAN-P 5:63) 0 - 20 %, PPS s10 roughness (SCAN-P 76:95) 3,0 - 4,5 μm, Bendtsen roughness (SCAN-P 21:67) 100 - 200 ml/min, density 200 - 750 kg/m^3, brightness (ISO 2470:1999) 57 - 63 %, and opacity (ISO 2470:1998) 90 - 96 %.

[0008] Uncoated magazine paper (SC=supercalendered) usually contains mechanical pulp to 50 - 70 %, bleached softwood pulp to 10 - 25 %, and fillers to 15 - 30%. Typical values for calendered SC paper (containing e.g. SC-C, SC-B. SC-A/A+) include basis weight 40 - 60 g/m^2, ash content (SCAN-P 5:63) 0 - 35 %, Hunter gloss (ISO/DIS 8254/1) < 20 - 50 %, PPS s10 roughness (SCAN-P 76:95) 1,2 - 2,5 μm, Bendtsen roughness (SCAN-P 21:67) 100 - 200 ml/min, density 700 - 1250 kg/m^3, brightness (ISO 2470:1999) 62 - 70 %, and opacity (ISO 2470:1998) 90 - 95 %.

[0009] Coated magazine paper (LWC = light weight coated) contains mechanical pulp to 40 - 60 %, bleached softwood pulp to 25 - 40 %, and fillers and coaters to 20 - 35 %. General values for LWC paper can be regarded as follows: basis weight 40 - 70 g/m^2, Hunter gloss 50 - 65 %, PPS s10 roughness 0,8 - 1,5 μm (offset), 0,6 - 1,0 μm (roto), density 1100 - 1250 kg/m^3, brightness 70 - 75 %, and opacity 89 - 94 %.

[0010] General values for MFC (machine finished coated) can be regarded as follows: basis weight 50 - 70 g/m^2, Hunter gloss 25 - 70 %, PPS s10 roughness 2,2 - 2,8 μm, density 900 - 950 kg/m^3, brightness 70 - 75 %, and opacity 91 - 95 %.

[0011] General values for FCO (film coated offset) can be regarded as follows: basis weight 40 - 70 g/m^2, Hunter gloss 45 - 55 %, PPS s10 roughness 1,5 - 2,0 μm, density 1000 - 1050 kg/m^3, brightness 70 - 75 %, and opacity 91 - 95 %.

[0012] General values for MWC (medium weight coated) can be regarded as follows: basis weight 70 - 90 g/m^2, Hunter gloss 65 - 75 %, PPS s10 roughness 0,6 - 1,0 μm, density 1150 - 1250 kg/m^3, brightness 70 - 75 %, and opacity 89 - 94 %.

[0013] HWC (heavy weight coated) has a basis weight of 100 - 135 g/m^2 and can be coated even more than twice.

[0014] Pulp-produced, wood free printing papers or fine papers include uncoated - and coated - pulp-based printing papers, in which the portion of mechanical pulp is less than 10 %.

[0015] Uncoated printing papers (WFU) contain bleached birchwood pulp to 55 - 80 %, bleached softwood

pulp 0 - 30 %, and fillers to 10 - 30 %. The values with WFU have a large variation: basis weight 50 - 90 g/m^2, Bendtsen roughness 250 - 400 ml/min, brightness 86 - 92 %, and opacity 83 - 98 %.

[0016] In coated printing papers (WFC), the amounts of coating vary widely in accordance with requirements and intended application the following are typical values for once- and twice-coated, pulp-based printing paper: once-coated basis weight 90 g/m^2, Hunter gloss 65 - 80 %, PPS s10 roughness 0,75 - 2,2 μm, brightness 80 - 88 %, and opacity 91 - 94 %, and twice-coated basis weight 130 g/m^2, Hunter gloss 70 - 80 %, PPS s10 roughness 0,65 - 0,95 μm, brightness 83 - 90 %, and opacity 95 - 97 %.

[0017] Release papers have a basis weight within the range of 25 - 150 g/m^2.

[0018] Other papers include e.g. sackkraft papers, tissues, and wallpaper bases.

[0019] Board making makes use of chemical pulp, mechanical pulp and/or recycled pulp. Boards can be divided e.g. in the following main groups cartonboards, containerboards and specialty boards. Cartonboards are mainly used for consumer product packaging and they comprise boxboards, used for making boxes, cases, which boxboards include e.g. liquid packaging boards; FBB = folding boxboard, WLC = white-lined chipboard, SBS = solid bleached sulfate board, SUS = solid unbleached sulfate board and LPB = liquid packaging board. Containerboards comprise f. ex. linerboard and fluting board and other corrugated boards and specialty boards comprise wallpaper base, plaster board etc. Graphic boards are used for making e.g. cards, files, folders, cases, covers, etc. and wallpaper bases. Each end use sets its own demands on the mechanical and functional properties of boards. Basically a certain mechanical strength and stiffness, especially bending stiffness is required, and in the optimum structure middle-ply is very bulky and top and back plies have high modulus of elasticity. Often also purity and cleanliness requirements are very high and also almost all boards have defined printing properties and for example the printing requirements of folding box board are usually very high and also high bulkiness is required of folding box board.

[0020] In US patent publication 4738197 is disclosed a method for accomplishing smoothness and glaze to paper of board webs in a calender by leading a web through hot nips which are formed between cooperating rolls of different hardness and having adjustable temperatures. In this prior art method for gradient calendering the temperature of the web is arranged to be cooled before the web enters the hot nip in order to increase the efficiency of the gradient calendering. As suitable temperatures of the web this prior art discloses temperatures not higher than 70°C, favorably not higher than 50 °C such that the temperature difference in the nip between the web and the rolls is at least 30 °C.

[0021] In US patent publication 5033373 is disclosed a process for producing a smooth and glossy surface on a paper web and a calender arrangement for carrying out the process. This prior art calender arrangement comprises two sets of rolls through which the paper web is conducted in succession and each set of rolls comprises a highly heated hard roll and a soft roll. A cooling device is arranged upstream of at least one of the calendering nips to restrict the amount of heat transfer to the inner layers of the paper web and the attendant, undesirable partial plasticization of the inner layers of the web.

[0022] One problem with calendering of fiber webs is to achieve required surface properties and simultaneously achieve required bulkiness i.e. relation of thickness of the web to its grammage (basis weight). When the fiber web has high bulkiness the basis weight can be reduced which results as considerable savings in raw material. Thus in recent times it has been one of the main focus points in developing calenders, mostly due to environmental and cost saving reasons.

[0023] In a reel-up of the fiber web production line, the as a continuous web produced fiber web, is reeled up into the form of a roll, a parent (machine, jumbo) roll. In the production process of the fiber web, the reeling is generally a first process part, wherein a continuous process is discontinued to be continued in sequences. One problem in reeling after calendering is that the fiber web is still rather warm, typically in temperature range of 50 - 80 °C, and during reeling of warm fiber web the brightness of the fiber web reduces which leads to the need of cooling devices located after calendering, for example as disclosed in WO publication 2006/000630.

[0024] An object of the invention is to create a method for producing fiber webs in which high bulkiness is received with less raw stock and a production line for carrying out the method.

[0025] Another object of the method is to create a method for producing fiber webs in which the problems relating to the reduced brightness in reeling are eliminated or at least minimized.

[0026] To achieve the objects mentioned above and later the method according to the invention is mainly characterized by the features of the characterizing part of claim 1.

[0027] The production line according to the invention is mainly characterized by the features of the characterizing part of claim 8.

[0028] According to the invention in the method the fiber web is cooled before calendering to temperatures of not higher than 40 °C, preferably to temperature in the range of 10 - 30 °C.

[0029] According to the invention in the method the fiber web is reeled in a reel-up after the calendering such that the temperature of the web is not higher than 50 °C, preferably in temperature in the range of 20 - 40 °C.

[0030] According to an advantageous feature the fiber web is calendered for a short dwell time for 0,01 - 6,0 ms (measured with the fiber web in the calendering nip), preferably for 0,2 - 3,0 ms (measured with the fiber web in the calendering nip).

[0031] According to advantageous features the fiber web is cooled by direct or indirect cooling effect by the cooling means.

[0032] According to an advantageous aspect of the invention the fiber web is cooled after drying before calendering and in the cooling vaporizing the moisture from the fiber web is utilized when the heat is decreased. By this a drying effect is achieved and drying capacity of the drying section can be reduced.

[0033] According to an advantageous feature the fiber web (W) is calendered to bulk loss less than 4 %.

[0034] According to an advantageous feature the fiber web (W) is calendered to surface roughness PPS s10 under 2,0 μm.

[0035] According to the invention the production line for producing fiber webs comprises at least one calender with at least one calendering nip, at least one cooling means before the at least one calender and a reel-up after the calender. The production line comprises at least one cooling means before the at least one calender for cooling the fiber web to temperatures of not higher than 40 °C, preferably to temperature in the range of 10 - 30 °C.

[0036] According advantageous features of the invention the cooling means is/are cooling cylinder and/or metal belt with cooling device and/or device for blowing or creating a flow of cooled gas, for example air.

[0037] According to an advantageous feature of the invention the cooled gas for cooling flow or blow is fresh, cool, outside air of which especially in the Nordic and in corresponding climate zone located countries is available an unlimited supply in required temperatures during most times of the year and no further device is needed for cooling the gas.

[0038] According advantageous features of the invention the calender is a hard nip calender or a soft nip calender or a shoe calender or a metal belt calender or a multinip calender. Preferably the calender is a soft nip or a hard nip calender or a corresponding calender with short dwell time of 0,01 - 6 ms, preferably of 0,2 - 3,0 ms.

[0039] According to an advantageous feature of the invention a moisturizing device is located in connection with the cooling means for providing moisture vaporization from the fiber web with latent thermal cooling effect. The moisture vaporization can be enhanced by the blow or flow created by the cooling means.

[0040] According to advantageous features the cooling means is/are located at machine level or below or above it in a machine hall of the production line for producing fiber webs.

[0041] By the invention several advantages are achieved: the bulkiness of the fiber web is higher which leads to savings in raw stock and thus to environmental benefits. This is achieved due to calendering in low temperatures when the calendering effect is focused to the surface if the fiber web and thus the middle layer of the web is under reduced calendering effect which leads to higher bulkiness after calendering.

[0042] In the following the invention is further explained in detail with reference to the accompanying drawing in which:

[0043] In figure 1 is very schematically shown one advantageous example of a production line for producing fiber web according to the invention.

[0044] In figure 2 is shown an example of effect of web temperature to bulk value during calendering.

[0045] In figure 3 is shown an example of effect of web temperature to PPS roughness value.

[0046] In the very schematical example of a production line for producing fiber webs shown in figure 1 the beginning sections and parts of the production line have been indicated by reference 50. Typically the beginning sections and devices 50 of the production line for fiber webs W comprise a head box, forming section, press part, drying section and a sizer. These devices and sections can be constructed in various different designs and constructions known as such to one skilled in the art. The production line also comprises a finishing part 60 with finishing sections and devices, for example a coating section etc. which are as such know to one skilled in the art and can be constructed in many various designs and constructions.

[0047] According to the invention the production line also comprises at least one calender 20A; 20B with at least one calendering nip NA; NB formed between two calendering rolls 101 A, 102A; 101 B, 102B and a cooling means 10A; 10B located before at least one of the calendering nips NA; NB of the calender 20A; 20B. In the example of figure 1 there are two calenders 20A, 20B which both have at least one calendering nip NA; NB and before the calenders 20A, 20B are located cooling means 10A, 10B. The first calender 20A in the main direction of the production is a pre-calender 10A and the second calender 20B is a final-calender 20B. It should be understood that the cooling means 10A, 10B can be located before each of the calenders 20A; 20B or before only either one of the calenders 20A, 20B. At the end of the main production line is a reel-up 40 for reeling the fiber web W into a parent roll. The parent rolls are transferred to slitting, winding and packing sections 70 for creating packaged customer rolls by slitting, winding and packaging. The construction of these slitting, winding and packaging sections 70 can be provided in many various designs and constructions as such known to one skilled in the art.

[0048] After the drying part of the beginning 50 of the production line the fiber web W is cooled by cooling means 10A to temperatures of not higher than 40 °C, preferably to temperature in the range of 10 - 30°C before calendering in the calender 20A. Before the final-calender 20B the fiber web W can be also cooled by cooling means 10B to temperatures of not higher than 40 °C, preferably to temperature in the range of 10 - 30°C. There after the fiber web W is reeled in a reel-up 40 after the calendering such that the temperature of the web is not higher than 50 °C, preferably in temperature in the range of 20 - 40 °C. The fiber web W can cooled by the first

cooling means 10A after drying it in a drying section before calendering it in the calender 20A such that in the cooling is utilized the remaining heat of the web W after the drying for vaporizing the moisture from the fiber web simultaneously.

[0049] The cooling means 10A; 10B can be a cooling cylinder and/or metal belt with cooling device and/or device for blowing or creating a flow of cooled gas, for example air.

[0050] The calender 20A; 20B can be of any type of a calender, for example a hard nip calender or a soft nip calender or a shoe calender or a metal belt calender or a multinip calender. Preferably the calender 20A; 20B is a soft nip or a hard nip calender or a corresponding calender with short dwell time.

[0051] A moistening device 15 can be located in connection with the cooling means 10A (also with cooling means 10B, not shown) for providing moisture vaporization from the fiber web W with latent thermal cooling effect. The moisture vaporization can be enhanced by the blow or flow created by the cooling means 10A; 10B.

[0052] In figure 2 is shown an example of effect of web temperature to bulk value during calendering and as can be seen from the figure 2 the cooling of the web before calendering to temperatures in the range of not higher than 40 °C has a great effect on saving bulk during calendering, the relative loss being less than 4 % and especially cooling to temperatures of 10 - 30 °C reduces the relative bulk loss to about 2 - 3,5 %.

[0053] In figure 3 is shown an example of increase of surface roughness PPS s10 value in relation to the web temperature before calendering and as can be seen from the figure 3 PPS roughness increases, when web temperature increases from 10 °C to 70 °C. Thus the cooling of the web before calendering to temperatures in the range of not higher than 40 °C has a effect on the surface smoothness during calendering, the values of surface roughness PPS s10 under 2,0 μm and especially cooling to temperatures of 10 - 30°C reduces the surface PPS s10 roughness values.

[0054] Above only one advantageous example of the invention is described in view of the very schematic example of the figure 1. It should be understood that many modifications to the example are possible within the invention.

Claims

1. Method for producing a fiber web (W), in which method the fiber web (W) is calendered in at least one calendering nip (NA; NB) of at least one calender (20A; 20B) and reeled up in a reel-up (40), **characterized in that** the fiber web (W) is cooled by cooling means (10A; 10B) before calendering to temperatures of not higher than 40 °C, preferably to temperature in the range of 10 - 30 °C.

2. Method according to claim 1, **characterized in that** the fiber web (W) is reeled in the reel-up (40) after the calendering such that the temperature of the web is not higher than 50 °C, preferably in temperature in the range of 20 - 40 °C.

3. Method according to claim 1, **characterized in that** the fiber web (W) is calendered for a short dwell time for 0,01 - 6 ms, preferably for 0,2 - 3,0 ms.

4. Method according to claim 1, **characterized in that** the fiber web (W) is cooled by direct or indirect cooling effect by the cooling means (10A; 10B).

5. Method according to claim 1, **characterized in that** the fiber web (W) is cooled after drying before calendering and in the cooling vaporizing the moisture from the fiber web is utilized when the heat is decreased.

6. Method according to claim 1, **characterized in that** the fiber web (W) is calendered to bulk loss less than 4 %.

7. Method according to claim 1, **characterized in that** the fiber web (W) is calendered to surface roughness PPS s10 under 2,0 μm.

8. Production line for producing fiber webs (W), which comprises at least one calender (20A; 20B) with at least one calendering nip (NA; NB) and a reel-up (40) after the calender (20A; 20B), **characterized in that** the production line comprises at least one cooling means (10A; 10B) before the at least one calender (20A; 20B) for cooling the fiber web to temperatures of not higher than 40 °C, preferably to temperature in the range of 10 - 30 °C.

9. Production line according to claim 8, **characterized in that** the cooling means (10A; 10B) is/are cooling cylinder and/or metal belt with cooling device and/or device for blowing or creating a flow of cooled gas, for example air.

10. Production line according to claim 8, **characterized in that** the cooling means (10A; 10B) is/are provided for cooling flow or blow is fresh, cool, outside air.

11. Production line according to claim 8, **characterized in that** the calender (10A; 10B) is a hard nip calender or a soft nip calender or a shoe calender or a metal belt calender or a multinip calender.

12. Production line according to claim 11, **characterized in that** the calender (10A; 10B) is a calender with short dwell time of 0,01 - 6 ms, preferably of 0,2 - 3,0 ms.

13. Production line according to claim 8, **characterized in that** a moisturizing device (15) is located in connection with the cooling means (10A; 10B) for providing moisture vaporization from the fiber web with latent thermal cooling effect.

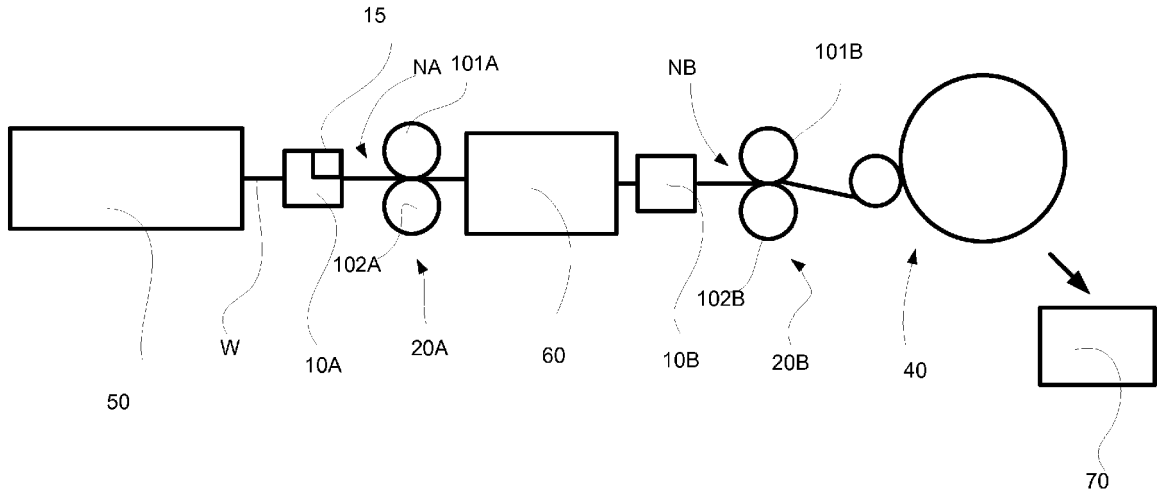
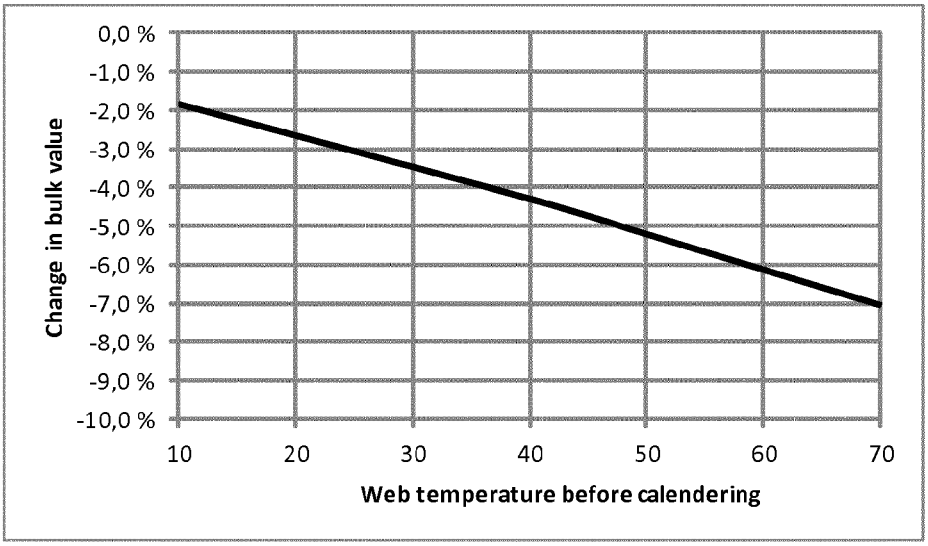


Fig. 1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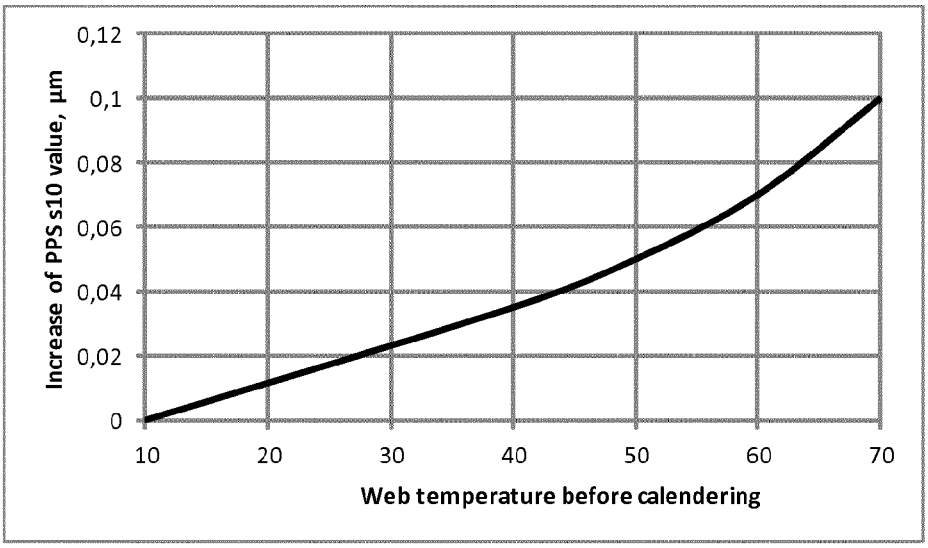
Change in bulk value
10
20
30
40
50
60
70
Web temperature before calendering

Fig. 2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0,06
0,04
0,02
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Increase of PPS s10 value, µm
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20
30
40
50
60
70
Web temperature before calendering

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 12 17 4715

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 September 2012	Maisonnier, Claire

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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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
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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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